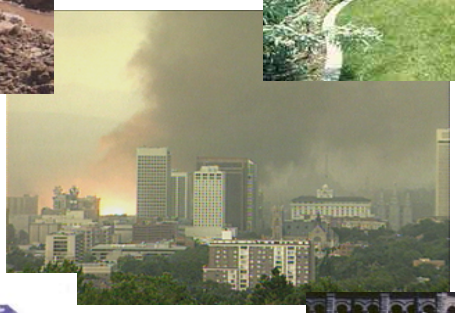
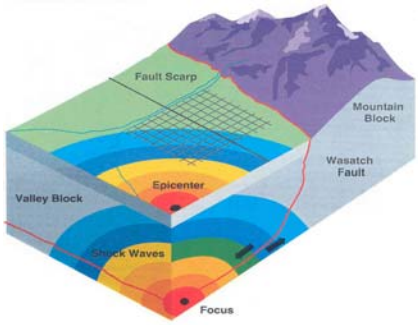
The State of Utah
Pre-Disaster Mitigation Plan

November 2004





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Utah Department of Public Safety
Division of
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Jurisdictions with Approved and Promulgated Pre-Disaster Mitigation Plans

City/County	Date Approved
Juab County	August 2, 2004
Eureka	August 4, 2004
Levan	September 2, 2004
Mona	August 24, 2004
Nephi	September 21, 2004
Rocky Ridge	July 22, 2004
Millard County	July 26, 2004
Delta	August 12, 2004
Fillmore	August 3, 2004
Hinckley	August 8, 2004
Holden	September 2, 2004
Kanosh	August 11, 2004
Leamington	August 8, 2004
Lynndyl	August 18, 2004
Meadow	September 14, 2004
Oak City	August 26, 2004
Scipio	August 2, 2004
Piute County	September 13, 2004
Circleville	August 23, 2004
Junction	September 14, 2004
Kingston	September 15, 2004
Marysvale	September 2, 2004
Sanpete County	September 7, 2004
Centerfield	August 5, 2004
Ephraim	August 4, 2004
Fairview	September 22, 2004
Fayette	August 5, 2004
Fountain Green	September 14, 2004
Gunnison	July 28, 2004
Manti	September 8, 2004
Mayfield	September 8, 2004
Moroni	August 30, 2004
Mt. Pleasant	July 19, 2004
Spring City	August 5, 2004
Sterling	July 15, 2004
Wales	August 25, 2004
Sevier County	August 2, 2004
Annabella	August 10, 2004
Aurora	September 10, 2004
Elsinore	September 7, 2004

Glenwood	August 11, 2004
Joseph	September 2, 2004
Koosharem	August 5, 2004
Monroe	July 27, 2004
Redmond	August 11, 2004
Richfield	July 15, 2004
Salina	September 8, 2004
Sigurd	September 3, 2004
Wayne County	August 2, 2004
Bicknell	July 15, 2004
Hanksville	August 14, 2004
Loa	July 19, 2004
Lyman	August 31, 2004
Torrey	August 12, 2004
Carbon County	June 16, 2004
East Carbon	June 8, 2004
Helper	June 17, 2004
Price	June 9, 2004
Scofield	July 12, 2004
Sunnyside	June 1, 2004
Wellington	July 28, 2004
Emery County	June 15, 2004
Castle Dale	June 10, 2004
Clawson	July 8, 2004
Cleveland	July 8, 2004
Elmo	August 24, 2004
Emery	June 30, 2004
Ferron	June 24, 2004
Green River	July 13, 2004
Huntington	June 16, 2004
Orangeville	June 10, 2004
Grand County	June 15, 2004
Castle Valley	September 22, 2004
Moab	July 13, 2004
San Juan County	June 7, 2004
Blanding	June 15, 2004
Bluff	June 2, 2004
Monticello	June 23, 2004
Box Elder County	March 30, 2004
Bear River	April 1, 2004
Brigham City	April 1, 2004
Corrine	June 1, 2004
Deweyville	April 8, 2004
Elwood	April 13, 2004
Fielding	April 8, 2004

Garland	April 20, 2004
Honeyville	April 14, 2004
Howell	July 15, 2004
Mantua	July 8, 2004
Perry	April 22, 2004
Plymounth	May 10, 2004
Portage	April 8, 2004
Snowville	April 22, 2004
Tremonton	April 6, 2004
Willard	May 13, 2004
Cache County	April 13, 2004
Amalga	May 12, 2004
Clarkston	July 8, 2004
Cornish	April 8, 2004
Hyde Park	May 26, 2004
Hyrum	May 20, 2004
Lewiston	May 16, 2004
Logan	April 20, 2004
Mendon	September 9, 2004
Millville	April 13, 2004
Newton	August 5, 2004
Nibley	May 20, 2004
North Logan	June 3, 2004
Paradise	July 21, 2004
Providence	May 25, 2004
Richmond	May 14, 2004
River Heights	August 24, 2004
Smithfield	April 28, 2004
Trenton	
Wellsville	May 5, 2004
Rich County	June 2, 2004
Garden City	June 10, 2004
Laketown	April 8, 2004
Randolph	April 14, 2004
Woodruff	April 13, 2004
Beaver County	July 6, 2004
Beaver	July, 13, 2004
Millford	May 18, 2004
Minersville	July 6, 2004
Garfield County	May 24, 2004
Antimony	June 3, 2004
Boulder	June 8, 2004
Cannonville	May 20, 2004
Escalante	June 15, 2004
Hatch	June 8, 2004

Henrieville	July 14, 2004
Panguitch	May 25, 2004
Tropic	May 27, 2004
Iron County	May 24, 2004
Brian Head	June 29, 2004
Cedar	June 9, 2004
Enoch	June 16, 2004
Kanarraville	June 10, 2004
Paragonah	June 9, 2004
Parowan	June 24, 2004
Kane County	June 14, 2004
Alton	July 12, 2004
Big Water	June 22, 2004
Glendale	June 24, 2004
Kanab	May 25, 2004
Orderville	June 2, 2004
Washington County	August 3, 2004
Enterprise	May 26, 2004
Hildale	May 18, 2004
Hurricane	May 20, 2004
Ivins	July 1, 2004
La Verkin	July 7, 2004
Leeds	May 26, 2004
New Harmony	June 2, 2004
Rockville	May 19, 2004
St. George	July 15, 2004
Santa Clara	July 28, 2004
Springdale	June 9, 2004
Toquerville	May 13, 2004
Virgin	May 26, 2004
Washington	June 9, 2004
Summit County	
Coalville	
Francis	October 19, 2004
Henefer	
Kamas	
Oakley	
Park City	
Utah County	September 14, 2004
Alpine	
American Fork	
Cedar Fort	
Cedar Hills	
Eagle Mountain	
Elk Ridge	September 14, 2004

Genola	
Goshen	
Highland	
Lehi	
Lindon	September 7, 2004
Mapleton	October 6, 2004
Orem	October 12, 2004
Payson	
Pleasant Gove	
Provo	
Salem	
Santaquin	
Saratoga Springs	
Spanish Fork	October 19, 2004
Springville	October 19, 2004
Vineyard	
Woodland Hills	September 8, 2004
Wasatch County	
Charleston	September 2, 2004
Heber City	
Midway	
Wallsburg	
Daggett County	July 9, 2004
Manila	July 9, 2004
Duchesne County	July 9, 2004
Altomont	July 9, 2004
Duchesne	July 14, 2004
Myton	July 9, 2004
Roosevelt	July 9, 2004
Tabiona	July 9, 2004
Uintah County	July 9, 2004
Ballard	July 14, 2004
Naples	July 22, 2004
Vernal	July 9, 2004
Davis County	July 13, 2004
Bountiful	August 10, 2004
Centerville	July 6, 2004
Clearfield	September 14, 2004
Clinton	June 22, 2004
Farmington	July 21, 2004
Fruit Heights	August 3, 2004
Kaysville	September 7, 2004
Layton	September 2, 2004
North Salt Lake	July 20, 2004
South Weber	July 13, 2004

Sunset	July 21, 2004
Syracuse	September 14, 2004
West Bountiful	July 20, 2004
West Point	July 20, 2004
Woods Cross	September 7, 2004
Morgan County	July 20, 2004
Morgan	July 13, 2004
Salt Lake County	September 14, 2004
Alta	August 12, 2004
Bluffdale	July 13, 2004
Draper	September 14, 2004
Herriman	July 22, 2004
Holladay	July 15, 2004
Cottonwood	July 15, 2004* not yet a city
Midvale	July 27, 2004
Murray	July 13, 2004
Riverton	September 7, 2004
Salt Lake City	August 10, 2004
Sandy	July 13, 2004
South Jordan	September 7, 2004
South Salt Lake	July 28, 2004
Taylorsville	July 21, 2004
West Jordan	
West Valley City	August 3, 2004
Tooele County	May 25, 2004
Grantsville	September 1, 2004
Ophir	
Rush Valley	
Stockton	June 14, 2004
Tooele	June 2, 2004
Vernon	September 14, 2004
Wendover	June 2, 2004
Weber County	August 3, 2004
Farr West	
Harrisville	June 10, 2004
Hooper	July 15, 2004
Huntsville	
Marriott-Slaterville	July 15, 2004
North Ogden	
Ogden	July 13, 2004
Plain City	
Pleasant View	
Riverdale	July 20, 2004
Roy	August 17, 2004
South Ogden	July 6, 2004

Uintah	
Washington Terrace	July 6, 2004
West Haven	
Paiute Indian Tribe	August 4, 2004
Kanosh Band	August 4, 2004
Koosharem Band	July 30, 2004

Abstract

Title: State of Utah Natural Hazard Mitigation Plan

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Judy Watanabe
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Subject: State of Utah Disaster Mitigation Act of 2000 State Natural Hazard Mitigation Plan

Date: Draft 1, May 7, 2004

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Number of Pages:

Abstract: Natural hazards in the State of Utah have caused significant damage due to disasters with subsequent losses of life and property. This plan has been written to address the rising cost of natural disasters, in terms of loss of human life and injuries, and property and natural resources damage. Planning has led to renewed interest in identifying effective ways to reduce vulnerability to disasters. This plan identifies natural hazards with the potential of causing harm to humans and their properties within the state of Utah. Once identified hazards were researched to determine location and identify measure to reduce or eliminate long-term risk from hazards.

This plan addresses seven natural hazards with the potential of causing damage they are earthquakes, floods, landslides, wildfires, dam failure, drought, and sever weather. This plan provides a comprehensive summary of the seven multi-jurisdictional plans completed for the entire state by the seven associations of government. Multi-jurisdictional plans contain locally generated mitigation measures to protect the citizenry of Utah and there property.

Preface

The Utah Division of Emergency Services and Homeland Security is the state's designated coordinating agency for disaster preparedness, emergency response and recovery, and hazard mitigation programs. This State Natural Hazard Mitigation Plan is the latest in a series of documents created under the title of "State Natural Hazard Mitigation Plan" and is intended to guide and direct Utah's mitigation efforts. These mitigation efforts attempt to reduce or eliminate the impact of identified hazards on life, property, and the environment.

This plan represents the end product of a two and half year statewide mitigation planning process. For the first time, this planning process included and encouraged involvement at the city and county level. As a result of this planning process every jurisdiction within the state has meet the federal mitigation planning requirement. This planning requirement was accomplished utilizing the Seven Associations of Government who completed seven regional mitigation plans for their respective planning areas.

This plan incorporates the following information under the Disaster Mitigation Act of 2000 (DMA 2000) 44 CFR Part 201.4, Interim Final Rule:

- A description of an effective planning process used to develop this plan,
- Hazard identification and risk assessment of natural hazards which provide the factual basis for activities proposed in the mitigation strategy section,
- A mitigation strategy that provides the state's blueprint for reducing the losses identified in the risk assessment,
- Current and past hazard mitigation programs, (HMGP, FMA, PDM, Project Impact), plans and resources,
- A section on the coordination of local mitigation planning throughout the state,
- A plan maintenance process for monitory, evaluating, and updating the plan,
- A plan adoption process on the state, regional, and local levels,
- Assurances that the state will comply with all applicable federal statues and regulation in effect with the respect to the periods for which it receives grant funding,
- Review and updates of the State Natural Hazard Mitigation Plan every three years with submittal to the FEMA Region VIII Director.

By,

Ryan Pietramali
State Mitigation Planner

Executive Summary

Plan Mission
The mission of the State Natural Hazard Mitigation Plan (SNHMP), is to substantially and permanently reduce the states vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities, which act as a guide, to assist the state in becoming safer and more sustainable.

Plan Organization
The SNHMP was developed and organized within the rules and regulations established under CFR Title 44, Part 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on state and jurisdiction risk, as well as a hazard identification study and a vulnerability analysis of seven hazards. To assist in the explanation of the above-identified contents several appendices are included which provide more detail on specific subjects. This plan is intended to improve the state's ability to handle disasters, and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing
The SNHMP has been financed and developed under the Pre-Disaster Mitigation Grant Program PDM, provided by the Federal Emergency Management Agency (FEMA). Additional funding was provide through the operating budgets of state and federal agencies participating in the planning process as part of the State Hazard Mitigation Team.

Plan Participation
The SNHMP has been completed as a result of a collaborative effort between the seven Associations of Government, Utah Department of Public Safety Division of Emergency Services, City and County Emergency Managers, State Hazard Mitigation Team members, and citizens and public employees of the cities and counties within Utah. The state plan represents the end product of a two and a half year state wide planning process. This planning process included extensive local input solicited as part of seven multi-jurisdictional plans completed by the associations of government.

Hazards Identified
It was suggested to DES by the State Hazard Mitigation Team that, at minimum, the SNHMP and multi-jurisdictional plans address the hazards of: earthquake, flood, landslide, wildfire, dam failure, severe weather, and drought. This plan in its current state does not and was not required to look at man made or technologic hazards. It is expected in the future this plan will be a holistic mitigation plan which includes natural and man made hazards.

Plan Goals

In an effort to ensure that the mission of the SNHMP is met, the participants in the planning process developed a defined list of goals, which are directly relevant to meeting the mission of the plan.

The following is a list of the goals identified during the planning process, which overall direction to the plan:

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire
- Minimize the risk of dam failure
- Minimize the impacts of landslides

Acknowledgements

The Department of Public Safety, Division of Emergency Services and Homeland Security would like to acknowledge the following individuals and agencies for their dedication and valuable contribution to this document:

Association of Governments

- Bear River Association of Government
- Five County Association of Government
- Southeastern Association of Governments
- Wasatch Front Regional Council
- Uintah Basin Association of Government
- Mountainlands Association of Government
- Six County Association of Government

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        - Ryan Pietramali
        - Nancy Barr
    - USGS
        - Paul Lambert

Local and County Governments

University of Utah

FEMA Region VIII

- Doug Bausch
- Tony Mendes
- Mike Hillenburg
- Heather Leigh

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All of the appendices are electronic located in the CD sleeves at the back of the plan. Hard copies can be obtained by contacting:

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Division of Emergency Services and Homeland Security
1110 State Office Building
Salt Lake City, Utah 84114
Point of Contact: Ryan Pietramali

List of Acronyms and Recognized Abbreviations

AGRC	Automated Geographic Reference Center
AOG	Association of Governments
Assoc.	Association
ATV	All Terrain Vehicle
Bldg.	Building
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
Bur.	Bureau
Corp.	Corporation
CRS	Community Rating System
Dept.	Department
DESHS/DES	Division of Emergency Services and Homeland Security
Div	Division
DMA 2000	Disaster Mitigation Act of 2000
DOT	Department of Transportation
DNR	Division of Natural Resources
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FFSL	Forestry Fire and State Lands
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FS	Forest Service
GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HAZUS MH	Hazards United States
ICS	Incident Command System
LEPC	Local Emergency Planning Committee
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
SCS	Soil Conservation Service
SLC	Salt Lake City
SPI	Standardized Precipitation Index
SWSI	Surface Water Supply Index
UFFSL	Utah Forestry, Fire, and State Lands
UGS	Utah Geological Survey
URWIN	Urban-Rural Wildland Interface Zone
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UT	Utah

Introduction

While a combination of hydrologic, geologic, and wildfire hazards face Utah's diverse landscape and settlements, this plan addresses, primarily flood, wildfire, landslide, earthquake, and drought hazard mitigation. Hazard mitigation planning is the process of analyzing a set of conditions relative to a natural hazard to determine if existing mitigation is adequate to reduce or eliminate impacts should that hazard become active to a prescribed level, for example to the level of the 100-year flood.

All hazards have an associated set of impact-causing conditions, once a hazard becomes active. An important aspect of hazard mitigation planning is to obtain adequate input from skilled professionals who work with specific hazards and their associated impacts. Through such input, the hazard mitigation planner can plan for those impact-causing conditions, which cause an unacceptable threat to life and to property. It is important to note not all threat to life and property is termed unacceptable, because people must accept some risk for living where they do.

The objective of hazard mitigation planning is to describe mitigation measures that can reduce, as much as possible, or eliminate the threat from those unacceptable impact-causing conditions resulting from a hazard that may become active. The identification of what the community feels is an acceptable or unacceptable risk is essential in any mitigation Plan. From this concept of what can be and is being mitigated for, the planner then can assist the community in preparing for the potential threat of the hazard.

For example, within the realm of a hazard, it may be possible to **mitigate** for 40 percent of the potential impact associated with the threat through either structural or nonstructural measures. That being the case, theoretically, one might then be able to adequately **prepare** for the resulting 60 percent of potential impact.

How This Plan is Organized

The SNHMP was developed and organized within the rules and regulations established under CFR Title 44, Part 201.6 of the Disaster Mitigation Act of 2000. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on state and jurisdiction risk, as well as a hazard identification study and a vulnerability analysis of seven hazards. To assist in the explanation of those items the plan contains a section on each hazard; with appendices providing more detail on specific subjects. This plan is intended to improve the state's ability to handle disasters, and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

How the Plan Should Be Used

This plan was written to provide usefulness in four broad areas. First, the plan should be used to assist state and local agencies in implementing programs and projects which reduce the states overall vulnerability to natural hazards. Second, this plan should be used as an aid to facilitate inter-governmental coordination and collaboration related to natural hazard mitigation planning and subsequent plan implementation. Third, this plan serves as a comprehensive strategy for dealing with natural disasters. Fourth, this plan

will bring the state into compliance with the Disaster Mitigation Act of 2000 and maintain State eligibility for federal mitigation funding.

This mitigation plan similar to all state natural hazard mitigation plans, which have come before, is not a comprehensive end all list of mitigation strategies. This plan is and must continue to be a living document, dynamically changing with Utah's transforming environment and ever-changing technology. For this reason the state maintains the right to add, subtract, or augment this plan as it sees fit to best meet the goals of the plan.

Scope

The Utah Pre-Disaster Mitigation Plan is a statewide plan addressing the natural hazards of dam failure, drought, earthquake, flooding, landslides, severe weather and wildfire. A more detailed focus on local risk and local mitigation can be found in the multi-jurisdictional plans completed by the Associations of Governments, which encompass all twenty-nine counties and two hundred and sixty-five incorporated municipalities, and five Indian tribes. This plan summarizes finding in the AOG document as well as meets state requirements set fourth in the Disaster Mitigation Act of 2000.

Purpose

To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is an aid in enhancing state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability and risk of each Utah jurisdiction.

Authority

Federal

Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

The Disaster Mitigation Act of 2000

In the past, federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA 2000) is the latest legislation, was put into motion on October 10, 2000, when the President signed the Act (Public Law 106-390). The new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. As such, this Act establishes a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP).

Section 322, of the Act, specifically addresses mitigation planning at the state and local levels. Identifying new requirements that allow HMGP funds to be used for planning activities, and increases the amount of HMGP funds available to states that have developed a comprehensive or enhanced mitigation plan prior to a disaster. States and communities must have an approved mitigation plan in place prior to receiving both pre and post-federal disaster funds. Local and tribal mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual communities.

State governments have certain responsibilities for implementing Section 322, including:

- Preparing and submitting a standard or enhanced state mitigation plan;
- Reviewing and updating the state mitigation plan every three years;
- Providing technical assistance and training to local governments to assist them in applying for HMGP grants and in developing local mitigation plans; and
- Reviewing and approving local plans if the state is designated a managing state and has an approved enhanced plan.

DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. It encourages and rewards local and state pre-disaster planning and promotes sustainability as a strategy for disaster resistance. This enhanced planning network will better enable local and state governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

To implement the new DMA 2000 requirements, FEMA prepared an Interim Final Rule, published in the Federal Register on February 26, 2002, at 44 CFR Parts 201 and 206, which establishes planning and funding criteria for states and local communities.

State Authority

- The Governor's Emergency Operation Directive
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended.
- Title 44, CFR, Federal Emergency Management Agency Regulations, as amended.
- State Emergency Management Act of 1981, Utah Code 53-2, 63-5.
- Disaster Response Recovery Act, 63-5A.

- Executive Order of the Governor, Executive Order 11
- Emergency Interim Succession Act, 63-5B.

Utah State Code
In Utah Code 53-2-104, it is stated that the Utah Division of Emergency Services* shall:
(c) prepare, implement, and maintain programs and plans to provide for:

(i) Prevention and minimization of injury and damage caused by disasters:
(iii) Identification of areas particularly vulnerable to disasters;
(iv) Coordination of hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters;
(v) Assistance to local officials in designing local emergency action plans;
(vi) Coordination of federal, state, and local emergency activities;
(vii) Coordination of emergency operations plans with emergency plans of the federal government; and
(x) Other measures necessary, incidental, or appropriate to this chapter.

* Updated with current name.

Assurances to Comply with Federal Laws and Regulations

The plan must include assurances that the State will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with §13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in §13.11(d).

Through the development and enforcement of this plan, the assurances listed below are provided as documentation that the state or any subsequent sub-grantee (recipients) that receives federal grant funding will comply with all applicable Federal statutes and regulations. Additionally, the state will amend the plan whenever necessary to reflect changes in Federal and State laws and regulations.

To the extent the following provisions apply to the award of assistance:

(a) Recipient possesses legal authority to enter into agreements, and to execute the proposed programs;

(b) Recipient's governing body has duly adopted or passed as an official act a resolution, motion or similar action authorizing the execution of hazard mitigation agreements, including all understandings and assurances contained therein, and directing and authorizing the Recipient's chief administrative officer or designee to act in connection with any application and to provide such additional information as may be required;

(c) No member of or delegate to the Congress of the United States, and no Resident Commissioner shall be admitted to any share or part of any agreement or to any benefit to arise from the same. No member, officer, or employee of the Recipient or its designees or agents, no member of the governing body of the locality in which the program is situated, and no other public official of such locality or localities

who exercises any functions or responsibilities with respect to the program during his tenure or for one year thereafter, shall have any interest direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed in connection with the program assisted under this plan. The
Recipient shall incorporate or cause to be incorporated, in all such contracts or subcontracts a provision prohibiting such interest pursuant to the purpose state above;

(d) All Recipient contracts for which the State Legislature is in any part a funding source, shall contain language to provide for termination with reasonable costs to be paid by the Recipient for eligible contract work completed prior to the date the notice of suspension of funding was received by the Recipient. Any cost incurred after a notice of suspension or termination is received by the Recipient may not be funded with funds provided under a grant agreement unless previously approved in writing by the Department. All Recipient contracts shall contain provisions for termination for cause or convenience and shall provide for the method of payment in such event;

(e) Recipient will comply with:

(1) Contract Work Hours and Safety Standards Act of 1962, 40 U.S.C.
327 et seq., requiring that mechanics and laborers (including watchmen and guards) employed on federally assisted contracts be paid wages of not less than one and one-half times their basic wage rates for all hours worked in excess of forty hours in a work week; and

(2) Federal Fair Labor Standards Act, 29 U.S.C. Section 201 et seq., requiring that covered employees be paid at least the minimum prescribed wage, and also that they be paid one and one-half times their basic wage rates for all hours worked in excess of the prescribed work-week.

(f) Recipient will comply with:

(1) Title VI of the Civil Rights Act of 1964 (P.L. 88-352), and the regulations issued pursuant thereto, which provides that no person in the United
States shall on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Recipient receives
Federal financial assistance and will immediately take any measures necessary to effectuate this assurance. If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the
Recipient, this assurance shall obligate the Recipient, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended, or for another purpose involving the provision of similar services or benefits;

(2) Any prohibition against discrimination on the basis of age under the

Age Discrimination Act of 1975, as amended (42 U.S.C.: 6101-6107), which prohibits discrimination on the basis of age or with respect to otherwise qualified handicapped individuals as provided in Section 504 of the Rehabilitation Act of
1973;

(3) Executive Order 11246 as amended by Executive Orders 11375 and 12086, and the regulations issued pursuant thereto, which provide that no person shall be discriminated against on the basis of race, color, religion, sex or national origin in all phases of employment during the performance of federal or federally assisted construction contracts; affirmative action to insure fair treatment in employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff/termination, rates of pay or other forms of compensation; and election for training and apprenticeship;

(g) The Recipient agrees to comply with the Americans With Disabilities Act
(Public aw 101-336, 42 U.S.C. Section 12101 et seq.), where applicable, which prohibits discrimination by public and private entities on the basis of disability in the areas of employment, public accommodations, transportation, State and local government services, and in telecommunications;

(h) Recipient will establish safeguards to prohibit employees from using positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties pursuant to Section 112.313 and Section
112.3135, FS;

(i) Recipient will comply with the Anti-Kickback Act of 1986, 41 U.S.C.
Section 51, which outlaws and prescribes penalties for "kickbacks" of wages in federally financed or assisted construction activities;

(j) Recipient will comply with the provisions of 18 USC 594, 598, 600-605 (further known as the Hatch Act) which limits the political activities of employees;

(k) Recipient will comply with the flood insurance purchase and other requirements of the Flood Disaster Protection Act of 1973 as amended, 42 USC
4002-4107, including requirements regarding the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquisition purposes for use in any area having special flood hazards. The phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance;

(l) Recipient will require every building or facility (other than a privately owned residential structure) designed, constructed, or altered with funds provided under a grant agreement to comply with the "Uniform Federal Accessibility Standards," (AS) which is Appendix A to 41 CFR Section 101-19.6 for general type buildings and Appendix A to

24 CFR Part 40 for residential structures. The Recipient will be responsible for conducting inspections to ensure compliance with these specifications by the contractor;

(m) Recipient will, in connection with its performance of environmental assessments under the National Environmental Policy Act of 1969, comply with Section 106 of the National Historic Preservation Act of 1966 (U.S.C. 470), Executive Order 11593, 24 CFR Part 800, and the Preservation of Archaeological and Historical Data Act of 1966 (16 U.S.C. 469a-1, et seq.) by:

(1) Consulting with the State Historic Preservation Office to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Section 800.8) by the proposed activity; and

(2) Complying with all requirements established by the State to avoid or mitigate adverse effects upon such properties.

(3) Abiding by the terms and conditions of the "Programmatic Agreement Among the Federal Emergency Management Agency, the Utah State Historic Preservation Office," which addresses roles and responsibilities of Federal and State entities in implementing Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. 470f, and implementing regulations in 36 CFR part 800.

(4) Notifying FEMA and the state if any project may affect a historic property. When any of Recipient's projects funded under a grant agreement may affect a historic property, as defined in 36 CFR 800. (2)(e), the Federal Emergency Management Agency (FEMA) may require Recipient to review the eligible scope of work in consultation with the State Historic Preservation Office (SHPO) and suggest methods of repair or construction that will conform with the recommended approaches set out in the Secretary of Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings 1992 (Standards), the Secretary of the Interior's Guidelines for Archeological Documentation (Guidelines) (48 Federal Register 44734-37), or any other applicable Secretary of Interior standards. If FEMA determines that the eligible scope of work will not conform with the Standards, Recipient agrees to participate in consultations to develop, and, after execution by all parties, to abide by, a written agreement that establishes mitigation and recondition measures, including but not limited to, impacts to archeological sites, and the salvage, storage, and reuse of any significant architectural features that may otherwise be demolished.

(5) Notifying FEMA and the state if any project funded under a grant agreement will involve ground disturbing activities, including, but not limited to: subsurface disturbance; removal of trees; excavation for footings and foundations; and installation of utilities (such as water, sewer, storm drains, electrical, gas, leach lines and septic tanks) except where these activities are restricted solely to areas previously disturbed by the installation, replacement or maintenance of such utilities. FEMA will

request the SHPO's opinion on the potential that archeological properties may be present and be affected by such activities. The SHPO will advise Recipient on any feasible steps to be accomplished to avoid any National Register eligible archeological property or will make recommendations for the development of a treatment plan for the recovery of archeological data from the property.

If Recipient is unable to avoid the archeological property, it will develop, in consultation with the SHPO, a treatment plan consistent with the Guidelines and take into account the Advisory Council on Historic Preservation (Council) publication "Treatment of Archeological Properties". Recipient shall forward information regarding the treatment plan to FEMA, the SHPO and the Council for review. If the SHPO and the Council do not object within 15 calendar days of receipt of the treatment plan, FEMA may direct Recipient to implement the treatment plan. If either the Council or the SHPO object, Recipient shall not proceed with the project until the objection is resolved.

(6) Notifying the state and FEMA as soon as practicable: (a) of any changes in the approved scope of work for a National Register eligible or listed property; (b) of all changes to a project that may result in a supplemental DSR or modify an HMGP project for a National Register eligible or listed property; (c) if it appears that a project funded under a grant agreement will affect a previously unidentified property that may be eligible for inclusion in the National Register or affect a known historic property in an unanticipated manner. Recipient acknowledges that FEMA may require Recipient to stop construction in the vicinity of the discovery of a previously unidentified property that may be eligible for inclusion in the National Register or upon learning that construction may affect a known historic property in an unanticipated manner. Recipient further acknowledges that FEMA may require Recipient to take all reasonable measures to avoid or minimize harm to such property until FEMA concludes consultation with the SHPO. Recipient also acknowledges that FEMA will require, and Recipient shall comply with, modifications to the project scope of work necessary to implement recommendations to address the project and the property.

(7) Acknowledging that, unless FEMA specifically stipulates otherwise, it shall not receive funding for projects when, with intent to avoid the requirements of the PA or the NHPA, Recipient intentionally and significantly adversely affects a historic property, or having the legal power to prevent it, allowed such significant adverse affect to occur.

(n) Recipient will comply with Title IX of the Education Amendments of 1972, as amended (20 U.S.C.: 1681-1683 and 1685 - 1686) which prohibits discrimination on the basis of sex;

(o) Recipient will comply with the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970, (42 U.S.C. 4521-45-94) Relating to nondiscrimination on the basis of alcohol abuse or alcoholism;

(p) Recipient will comply with 523 and 527 of the Public Health Service Act of

1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records;

(q) Recipient will comply with Lead-Based Paint Poison Prevention Act (42 U.S.C.: 4821 et seq.) which prohibits the use of lead based paint in construction of rehabilitation or residential structures;

(r) Recipient will comply with the Energy Policy and Conservation Act (P.L. 94-163; 42 U.S.C. 6201-6422), and the provisions of the state Energy Conservation Plan adopted pursuant thereto;

(s) Recipient will comply with the Laboratory Animal Welfare Act of 1966, 7 U.S.C. 2131-2159, pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by an award of assistance under this agreement;

(t) Recipient will comply with Title VIII of the Civil Rights Act of 1968, 42 U.S.C. 2000c and 42 3601-3619, as amended, relating to non-discrimination in the sale, rental, or financing of housing, and Title VI of the Civil Rights Act of 1964 (P.L. 88-352), which prohibits discrimination on the basis of race, color or nation origin;

(u) Recipient will comply with the Clean Air Act of 1955, as amended, 42 U.S.C. 7401-7642;

(v) Recipient will comply with the Clean Water Act of 1977, as amended, 42 U.S.C. 7419-7626;

(w) Recipient will comply with the Endangered Species Act of 1973, 16 U.S.C. 1531-1544;

(x) Recipient will comply with the Intergovernmental Personnel Act of 1970, 42 U.S.C. 4728-4763;

(y) Recipient will assist the awarding agency in assuring compliance with the National Historic Preservation Act of 1966, as amended, 16 U.S.C. 270;

(z) Recipient will comply with environmental standards, which may be prescribed pursuant to the National Environmental Policy Act of 1969, 42 U.S.C. 4321-4347;

(aa) Recipient will assist the awarding agency in assuring compliance with the Preservation of Archeological and Historical Preservation Act of 1966, 16 U.S.C. 469a, et seq;

(bb) Recipient will comply with the Rehabilitation Act of 1973, Section 504, 29

U.S.C. 794, regarding non-discrimination;
(cc) Recipient will comply with the environmental standards, which may be prescribed pursuant to the Safe Drinking Water Act of 1974, 42 U.S.C. 300f-300j, regarding the protection of underground water sources;

(dd) Recipient will comply with the requirements of Titles II and III of the Uniform Relocation Assistance and Property Acquisition Policies Act of 1970, 42 U.S.C. 4621-4638, which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs;

(ee) Recipient will comply with the Wild and Scenic Rivers Act of 1968, 16 U.S.C. 1271-1287, related to protecting components or potential components of the national wild and scenic rivers system;

(ff) Recipient will comply with the following Executive Orders: EO 11514 (NEPA); EO 11738 (violating facilities); EO 11988 (Floodplain Management); EO 11990 (Wetlands); and EO 12898 (Environmental Justice);

(gg) Recipient will comply with the Coastal Barrier Resources Act of 1977, 16 U.S.C. 3510;

(hh) Recipient will assure project consistency with the approved State program developed under the Coastal Zone Management Act of 1972, 16 U.S.C. 1451-1464; and

(ii) Recipient will comply with the Fish and Wildlife Coordination Act of 1958; 16 U.S.C. 661-666.

(jj) With respect to demolition activities, recipient will:

1. Create and make available documentation sufficient to demonstrate that the recipient and its demolition contractor have sufficient manpower and equipment to comply with the obligations as outlined in a grant agreement.

2. Return the property to its natural state as though no improvements had ever been contained thereon.

3. Furnish documentation of all qualified personnel, licenses and all equipment necessary to inspect buildings located in Recipient's jurisdiction to detect the presence of asbestos and lead in accordance with requirements of the U.S. Environmental Protection Agency, the Florida Department of Environmental Protection and the County Health Department.

4. Provide documentation of the inspection results for each structure to indicate:

a. Safety Hazards Present

b. Health Hazards Present
c. Hazardous Materials Present

5. Provide supervision over contractors or employees employed by Recipient to remove asbestos and lead from demolished or otherwise applicable structures.

6. Leave the demolished site clean, level and free of debris.

7. Notify the Department promptly of any unusual existing condition, which hampers the contractor's work.

8. Obtain all required permits.

9. Provide addresses and marked maps for each site where water wells and septic tanks are to be closed along with the number of wells and septic tanks located on each site. Provide documentation of closures.

10. Comply with mandatory standards and policies relating to energy efficiency that are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Public Law 94-163).

11. Comply with all applicable standards, orders, or requirements issued under Section 112 and 306 of the Clean Air Act (42 U.S.C. 1857 (h),
Section 508 of the Clean Water Act (33 U.S. 1368), Executive Order 11738, and the U.S. Environmental Protection Agency regulations (40 CFR Part 15 and 61).
This clause shall be added to any subcontracts.

12. Provide documentation of public notices for demolition activities.

What is Planning?

It is important to have a good understanding of what is meant by "planning". As a general practice, planning is a way that people figure out how to accomplish a goal or solve a problem. The methods for planning are quite varied, based on what people are trying to do. The following examples of planning in your personal life can be used to understand the different approaches to planning, including mitigation planning.

Sometimes people plan as they go, literally making it up along the way. For example, if you decide to take a weekend drive in the country with your family, the "plan" simply consists of deciding when to leave the house and the general direction you will take to get out of town. As you travel the roadways, your family makes decisions about where to stop, where to turn, and when to head back home, i.e., the plan continues to be developed as it occurs. This type of planning is fine when the desired result is simply to have an experience without a lot of specific expectations.

When there is a more specific goal in mind, a more thoughtful planning approach is required. For example, this time your family needs to visit relatives in a distant city. You research and evaluate your options for traveling, weighing the cost of various transportation alternatives (cars, trains, airplanes, etc.) versus the amount of time it requires for each mode of transport. You decide on a method and a time to travel that meets your needs and budget, make the necessary travel arrangements, and undertake the journey. In so doing, the planning process helps you realize the goal of visiting your relatives using your resources (in this case, time and money) in the most efficient manner. This approach only involves a few simple steps – researching and comparing options, and implementation – and works well to attain a single distinct result.

When the ultimate goal is more complex, however, the planning process required to reach a successful result must account for more issues and takes a little more effort. Suppose you want to plan for your eventual retirement so that you and your spouse will have enough funds to take care of your basic needs and to enjoy yourselves. You (perhaps with the help of a financial advisor) take stock of your resources and earning potential, your likely expenses over time, and options for saving and investing your money to provide different levels of return and security. As part of this process, you evaluate the risk that is inherent in different types of investments, the number of years you will be working and saving, and a host of other factors. During the planning process, you will probably refine and revise your retirement goals as you find out more about what you can realistically accomplish. Also, an important difference in this type of planning process, compared with the previous two examples, is that you will be making decisions about how to start your investment program, but if you are wise, you will revisit your financial plan from time to time to make sure it continues to fit your needs and capabilities.

In doing so, you will have embarked on a long-term planning process that:

- Has an overarching mission (in this example, "attaining financial security") but also allows for flexibility regarding specific actions to be taken as the plan develops;
- Accounts for the interactions of a number of dynamic factors that might influence your decision making; and
- Does not have a finite life span, i.e., ultimate success requires periodic attention through the years to make sure that your mission is attained.

You have also expanded your decision-making framework in such a way that all of the other decisions in your life will now have to consider your financial goals with respect to retirement. Your retirement goals have now become integrated into other important decisions in your life.

Mitigation Planning

Mitigation planning is simply adapting the planning process discussed above to focus on mitigation and hazard reduction. The mitigation planning process in all of its various forms follows several simple steps to reduce the effects of hazards.

Organize resources

From the start, communities should focus the resources needed for a successful mitigation planning process. Essential steps include identifying and organizing interested members of the community as well as the technical experts required during the planning process

Assess risks

Communities need to identify the characteristics and potential consequences of natural hazards. It is important to understand how much of the community can be affected by specific hazards and what the impacts would be for important assets.

Development of the mitigation plan

Armed with an understand of the risks posed by natural hazards, communities need to determine what their priorities should be and then look at possible ways to avoid or minimize the undesired effects. The result is a natural hazard mitigation plan and strategy for implementation.

Implementation of the plan and monitoring of the plans progress

Communities can bring the plan to life in a variety of ways ranging from implementing specific mitigation projects to changes in the day-to-day operation of the local or state government. To ensure the success of an on-going program, it is critical that the plan remains effective. Thus, it is important to conduct periodic evaluations and make revisions as needed.

Adapted from State and Local Mitigation Planning How-to guide Understanding Your Risk FEMA 386-2

Planning Process

The plan must include a description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated.

The State Department of Public Safety Division of Emergency Services and Homeland Security is the lead agency responsible for coordinating the development of the State Hazard Mitigation Plan. Staff members from DES completed the State Hazard Mitigation Plan with assistance from our most significant partner the State Hazard Mitigation Team. The process utilized by DES to complete the state hazard mitigation plan is two fold. First the state plan is a result of a separate planning process put into motion twenty-four months prior to the state planning process. The initial PDM planning process involved the seven associations of government (AOG). The second process initiated to complete the state natural hazard mitigation plan was a result of a strengthening and augmentation of the process used over the last 15 years, to complete previous state hazard mitigation plans. The state plan and process used to create it, relied heavily on mitigation and program experts from the Division of Emergency Services and numerous state agencies.

Pre-Disaster Mitigation Funding

The Federal Emergency Management Agency (FEMA) provided grant funding to the state, under the Pre-Disaster Mitigation Grant Program. This funding is dependent upon a yearly appropriation from Congress. Once funding is allocate, it is guaranteed, but future funding for mitigation planning, while likely, has been tied to a competitive grant process. To initiate the PDM planning process FEMA's budget contained a non-competitive set aside in federal fiscal year 2002 and 2003. Though expected, the 2004 PDM program contained no planning set aside.

In Federal Fiscal Year 2002 the State of Utah received approximately of $300,000, $30,000 of which was used to instigate local planning, a approximately $270,000, was passed through to locals jurisdictions to complete multi-jurisdictional mitigation plans. In Federal Fiscal Year 2003, Utah received approximately $248,000; most of this funding was again passed down to local governments in support of the multi-jurisdictional planning initiative. Unfortunately, DES discovered there would be no PDM planning set aside in Federal Fiscal Year 2004 until after the submittal deadline for the PDM-C grant program. This resulted in a funding gap, which left the state with the task of completing the State Natural Hazard Mitigation Plan on a very limited budget.

Association of Government Planning Process

The planning process suggested by the DES and carried out by the seven AOG is being discussed here in brief to explain the utility of having to separate but intergrated planning processes. A more detailed explanation of the planning processes individual Associations used to complete their plans can be found in each of the seven multi-jurisdictional plans. The state contracted with at the AOG to complete a PDM plan for the counties in their

planning area. When the planning requirement in DMA 2000 was released the state determined it would be best to complete regional or multi-jurisdictional mitigation plans rather then single jurisdiction or countywide plans.

At the beginning of the planning process GIS technicians and senior planners from each AOG were asked by the AOG Board of Directors to form a technical PDM planning team. This core group met regularly to share ideas, concentrate limited resources, and ensure plans were similar in methodology selection. State technical assistance was made available to this group through out the process when requested. A member of the Natural Hazard Mitigation Planning Team served as chair of the AOG technical committee to facilitate coordination and ensure needs were fully met.

Table I-1 PDM Technical Team

Name	Organization
Ryan Pietramali, Chair	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council
Jeff Adams	Southeastern Utah Association of Local Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Regardless of the alterations made by individual AOGs each AOG formed a core PDM planning committee, a County Mitigation Committees, and participated in the Association of Government PDM Technical Team. The Division of Emergency Services recommended a planning process to the AOG Technical Team containing the following steps.

The planning process included the following steps:

1. Resource Organization
2. Public Officials Outreach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. Hazard Risk Identification and Analysis
6. County Vulnerability Assessment
7. Community Goals Assessment
8. Formation of County Mitigation Steering Committee
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

State Natural Hazard Mitigation Planning Process

Since, the state plan is so integrated with the planning effort at the local level many similarities exist in the steps following. Many of the steps taken during the state planning process were done in support of local plans. Difficulty exists in attempting to describe a planning process, which took over two years to complete, into simple steps. With so many different entities and individuals' involved steps begin to congeal into a fluid step-less process. Nonetheless the three basic steps in the state planning process were:

1. Determine Need and Overall State PDM Planning Process
2. State Support for Multi-Jurisdictional Mitigation Plans
3. Development of State Hazard Mitigation Plan

1. DETERMINE NEED AND OVERALL STATE PDM PLANNING PROCESS

At the onset of most planning processes a need to complete or initiate planning must be determined. Changes were made in to the Stafford Act with the passage of the Disaster Mitigation Act of 2000. These changes resulted in states having to complete a mitigation plans as a contingent of receiving pre and post disaster federal assistance. The most recent State Hazard Mitigation Plan which, represented the latest in a series of plans, was written to conform to section 409 in the Stafford Act. This plan was compared with the new DMA 2000 Section 322 requirements. The comparison results along with the fact the plan had not been officially updated since 1999 resulted in a need to complete a new plan.

Form the Utah Pre-Disaster Mitigation Planning Committee (UPDMPC)

The state natural hazard mitigation planner formed the Utah Pre-Disaster Mitigation Planning Committee to serve as the core PDM planning body within the state. This planning team was tasked with providing technical assistance to the seven AOG, reviewing multi-jurisdictional plans, writing the state mitigation plan, coordinating with state agencies, and representing DES on various committees and commissions related to mitigation. The UPDMPC was comprised of:

Judy Watanabe	State Floodplain Manager
Nancy Barr	State Hazard Mitigation Officer
Bob Carey	State Earthquake Program Manager
Ryan Pietramali	State Natural Hazard Mitigation Planner
Jim Brown	Operations and Natural Hazard Section Manager

Assess Planning Capabilities

How the state was going to complete a state mitigation plan and administer a program, which ensured successful mitigation planning at the local level in a post 9/11 environment was problematic at best. The new emphasis on homeland security and the grants and programs offered by various federal agencies, was proving taxing on county and city emergency program managers. Typically, emergency managers would have been funded to complete county mitigation plans, as mitigation is one of the core functions of emergency managers and the four-phase approach to providing citizen safety.

The new requirements placed an emphasis on assessing risk and vulnerability at the local level.

The higher level of detail required in the local plans had not been completed in the state prior to the DMA 2000 requirement. It was determined assessing risk and determining vulnerability could only be carried out through use of Geographic Information Systems GIS. Fortunately, Utah has an abundance of natural hazard GIS base layers, with the exception of flood plains, to use in the analysis. It was determined the counties did not have the resources to complete mitigation plans for the level of funding, available to them.

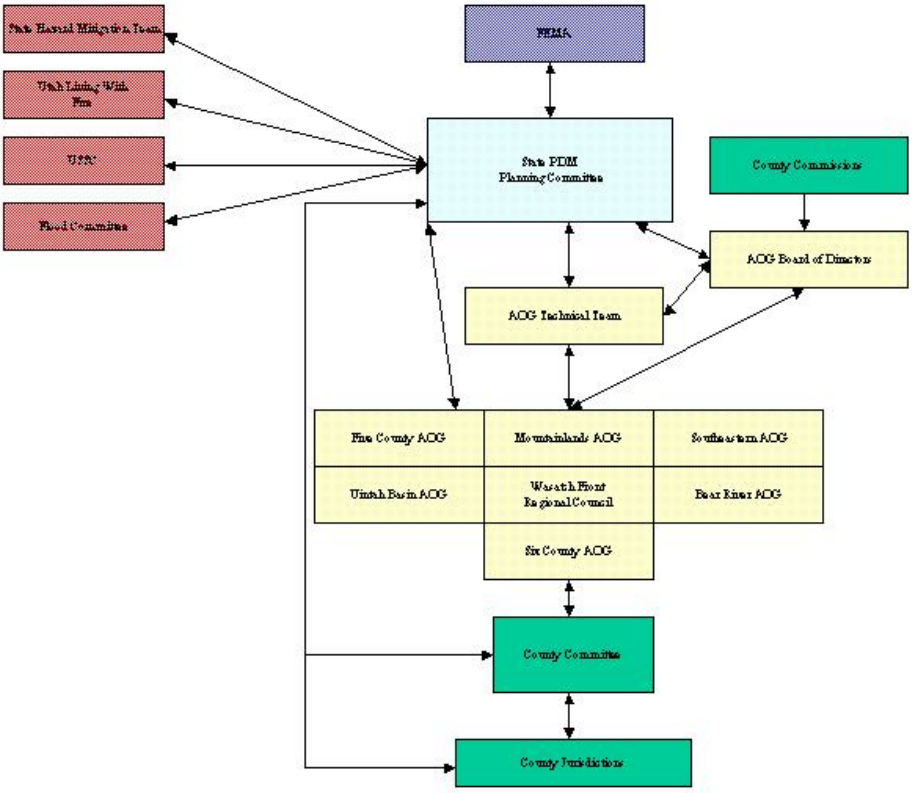
The state has a number of agencies with proficiency in natural hazards and natural hazard mitigation, the Utah Geologic Survey, Dam Safety, Water Resources, and Forestry, Fire, and State Lands to name a few. These agencies were willing to provide input on mitigation plans but did not have the resources to aid all 29 counties and 265 cities.

Contract Seven Associations of Government

It was determined following the analysis of state and local capabilities to meet the DMA 2000 requirements that; the state needed:

1. Planning entity with a dedicated planner,
2. GIS analyst,
3. Experience dealing with the elected officials on a more local level.

It was determined with assistance from the State Office of Planning and Budget that the seven



Associations of Government meet the requirements DES was looking for.

The initial 2002-planning grant, received by the State, from FEMA was utilized to contract with the seven associations of government. Contracts were put in place to complete natural hazard mitigation plans for those jurisdictions represent by each AOG.

2. STATE SUPPORT FOR MULTI-JURISDICTIONAL MITIGATION PLANNING

Coordination With Associations of Government

To ensure the AOGs were completing plans, containing the elements, which meet the DMA 2000 requirements and at the same time were useful for local governments. Enormous amounts of coordination took place between DES and the seven AOGs. This coordination included participation at Association of Governments Board of Directors meetings, involvement in local jurisdictions when meeting with the AOGs, training, data acquisition, presentations at elected officials meetings in support of PDM, and chairing the PDM Technical Team. The completed plans prove the close working relationship was beneficial.

Supporting Association of Governments Planning

Data and Information

A considerable amount of information was gathered at the onset and thought out the mitigation planning process. This information was disseminated to the seven Associations of Government and county governments. Information includes:

- GIS data on fault locations, fault zones, wildfire risk, flooding, dam location and hazard rating, landslide and debris flow location, business data, and critical facilities.
- Flood Insurance Rate Maps and Flood Insurance Studies
- History of past disaster occurrences
- Studies and technical reports

Development of Loss Estimation Methodology

Loss estimates in each AOG plan, were the result of methodology developed by the AOG technical team in conjunction with DES. Methodology used to ascertain loss in each multi-jurisdictional plan differs slightly. This difference is due in part to differences in data, data quality, and data availability.

Provide Subject Matter Experts

Upon request UPDMPC provided or coordinated technical experts to assist in developing both local mitigation strategies and multi-jurisdictional plans. These experts were primarily part of the State Hazard Mitigation Team with technical expertises in the following areas:

- Mitigation
- Geology

- Meteorology
- Engineering
- Climate
- Water Resource Management
- Wildfire
- Dam Safety
- Flood Plain Management

Multi-Jurisdictional Plan Review

Mitigation plans submitted by each AOG were formally reviewed three times (October 15, 2003, January 1, 2004, and February 1, 2004). These reviews were conducted by the UPDMPC with each member reviewing and commenting on the plan. Plans were reviewed against the FEMA crosswalk. Additional plan reviews were completed at the request of either the AOG or county with several reviews taking place per AOG. To prevent slowing the planning process and meet timelines, plans were returned to the AOG within 15 calendar days.

Public Officials Outreach

Completed local mitigation plan must be approved and promulgated by the jurisdictions. Understanding this could be problematic the members of the Utah Pre-Disaster Mitigation Planning Committee made numerous presentations to elected officials and jurisdiction representatives at the City and County Directors meetings, the League of Cities and Towns meeting, and various other elected officials meetings. The planning committee also designed presentations and encouraged each AOG to present to elected officials in their planning district. This brought on board those with the final responsibility of approving the plan at the bringing of the planning process.

Mitigation Training

Mitigation, and the concept of mitigation is an area of emergency management neglected at the state level for some time. While most county emergency managers had a general understanding of mitigation most still benefited from a refresher on new techniques and programs.

The seven AOGs had planning and GIS staff, who had never been exposed to mitigation or characteristics of natural hazards. Training was conducted on May 15 and 16, 2002 in Salt Lake City for the AOG. Training conducted by UPDMPC members at each association followed up this training.

Additional mitigation training was made available statewide on October 15, 2003 and on November 17-19 2003. These training were both well attended by AOG planning staff and county emergency managers.

3. DEVELOPMENT OF STATE HAZARD MITIGATION PLAN

Coordination With State Hazard Mitigation Team

The State Hazard Mitigation Team (SHMT), formally the Interagency Technical Team, has and will continue to be the cornerstone of any mitigation plan or project within the state of Utah. The SHMT is comprised of technical experts, representing numerous state and federal agencies. The UPDMPC worked directly with the numerous subject matter experts on the SHMT during completion of this mitigation plan.

Coordination Among State and Federal Agencies

The UPDMPC served as the single point of contact for most state and federal agencies resources utilized in the pre-disaster mitigation planning process. During the planning process, subject matter experts, from state and federal agencies, where used to verify information in the review of multi-jurisdiction mitigation plans submitted by the association of government. State and federal resources pertaining to mitigation are typically part of one of three committees: SHMT, USSC, or ULWF.

Complete State Natural Hazard Mitigation Plan

Following an extensive process and twenty-four months of local, regional, and state planning the UPDMPC began writing the state mitigation plan. This planning began following the final review of the seven multi-jurisdictional plans. Information from these plans was instrumental in completing the state plan.

Sections were split from the state mitigation plan for review. Each member of the SHMT reviewed sections of the plan pertinent to their field of expertise. Additionally the plan was put on the DES website and comments were solicited from interested parties.

Integration With Existing Plans

Several planning efforts, some similarly initiated by Department of Homeland Security, were taking place simultaneously to the PDM process. These planning initiatives include planning for the Flood Map Modernization Program, The Office of Domestic Preparedness, County updates of their Emergency Preparedness Plans to include Terrorism Annexes, and Envision Utah Program planning programs. These planning programs are further discussed, in subsequent sections of this plan. Every attempt was made to coordinate these planning efforts to reduce duplication of effort.

Comment Period

Following the completion of the State Hazard Mitigation Plan the plan was placed on the DES website. This web address was emailed to stake holders for plan comments.

A draft pre-disaster mitigation plan was submitted to FEMA region VIII in May of 2004. Following the draft submittal the state adjusted the plan based on FEMA comments and resubmitted the plan in August of 2004 for final approval. Between draft and final approval the state plan was put out for a 30-day comment period via the Internet, this web link was put in the legal notice section of several major newspapers requesting comment. Readers were allowed to submit comments for 30 days. Received comments can be found in Appendix A

Coordination Among State Agencies

The mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, [and] interested groups.

The Utah Pre-Disaster Mitigation Committee (UPDMC) coordinated the development of the State Natural Hazard Mitigation Plan with other state, federal, and local agencies. Coordination among state and federal agencies involved in the planning process was primarily concentrated into six organizations or planning councils with members representing virtually all state, federal, and local agencies with responsibility related to natural hazards. These five principle agencies are: the State Hazard Mitigation Team, Utah Seismic Safety Commission, Associations of Governments, Utah Living With Fire Committee, City and County Emergency Managers, and State Floodplain Management Committee.

Description of Participating Agencies

State Hazard Mitigation Team

The Utah State Hazard Mitigation Team (SHMT) consists of representatives from State and Federal agencies, local agencies, and professional organizations. Individuals are subject matter experts in fields related to hazard mitigation. The Team includes geologists, hydrologist, meteorologists, engineers, and biologists to name a few. The primary role of the SHMT is to:

- Provide per and post hazard mitigation information and technical assistance to local governments and individuals.
- Identify specific mitigation measures and assist in their implementation.
- Assist in evaluation and review of existing hazard mitigation plans.

The State Hazard Mitigation Team consists of the following principal individuals with addition experts available if requested.

Table I-2 State Hazard Mitigation Team Members

Name	Agency Representing
Gary Christenson	Utah Geologic Survey
Richard Giraud	Utah Geologic Survey
Francis Ashland	Utah Geologic Survey
Kevin Barjenbruch	National Weather Service
Brian McInerney	National Weather Service
Dave Dalyrmple	State Forestry, Fire, and State Lands
Tracy Dunford	State Forestry, Fire, and State Lands
Scott Stoddard	U.S. Army Corps of Engineers
Robert Rasely	NRCS
Randy Julander	NRCS
Al Jones	Department of Environmental Quality
John Oakeson	Department of Environmental Quality
Kim Dykes	Department of Environmental Quality
Jim McMinimee	Utah Department of Transportation

Darren Rasmussen	Department of Natural Resources
Ken Short	Department of Natural Resources
Bill Bradwisch	Department of Natural Resources
Matt Lindon	Department of Natural Resources
Kyle Stephens	Utah Department of Agriculture
Ryan Pietramali	Utah Division of Emergency Services
Judy Watanabe	Utah Division of Emergency Services
Nancy Barr	Utah Division of Emergency Services
Bob Carey	Utah Division of Emergency Services
Paul Lambert	U.S. Geologic Survey

The SHMT meet on the following dates during the planning process:

- December 12, 2002
- April 1, 2003
- July 8, 2003
- October 28, 2003
- February 3, 2004
- May 4, 2004
- August 5, 2004
- November 2, 2004

Utah Seismic Safety Commission

The Utah Seismic Safety Commission USSC was established with the passage of House Bill 358, during the 1994 legislative session. The USSC committee primarily advises the Governor, Utah Legislature, state and local government agencies, and the private sector on issues related to earthquake safety.

The objective of USSC is to:

- Review earthquake-related hazards and risk in Utah,
- Prioritize recommendations to identify and mitigate these hazards and risks,
- Prioritize recommendations for adoption as policy or loss reduction strategies,
- Act as a source of information for earthquake safety and promote loss reduction measures,
- Prepare a strategic seismic safety planning document, and
- Update the strategic-planning document and other supporting studies or reports.

The USSC has compiled a report outlining a long-term plan to improve earthquake safety in the state of Utah entitled "A Strategic Plan for Earthquake Safety in Utah." The plan lists 33 specific strategies grouped into five key objectives and are outlined in a 64-page report found in Appendix C. Table I-3 lists the agencies, organizations, and private businesses represented on the USSC.

Table I-3 Utah Seismic Safety Commission Members

Name	Organization Represented
Chair Barry H. Welliver	Structural Engineers Association
Rick Allis	Utah Geologic Survey
Walter J. Arabasz	University of Utah Seismograph

	Stations
Hagop Jake Arslanian	American Public Works Association
Kerry Baum	Associations of Contingency Planners
Doug Bausch	FEMA
Nannette Rolfe	Utah Division of Emergency Services
Representative Don Bush	Utah House of Representatives
Catherine Howick	Utah Insurance Department, Property & Casualty Division
Michael Keene	State Science Advisor
Senator Peter C. Knudson	Utah State Senate
Peter W. McDonough	American Society of Civil Engineers
Matthias Mueller	Utah Division of Facilities Construction
David Nazare	Utah Department of Transportation
Barry Smith	American Institute of Architects
Mark Peterson	U.S. Geologic Survey
Carl Eriksson	Utah League of Cities and Towns

Bob Carey, represents the Utah Pre-Disaster Mitigation Planning Committee on the Utah Seismic Safety Commission. USSC conducted meetings on the following days during the PDM planning process:

- October 25, 2002
- January 17, 2003
- April 11, 2003
- July 18, 2003
- October 24, 2003
- January 16, 2004
- April 2, 2004
- July 9, 2004
- October 22, 2004

Associations of Governments

Associations of Governments AOG, implement the vision of multi-county or regional planning districts to coordinate planning and governmental activities within a specified geographic area of the state. These multi-county planning districts, or Associations of Governments (AOG), encompass and combine three or more counties with the primary concern to provide a framework to aid and encourage better coordination of and communication between plans and programs and to facilitate more efficient and effective ways for the administration and delivery of services that will carry out the responsibilities of government. . . (and) provide and operate various types of services or to develop facilities that would be more efficient on a district basis. Thus, regional planning districts have a few distinct purposes:

- Regional (and state-wide) planning and integration,

- Reduce duplication of local government efforts,
- Economies of scale.

With these distinct advantages, regional planning districts appeared the obvious solution to the rising difficulties of government activities in the middle 1960s when they were started and again when the state was faced with meeting the task of regional mitigation planning. In fact, Utah took to this concept almost out of necessity.

Table I-4 Associations of Government Board of Directors

Name	Association of Governments
John Williams	Five County Association of Governments
Bill Howell	Southeastern Association of Governments
Roger Jones	Bear River Association of Governments
Laurie Brummond	Uintah Basin Association of Governments
Russell Cowley	Six County Association of Governments
Chuck Chappell	Wasatch Front Regional Council
Darrell Cook	Mountainland Association of Governments

Necessity

Several factors pushed Utah to consider regional planning districts, including, but not limited to, the following:

- Utah's rural county makeup--and its declining rural county population--enhanced the difficulty of providing effective state and federal programs.
- These local government entities also found it difficult to resolve and develop support services for the rising social and economic problems of modern society.
- Many state or federal programs encompassed boundaries broader than, and separate from, city and county lines, resulting in overlapping jurisdictions, duplication, and competition for resources (i.e. law enforcement and employment security).
- Various regional groups had been formed, but not in any organized fashion, increasing the difficulty of approving, funding, and administering government programs.

Creation

On the federal level, a presidential memorandum issued in 1966 recognized the problem and requested federal agencies to coordinate and establish the multi-jurisdictional planning units with boundaries congruous with state planning and development districts. Subsequently, circulars A-80 (1967) and A-95 (1969) were issued by the Bureau of the Budget encouraging the establishment of these state planning and development districts. The catalyst of circular A-95, the Intergovernmental Cooperation Act of 1968, requested the creation of mechanisms to evaluate and review federal programs that heavily influence local planning and development.

Utah Living With Fire Committee

The Utah Living With Fire Program is a statewide effort, designed by agencies and communities, committed to providing wildfire information and education to mobilize

citizens to establish and maintain wildfire defensible communities. The Utah Living with Fire Committee was formed to initiate and oversee the Utah Living With Fire Program. The committee includes members from city, county, state, and federal agencies responsible for wildfire suppression and education. Through this effort home owners living in wildland areas have been educated on the threat of wildland fire and mitigation measures they can take to help defend there property. The following agencies are represented on the ULWF committee: UFFSL, BLM, USFS, DES, State Fire Marshals Office, U of U, USU, Big Cottonwood Canyon Association, Salt Lake City, Salt Lake County, Utah County, and Davis County.

Utah Floodplain and Stormwater Management Association UFSMA

The Utah Floodplain and Stormwater Management Association, is an organization of professionals involved in floodplain management, stormwater management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness. UFSMA has become a respected voice in floodplain management practice in Utah because it represents the flood hazard specialists of local, state and federal government, the research community, the insurance industry, and the fields of engineering, hydrologic forecasting, emergency response, water resources, and others.

Each year UFSMA holds an annual conference on various floodplain and stormwater management issues. This conference is typically held in October. The conference is moved around to different parts of the state to incorporate more individuals into our association and to discuss different issues for the different regions. We also conduct roundtable discussions on specific topics. These roundtables in the past have been on the map revision process, stormwater management guidelines, and local stormwater management programs. They are offered throughout the year, usually in the summer.

The purposes of the Utah Floodplain and Stormwater Management Association are:

- To educate those involved in floodplain and / or stormwater management about the regulations governing their programs and keep them in compliance with those regulations.
- To encourage communities involved in the Stormwater Phase II to be aware of upcoming deadlines and assist them in implementing their stormwater management programs.
- To promote flood awareness and encourage wise use and management of floodplains.
- To educate locals on new techniques and innovative and improved measures for floodplain management.

Table I-5 Utah Floodplain and Stormwater Management Association Board of Directors

Name	Organization Represented
Dr. George Burbidge, Chairman	Weber County Storm Water Management
Dave Adamson, Vice-Chair	Davis County Public Works

W.D. Robinson, Secretary	Department of Agriculture and Food, Development and Conservation Division
Judy Watanabe, Treasure	Utah Division of Emergency Services
Derrick Radke	Summit County Division of Engineering
Dr. William Rahmeyer	Water Research Lab, Utah State University
Ross Wilson	JUB Engineers
Scott Stoddard	Intermountain Representative, USACE
Dustin Lewis	Centerville City Public Works

City and County Emergency Managers

There are 144 designated City and County Emergency Managers in the state of Utah. The majority of these emergency managers are; volunteers, as a current City/County employee have this additional duty assigned to them, or are part time employees paid through a Federal grant. There are only five designated full time emergency managers in the state. These dedicated professional ensure Utah can respond to, recover from, prepare for and mitigate for disasters in the state.

City and County Emergency Managers played a significant role in the mitigation planning process. Their knowledge of natural hazards in their communities allowed for the development of sound, realistic mitigation strategies, identified in the Regional plans. As emergency managers they are aware of the importance of planning principles and support efforts to ensure the Regional plans reflect their unique hazards and risks. Emergency Managers were instrumental in the formal adoption of the Regional mitigation plans.

Quarterly emergency manager's meetings are held to discuss current issues and update the emergency management community on ongoing natural, technological, and human event planning activities, grant opportunities, training, and other items related to their responsibilities as emergency managers. A yearly Public Officials Conference POC is also held to educate and inform elected officials and emergency managers of current emergency management issues and trends.

Integration With Ongoing Planning Efforts

The Standard State Plan must be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives.

National Fire Plan and Utah Forestry, Fire, and State Lands Community Fire Planning

The Utah Division of Forestry, Fire, and State Lands UFF&SL initiated Community Fire Planning for the wildland urban interface communities of Utah. Over 400 Utah communities have been classified as "at risk" to wildfire, in the National Fire Plan. To protect these communities; community fire planning was initiated to:

- Empower communities to organize, plan, and take action on issues impacting community safety.
- Enhance levels of fire resistance and protection to the community
- Identify the risks of wildland/urban interface fires in the area
- Identify strategies to reduce the risks to homes and business in the community during a wildfire.

Above all, the community plans, because of their grass roots organization and training have enforced the fact that wildfire is a local issue and the ownership of the problem resides at the local level.

The community wildfire plans in table I-6 were both supported and utilized in the creation of this mitigation plan and the multi-jurisdictional mitigation plans.

Table I-6 Community Fire Planning Completed and in Progress

Community Fire Plans Completed		
No.	***Community***	***County***
1.	Mt. Haven	Salt Lake
2.	Cardiff Fork	Salt Lake
3.	Mill D	Salt Lake
4.	Pinetree	Salt Lake
5.	Silver Fork	Salt Lake
6.	Evergreen	Salt Lake
7.	Giles Flat	Salt Lake
8.	Brighton	Salt Lake
9.	Summit Park	Summit
10.	Sundance	Utah
11.	Woodland Hills	Utah
12.	Central	Washington
13.	Dixie Deer	Washington
14.	Mt. Aire	Salt Lake
15.	Covered Bridge	Utah
16.	Fruitland	Duchesne
17.	Bandanna Ranch	Duchesne
18.	Tabby Shadows	Duchesne
19.	Sundowner Ridge	Duchesne
20.	Pinyon Ridge	Duchesne
21.	Young Ranch	Duchesne
22.	Coleman Mountain Ranch	Duchesne
23.	Clark Estate	Duchesne
24.	Lower Red Creek	Duchesne
25.	Manorlands	Summit
26.	Pinebrook	Summit
27.	Colony at White Pine Canyon	Summit
28.	Bridgerland	Rich
29.	Cedar Highlands	Iron
30.	Interlaken	Wasatch
31.	Eureka	Juab
32.	Mammoth	Juab
33.	Silver City	Juab
34.	Brian Head	Iron
35.	Duck Creek	Kane
36.	Skyline Mtn. Resort	Sanpete
37.	Canaan	Washington
38.	Hi-Low / Arrowhead	Beaver
39.	Quichipa	Iron
40.	Brookside	Washington
41.	Hideaway Valley	Sanpete

Community Fire Plans in Process		
No.	***Community***	***County***
1.	Bullion Canyon (BLM)	Piute
2.	Monroe/Manning Meadows (BLM)	Sevier/Piute
3.	SUU Mountain Center (BLM)	Iron
4.	East Zion (BLM)	Kane
5.	Vista Grande (BLM)	Rich
6.	Willow Glen	Sanpete
7.	Swiss Mountain	Wasatch
8.	Echo Creek	Summit
9.	Hobble Creek	Utah
10.	Diamond Hills	Wasatch
11.	Woodland Estate	Wasatch
12.	Pine Mountain	Summit
13.	Canyon Rim	Summit
14.	Hidden Lake	Summit
15.	Echo Creek Ranches	Summit
16.	Pine Meadows	Summit
17.	Dry Fork / Deep Creek	Uintah
18.	Taylors Flat (BLM)	Daggett
19.	Nordic Valley	Weber
20.	Springdell	Utah
21.	Uintah Highland	Weber
22.	Sourdough	Weber
23.	Causey Estate	Weber
24.	Birch Glen	Cache
25.	Scare Canyon	Cache
26.	Cedar Ridge	Cache
27.	Argyle (BLM)	Duchesne
28.	Gunlock (BLM)	Washington
29.	Enterprise (BLM)	Washington
30.	Veyo (BLM)	Washington
31.	Pine Valley	Washington
32.	Zion Ponderosa	Kane
33.	Big Water	Kane
34.	Hildale	Washington
35.	Torrey/Teasdale/Grover (BLM)	Wayne
36.	Rockport Area	Summit
37.	Winchester Hills (BLM)	Washington
38.	Rocky Ridge	Juab
39.	Eastland (BLM)	San Juan
40.	Shivwits Band of Piute (BLM)	Washington
41.	Holiday Park	

42.	Indian Ridge	Sanpete
43.	Blackhawk Estates	Sanpete
44.	Panorama Woods	Sanpete
45.	Fairview Ranchos	Sanpete
46.	Indianola	Sanpete
47.	Camp Kolob	Washington
48.	Bryce Woodlands	Kane
49.	Far West/Comstock/Diamond Z Ranch	Iron
50.	Mammoth Creek	Garfield
51.	Pine Creek Ranch	Sanpete
52.	Apple Valley	Washington
53.	Gooseberry	Washington
54.	Little Creek	Washington
55.	South Zion Estates	Washington
56.	Mountain Meadows	Washington
57.	Saratoga Springs (BLM)	Utah
58.	Forest Home at Lambs Canyon	Salt Lake
59.	Castle Valley (BLM)	Grand
60.	Hi-Country Estates	Salt Lake
61.	Joe's Valley	Emery
62.	Pack Creek	San Juan
63.	East Carbon/Columbia (BLM)	Carbon
64.	Wray Mesa/Old LaSal	San Juan
65.	Aspen Hills	Sanpete

42.	Hildale (BLM)	Washington
43.	Westwater (BLM)	Grand
44.	Clear Creek	Carbon
45.	Scofield	Carbon
46.	Monument Canyon (BLM)	San Juan
47.	Kenilworth (BLM)	Carbon
48.	Monticello (BLM)	San Juan
49.	Emigration Canyon	Salt Lake
50.	New Harmony (BLM)	Washington
51.	Eagle Mountain (BLM)	Utah
52.	Cedar Fort (BLM)	Utah
53.	Grantsville (BLM)	Tooele
54.	Comstock Corridor (BLM)	Iron
55.	Iron Town (BLM)	Iron
56.	Timberlakes	Wasatch
57.	Samak	Wasatch
58.	Diamond Mtn. (BLM)	Uintah
59.	Uintalands	Summit

Office of Domestic Preparedness Assessment

The Office of Domestic Preparedness assessment is designed to give the state a comprehensive planning document that includes all needs for a WMD response to a terrorism incident. This planning is in its infancy, yet DES is working to coordinate ODP planning and assessment results with the State Hazard Mitigation plan. There is the potential for future mitigation plans to include risk assessments and dollar values for both natural and man made hazard events. GIS analysis has begun, comparing data compiled during the ODP assessment with data compiled during the PDM planning process; the end product should provide an understanding of total risk.

Floodplain Management

Within Utah's floodplain management program one of the top priorities has been and will continue to be updating current floodplain maps and mapping those areas of the state yet to be mapped. This effort is directly integrated into the PDM planning process. Through coordination with local governments, during the completion of the multi-jurisdictional PDM plans, the age of floodplain maps along with their inaccuracy was a consistent concern raised at the local level. This is evident in the mitigation recommendations put forward in the local mitigation plans.

To address this problem the Utah Floodplain Manager has completed the 'Map Modernization Program Business Case Plan" specifying how the state will implement and administer the map modernization program, if funded; and "The Utah Mapping Priority Assessment" which mathematically prioritizes map modernization funding based on need. Both plans are available for reviewed in Appendix D and E.

County Emergency Operations Plans

Mitigation, one of the four phases of emergency management is included in most city and county emergency operations plans EOP. These plans detail how local governments will

respond to events. These plans include information on vulnerability, potential dollar losses, and likelihood of natural events; all products of the multi-jurisdictional PDM plan. Incorporating PDM data is aiding locals in developing and updating their county and city EOP. Understanding the cost of infrastructure within a given jurisdiction regardless of how it was damaged is assisting locals in developing exercises based on real world estimates.

Terrorism Annex

Following the events that took place on September 11, a new emphasis was placed on terrorism. To address this threat most jurisdictions have begun working on terrorism annexes to their EOP. Many of the teams and committees joined together during the PDM planning process are being utilized to complete the terrorism annexes.

Emergency Management Accreditation Program

The Emergency Management Accreditation Program or EMAP is a voluntary review process for state and local emergency management programs. Accreditation is a means of demonstrating, through self-assessment, documentation and peer review, that a program meets national standards for emergency management programs.

EMAP was created by a group of national organizations to foster continuous improvement in emergency management capabilities. It provides emergency management programs the opportunity to be recognized for compliance with national standards, to demonstrate accountability, and to focus attention on areas and issues where resources are needed.

It has been suggested that Utah go through the EMAP base line assessment prior to 2005. Getting ready for the accreditation process forced coordination with planning done by DES and several other divisions and bureaus within the Department of Public Safety. Members of the Utah Pre-Disaster Mitigation Planning team are also working with the State EMAP accreditation team.

Envision Utah

In January 1997, Envision Utah a Public/Private Partnership was formed to guide the development of a broadly and publicly supported Quality Growth Strategy - a vision to protect Utah's environment, economic strength, and quality of life for generations to come. Five years of scenarios analysis, research and public involvement have helped Envision Utah bring the topic of planning and preparing for growth to the forefront of the public mind. With the help of thousands of Utah residents, Envision Utah has developed a Quality Growth Strategy which will help preserve critical lands, promote water conservation and clean air, improve our region-wide transportation systems, and provide housing options for all residents.

Envision Utah's goal throughout the process has been to involve key decision-makers and the community to gain support at the ground level. Building grass roots support for the project will ensure successful implementation. The Envision Utah effort has included research concerning core values of Utah residents, workshops with key stakeholders to

address where and how to grow, and extensive public awareness and education efforts asking Utah residents to express their preferences for their communities' future. The Governor's Office of Planning and Budget coordinates a technical committee, Quality Growth Efficiency Tools (QGET) that provided critical technical information to help analyze the impacts of growth on transportation, air quality, land use, water supply/demand, and infrastructure costs. Through the exhaustive involvement of the public, local and state elected officials, the business, civic, and religious communities, and other key stakeholders, Envision Utah has gathered information about what Greater Wasatch Area residents value and how they think growth should be accommodated. Based on this information, Envision Utah identified six primary goals that need to be addressed in the Greater Wasatch Area if we are to protect our environment and maintain our economic vitality and quality of life as we accommodate anticipated growth:

- enhance air quality;
- Increase mobility and transportation choices;
- Preserve critical lands, including agricultural, sensitive and strategic open lands;
- Conserve and maintain availability of water resources;
- Provide housing opportunities for a range of family and income types; and
- Maximize efficiency in public and infrastructure investments to promote other goals.

These goals can be realized over time by the careful and deliberate pursuit of the thirty-two individual strategies identified by Envision Utah in the Quality Growth Strategy. These strategies rely on citizen involvement with local officials, local land-use decision-making and more awareness of free market needs in housing choices. Cooperation at the regional level, state incentives to local governments and local government incentives to developers will also be necessary to address issues such as air quality, water conservation, housing opportunities, transportation, and critical lands.

Envision Utah has developed model codes and development standards for quality growth, including for environmentally sensitive areas such as:

- Floodplain corridor lands
- Riparian preserve lands
- Erosive and slope failure lands
- Wildfire lands

Additional Plans and Programs relate to the State Hazard Mitigation Plan

In addition to the planning efforts discussed above, this Natural Hazard Mitigation Plan incorporates by reference the following plans and/or programs developed by state or federal agencies. Mitigation programs, priorities, and initiatives described within these plans, should be conformed to, supported, and incorporated into mitigation planning done by local jurisdictions and state agencies.

National Fire Plan, USFS
Reference: www.fireplan.gov

Dam Safety Section
Utah Dam Safety Guide to Routine Maintenance of Dams 2003

Reference: http://www.waterrights.utah.gov/daminfo/maint_guide.pdf

Utah Dam Safety Guide to Emergency Action Plans Development and Implementation 2003
Reference: http://www.waterrights.utah.gov/daminfo/eap.pdf

Utah Drought Response Plan, Utah Natural Resources Water Resources, March 1993
Reference: http://www.drought.unl.edu/ndmc/plan/state%20plans/Utah.pdf

Utah's M&I Water Conservation Plan, State of Utah Natural Resources Division of Water Resources
Reference: http://www.conservewater.utah.gov/WCPlan/Plan7-14-03.pdf

Utah State Water Plan, State of Utah Natural Resources Division of Water Resources
Reference: www.water.utah.gov/waterplan

A Strategic Plan for Earthquake Safety in Utah, 1995 Utah Seismic Safety Commission
Reference: http://www.barrywelliver.com/html/plan_1994.html

Earthquake Safety in Utah "A Progress Report on Activities for the Period July 1994-June 1996" Utah Seismic Safety Commission
Reference: http://www.barrywelliver.com/html/plan_1996.html

Earthquake Safety in Utah "A Progress Report on Activities and Accomplishments of the Utah Seismic Safety Commission for the Period July 1, 1996 to June 30, 2000" Utah Seismic Safety Commission
Reference: http://www.barrywelliver.com/html/plan_2000.html

Utah Forest Health Report A Baseline Assessment 1999-2001. Department of Natural Resources Division of Forestry, Fire, and State Lands.
Reference: http://www.ffsl.utah.gov/utfor-lr.pdf

Integration with FEMA Programs and Initiatives

FEMA is the backbone of natural hazard mitigation with FEMA programs driving mitigation nation wide. FEMA initiated mitigation planning and has administered funding for the new PDM planning requirement for which this plan was prepared for. It is difficult if not impossible, not to fully integrate FEMA mitigation programs into mitigation planning. What follows is a description of several major FEMA programs integrated into this mitigation plan.

Pre-Disaster Mitigation

Pre-Disaster Mitigation or PDM is a Federal program administered by FEMA, which initially funded local and state mitigation planning being completed to meet the requirements of DMA 2000. Over two years the state of Utah received slightly under $500,000 dollars to facilitate PDM planning. With this funding as discussed previously

the State funding local mitigation planning through the seven associations of government and conducted training on mitigation planning.

Pre-Disaster Mitigation Planning Competitive

This federal grant program is a competitive program administered by FEMA, a first for this federal agency. Grant applications are forwarded to a national review panel where they compete against one another for funding. Competition is based benefit to cost, feasibility, mitigation merit, etc.

In 2004 the state of Utah was awarded a grant through the competitive program to seismically retrofit the University of Utah's Marriott Library. This is a vital building in the states inventory one it's content is of incredible value and two the large life safety risk associated with the collapse of this building.

The state will look to the PDM-C program to complete many of the mitigation strategies described within the pages of this plan.

Flood Map Modernization

Utah has always been a great supporter of FEMA's flood mapping efforts. Utah's maps are some of the oldest in the country, yet we are the 4th fastest growing state. The need for new and accurate mapping is evident.

The following programs support flood mapping the State: State Community Assistance Program (CAP), State Map Modernization Management Support Program (MMMS), and the State Hazard Mitigation Program. The State Hazard Mitigation Program supports and assist in all hazard mitigation programs within the State.

Three plans have been developed and supported by FEMA in State's efforts to implement and fund flood mapping. These plans are: Utah's Flood Map Modernization Implementation Plan, Utah's Flood Mapping Business Case Plan, and the Five-Year Strategic Plan for that addresses both flood mapping and the CAP.

Through the current Flood Map Modernization Program the State has received an FY 04 funding amount of approximately $600,000 to fund flood mapping for Davis and Cache Counties. FY 05 funding levels are not yet available. We have also received funding for a Mapping Coordinator through the MMMS Program for FY04. The State anticipates the Federal funding level will remain consistent as we continue to support the updating of the State's floodplain maps.

National Repetitive Loss Program

The floods of 1983 and 1984 proved to be more than just significant flood events. With damages over $500 million, and flooding in virtually every county in the state, these events forced Utah to mitigate flood hazards so that this type of flooding would never happen again.

The 2 million Utah inhabitants are clustered in relatively small geographic areas at the base of steep mountain ranges, with 90 percent of the population concentrated in the Wasatch Front region. Major floods in Utah are almost always the result of rapidly melting snow in late spring and early summer, often intensified by accompanying rain. The snowmelt, combined with precipitation and climate patterns, also impacts the eventual level of the Great Salt Lake, which has no outlet and is thus controlled solely by evaporation.

The flood events of 1983 and 1984 are when Utah has had its most repetitive losses. Fortunately, the state and local communities have mitigated many of the problems that caused this flooding. Pictures from the 1983 flood shows State Street in downtown Salt Lake as a river. This flooding was caused by too small of culverts clogged by debris in City Creek Canyon. Since then, larger culverts have been installed and a stormwater management plans and regulations keep the channels free from debris on a regular basis. The Great Salt Lake flooding was a major problem in the 80's. A closed basin lake posed a dilemma of what to do with the excess water. Huge pumps were installed in 1985 to pump thousands of cubic feet of water from the Great Salt Lake to the west desert to prevent flooding. These kind of stories are popular throughout the state where mitigation has occurred to reduce Utah's flooding and eliminate repetitive losses.

The following report shows that 95% of all of the Utah repetitive losses listed in the report, have been mitigated through channel modification, regular channel maintenance, or structure removal.

National Earthquake Hazard Reduction Program NEHRP

In October 1977, Congress passed the Earthquake Hazards Reduction Act to "reduce the risks life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. NEHRP is supported by:

- FEMA
- National Institute of Standards and Technology
- National Science Foundation
- United States Geologic Survey

With four basic goals:

- Promote understanding or earthquakes and there effects
- Work to better identify earthquake risk
- Improve earthquake-resistant design and construction techniques
- Encourage the use of earthquake-safe policies and planning practices

NEHRP and the four goals have been integrated throughout the development of this plan.

HAZUS MH

HAZUS-MH, is a nationally applicable standardized methodology and software program, which contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS).

NIBS maintains committees of wind, flood, earthquake and software experts to provide technical oversight and guidance to HAZUS-MH development. Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing mitigation plans and policies, emergency preparedness, and response and recovery planning.

HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods, and earthquakes on populations.

HAZUS MH was utilized to produce damage loss estimates extensively in this state mitigation plan as well as multi-jurisdictional mitigation plans developed by the seven AOG. In some instances where the model was not fully utilized the loss methodology used by HAZUS or its data was.

State Background

Climate

Topographic Features

The topography of Utah is extremely varied, with most of the State being mountainous. A series of mountains (including the Wasatch Range), which runs generally north and south through the middle of Utah, and the Uinta Mountains, which extend east and west through the northeast portion, are the principal ranges. Crest lines of these mountains are mostly above 10,000 feet. Less extensive ranges are scattered over the remainder of the State. The lowest area is the Virgin River Valley in the southwestern part with elevations between 2,500 and 3,500 feet, while the highest point is Kings Peak in the Uinta Mountains, which rises to 13,498 feet.

The Colorado River and its principal tributary within the State, the Green River, drain practically all of eastern Utah although neither rises within its borders. Western Utah is almost entirely within the Great Basin, with no outlet to the sea. The largest rivers in this area are the Bear, Weber, Jordan, Provo, and Sevier, the first three of which empty into Great Salt Lake, The Sevier River drains the west-central area and empties into Sevier Lake, a brackish saline basin in southwest Utah.

The main streams in the eastern portion of the State flow through canyons or very narrow, confined mountain valleys and finally into desert canyons. Some meadows, usually in native grass, and only a few small local areas of farmland are subject to overflow. Nearly all the main highways and railroads, as well as residential areas, are above flood levels. Highest flow occurs in the steams in this region in May and June during spring runoff from melting snow.

The most serious floods in Utah have occurred in the Great Lake Basin, particularly in the Weber River drainage on the western slopes of the Wasatch Mountains. During the

past 100 years approximately 300 flask floods, resulting from high intensity rainfall accompanying thunderstorms, and 135 snowmelt floods, have been recorded. Some have been very limited in area and extent of damage, while others have been highly destructive in cities, towns and agricultural areas. However, severe floods are not likely to occur in any given locality more than once in several years, or even several decades.

Great Salt Lake, in northwestern Utah, lies in the Great Basin, the largest closed basin in North America. Part of this drainage area is below 4,500 feet in elevation, with the Lake being about 4,200 feet. Great Salt Lake is the largest lake at this elevation (or higher) in the world. In glacial times it was a fresh water lake occupying an area 346 miles long and 145 miles wide; but due to increased evaporation and/or reduced precipitation, it gradually shrank in size and the salinity increased. Since this large body of water now has no drainage outlet, the salt content is high, averaging about 25 percent. Thus, the Lake, which never freezes over, provides a moderating effect throughout the year on temperatures in the immediate vicinity.

General Climatic Features

Essentially, Utah's climate is determined by its distance from the equator; its elevation above sea level; the location of the State with respect to the average storm paths over the Intermountain Region; and its distance from the principal moisture sources of the area, namely, the Pacific Ocean and the Gulf of Mexico. Also, the mountain ranges over the western United States, particularly the Sierra Nevada and Cascade Ranges and the Rocky Mountains, have a marked influence on the climate of the State. Pacific storms, before reaching Utah, must first cross the Sierras or Cascades. As the moist air is forced to rise over these high mountains, a large portion of the original moisture falls as precipitation. Thus, the prevailing westerly air currents reaching Utah are comparatively dry, resulting in light precipitation over most of the State.

Temperature

There are definite variations in temperature with altitude and with latitude. Naturally, the mountains and the elevated valleys have the cooler climates, with the lower areas of the State having the higher temperatures. There is about a 3° F decrease in mean annual temperature for each 1,000-foot increase in altitude, and approximately 1.5 to 2° F decrease in average yearly temperature for each one degree increase in latitude. Thus, weather stations in the southern counties generally have average annual temperatures 6 to 8 degrees higher than those at similar altitudes over the northern counties.

Temperatures below zero during winter and early spring are uncommon in most areas of the State, and prolonged periods of extremely cold weather are rare. This is primarily due to the mountains east and north of the State, which act as a barrier to intensely cold continental Artic air masses. The lowest temperature of record is 50° F below zero.

Utah experiences relatively strong insulation during the day and rapid nocturnal cooling, resulting in wide daily ranges in temperature. Even after the hottest days, nights are usually cool over the State.

On clear nights the colder air accumulates, by drainage, on the valley bottoms, while the foothills and bench areas remain relatively warm. For this reason, the higher lands at the edges of the valleys are devoted ordinarily to the more valuable and delicate fruits, berries, and vegetables, while the hardier grains and vegetables are planted in the bottom lands.

Owing to the varied topography of the State, there are no orderly or extensive zones of equal length of growing season between the last freeze in spring and the first in fall. There are, however, from 4 ½ to 5 months of freeze-free growing weather in the State's principal agricultural areas. A difference of two weeks in the growing season is often noted in the same valley between the bottomlands and the adjacent farming lands at the foot of the mountains.

Precipitation

Precipitation varies greatly, from an average of less than five inches annually over the Great Salt Lake Desert (west of Great Salt Lake), to more than 40 inches in some parts of the Wasatch Mountains. The average annual precipitation in the leading agricultural areas is between 10 to 15 inches, necessitating irrigation for the economic production of most crops. However, the mountains, where winter snows form the chief reservoirs of moisture, are conveniently adjacent to practically all farming areas, and there is usually sufficient water for most land under irrigation. The areas of the State below an elevation of 4,000 feet, all in the southern part, generally receive less than 10 inches of moisture annually.

Northwestern Utah, over and along the mountains, receives appreciably more precipitation in a year than is received at similar elevations over the rest of the State, primarily due to terrain and the direction of normal storm tracks. The bulk of the moisture falling over that area can be attributed to the movement of Pacific storms through the region during the winter and spring months. In summer northwestern Utah is comparatively dry. The eastern portion receives appreciable rain from summer thunderstorms, which are usually associated with moisture-laden air masses from the Gulf of Mexico.

Snowfall is moderately heavy in the mountains, especially over the northern part. This is conducive to a large amount of winter sports activity, including skiing and hunting. While the principal population centers along the base of the mountains receive more snow, as a rule, than many middle and northeastern sections of the United States, a deep snow cover seldom remains long on the ground.

Runoff from melting mountain snow usually reaches a peak in April, May or early June, and sometimes causes flooding along the lower streams. However, damaging floods of this kind are infrequent. Flash floods from summer thunderstorms are more frequent, but they affect only small, local areas.

Other Climatic Features

Sunny skies prevail most of the year in Utah. There is an average of about 65 to 75 percent of the possible amount of sunshine at Salt Lake City during spring, summer, and fall. In winter Salt Lake City has about 50 percent of the possible sunshine.

During the late fall and winter months, anticyclones tend to settle over the great Basin for as long as several weeks at a time. Under these conditions, smoke and haze accumulate in the lower levels of the stagnant air over the valleys of northwestern Utah, frequently becoming an obstruction to visibility. This is also true of fog, which may persist for several weeks at a time.

Wind speeds are usually light to moderate, ranging below 20 miles per hour. There are only a few tornadoes in Utah as a rule, and those reported usually cause only slight damage. However, strong winds occur occasionally, sometimes attaining damaging proportions in local areas, particularly in the vicinity of the canyon mouths along the western slopes of the Wasatch Mountains. Dust storms occur occasionally, principally over western Utah. These storms are associated with the movement of low-pressure disturbances through the area during the spring months.

Hailstorms may damage fruit and vegetables in limited areas during spring and summer, although the hail is usually small.

Climate and Economy

Utah is not a large agricultural state, even through appreciable crops, livestock, and dairy products are produced within its boundaries. Only four percent of the land is under cultivation, but approximately 35 percent of the land area is utilized for livestock grazing purposes. Livestock represent the largest portion of cash farm income within the State. The largest crop is wheat, most of it being “winter” or “dryland” wheat. Other principal crops are barley, oats, hay, potatoes, corn, and sugar beets. Lesser crops include other grains, fruits, vegetables, berries, melons, dry beans, and alfalfa and sugar beets for seed. Range feeds and dryland crops in non-irrigable areas, particularly in the southern portion, often suffer from lack of moisture.

Mining and manufacturing are the two other basic industries in Utah. The State ranks high in the quantity and value of minerals it produces each year, mainly copper, lead, zinc, gold, and silver. Because of the dry climate, several companies have found it economically feasible to produce salt from the brine of the Great Salt Lake by the evaporation process.

Salt lake City is the commercial, industrial, and financial center of Utah. Three-fourths of the State’s population is concentrated within a 100-mile radius of that City, and well over one-half the people reside within 50 miles of Salt Lake City.

Tourists come to Utah primarily to visit historic Salt Lake City; to see the Great Salt Lake; to tour the park areas, including Zion National Park, Cedar Breaks National Monument, and Bryce Canyon National Park; and to fish in the cool mountain streams. Persons traveling in the State during the winter and early spring months should be

prepared for cold weather and snow. When crossing the less-frequently traveled desert areas of the western portion, motorists should carry a supply of fresh water as a safeguard, particularly during the summer months

Source: http://www.wrcc.dri.edu/narratives/UTAH.htm accessed on 12/8/03 Western Regional climate center

Geology

Geology in Utah is multifaceted, very interesting and instrumental in understanding the hazards within the state. The complexity has yielded some of the worlds most inspiring geologic features, such as the Water Pocket Fold of Capitol Reef National Park and the canyons and plateaus of Zion National Park. However complex, Utah's geologic history can be explained with broad generalizations, which serve as a good starting point for interpreting Utah's world-famous topography and scenery.

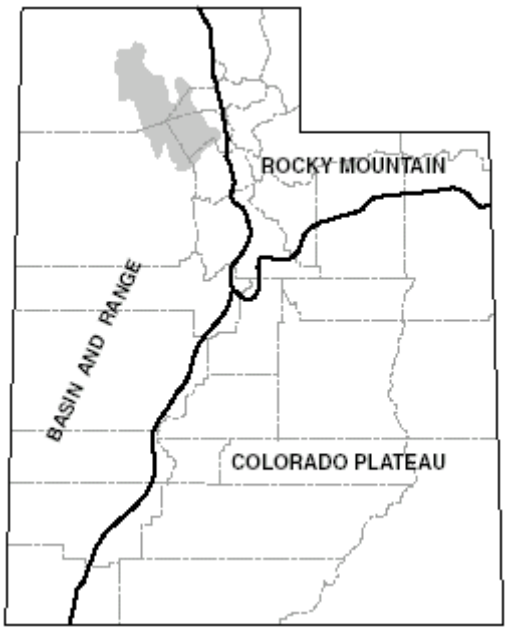


Figure I-1
Major Physiographic Provinces of Utah

Based on characteristic landforms, geologists and geographers have subdivided the United States into areas called physiographic provinces. Features that distinguish each province result from the area's unique geology, including prominent rock types, history and type of deformation (including crustal-scale forces of compression and extension), and erosional characteristics.

Utah contains parts of three major physiographic provinces: the Colorado Plateau, Basin and Range, and Rocky Mountains.

The three provinces meet near the center of the state, with the Basin and Range Province extending across western Utah, the Colorado Plateau across southeastern Utah, and the Rocky Mountains across northeastern Utah.

Where to draw the line between the Colorado Plateau and Basin and Range is subject to debate. Between the two provinces lies an area that displays characteristics of both, and some geologists would make this area a distinct, fourth physiographic province called the Basin and Range - Colorado Plateau Transition. The same holds true for the area between the Rocky Mountains and Basin and Range provinces.

Additionally, each major province can be further divided into sub-provinces. Here, however, we will keep things "simple" and stick to highlights of the three major provinces.

Basin and Range Province

Steep, narrow, north-trending mountain ranges separated by wide, flat, sediment-filled valleys characterize the topography of the Basin and Range Province. The ranges started taking shape when the previously deformed Precambrian (over 570 million years old) and

Paleozoic (570 to 240 million years old) rocks were slowly uplifted and broken into huge fault blocks by extensional stresses that continue to stretch the earth's crust.
Sediments shed from the ranges are slowly filling the intervening wide, flat basins. Shorelines and sediments of lakes that intermittently cover the valley floors have further modified many of the basins. The most notable of these was Lake Bonneville, which reached its deepest level about 15,000 years ago when it flooded basins across western Utah.

Colorado Plateau Province

In contrast with the Basin and Range Province, a thick sequince of largely undeformed, nearly flat-lying sedimentary rocks characterize the Colorado Plateau province. Erosion sculpts the flat-lying layers into picturesque buttes, mesas, and deep, narrow canyons.
For hundreds of millions of years sediments have intermittently accumulated in and around seas, rivers, swamps, and deserts that once covered parts of what is now the Colorado Plateau. Starting about 10 million years ago the entire Colorado Plateau slowly but persistently began to rise, in places reaching elevations of more than 10,000 feet (3,000 meters) above sea level. Miraculously it did so with very little deformation of its rock layers. With uplift, the erosive power of water took over to sculpt the buttes, mesas, and deep canyons that expose and dissect this "layer cake" of sedimentary rock.
Of course, exceptions to this layercake geology do exist. For example, igneous rocks that cooled from oncerising magma form the core of the Henry, La Sal, and Abajo Mountains, and several wrinkles or folds, such as the San Rafael Swell and Waterpocket Fold, can also be found as exceptions to the rule of flat-lying beds.

Rocky Mountains Province

High mountains carved by streams and glaciers characterize the topography of the Rocky Mountains province. The Utah portion of this province includes two major mountain ranges, the north-south-trending Wasatch and east-west-trending Uintas. Both ranges have cores of very old Precambrian rocks, some over 2.6 billion years old that have been altered by multiple cycles of mountain building and burial.

Uplift of the modern Wasatch Range only began within the past 12 to 17 million years. However, during the Cretaceous Period (138 to 66 million years ago), compressional forces in the earth's crust began to form mountains by stacking or thrusting up large sheets of rock in an area that included what is now the northeastern most part of Utah, including the northern Wasatch Range. This thrust belt was then heavily eroded. About 38 to 24 million years ago large bodies of magma-intruded parts of what is now the Wasatch Range. These granitic intrusions, eroded thrust sheets, and the older sedimentary rocks form the uplifted Wasatch Range as it is seen today.

The Uinta Mountains were first uplifted approximately 60 to 65 million years ago when compressional forces created a buckle in the earth's crust, called an anticline. The mountains formed by this east-west-trending anticline were subsequently eroded back down, but began to rise again about 15 million years ago to their present elevations of over 13,000 feet above sea level.

The Rocky Mountains province is further characterized by sharp ridgelines, U-shaped valleys, glacial lakes, and piles of debris (called moraines) created during the Pleistocene (within the last 1.6 million years) by mountain glaciers.
This is, of course, a most cursory overview of the geologic events that formed the topography of Utah's three physiographic provinces. Numerous anomalies and variations give color and detail to the big picture outlined here.
Derived: Glad You Asked article, *Survey Notes*, v. 32 no. 1, January 2000

Economy

In the 1990s Utah's economy diversified, becoming increasingly integrated with the national economy and much less dependent on key industries such as federal government (defense) and mining. During 2001 a predicted slowdown in the Utah economy became pronounced after the September 11th terrorist attacks on the World Trade Center. While the national recession of 1991 was hardly felt in Utah, the current national recession is being mirrored in Utah. Since 1994, the peak year of the current cycle, the rate of job growth has fallen gradually from 6.2% to 0.9% in 2001. This is Utah's slowest job growth since 1983 and is only a fraction of the long-term average of 3.5%. Correspondingly, Utah's 4.4% unemployment rate for 2001 is a nine-year high. A monthly average of about 50,000 individuals were out of work in 2001.

The 2002 Olympic Winter Games will provide a temporary but timely boost in early 2002. However, economic activity will once again slow in 2002 as the Olympics wind down, and the year's economic performance will appear similar to that of 2001. Job growth will remain near 1% (12,000) and the unemployment rate near 5% (58,000 unemployed). Still, Utah's unemployment rate in 2002 should be lower and job growth higher than nationally. Assuming that the projections for a relatively shallow and brief national recession hold, after a few months' rest the Utah economy should rebound and by the end of 2002 it should be back on a moderate growth path. The Services industry will remain the largest source of new jobs and will continue to increase its share of total non-farm jobs. Manufacturing and mining job growth will be flat or negative, and the construction industry will contract noticeably.

Job Growth by Industry

Construction

The record-breaking 11-year expansion in Utah's construction industry ended in 1999. 2001's net loss of some 2,000 jobs is the second year of the long-anticipated downturn as major projects have been completed. With fewer construction projects anticipated for 2002, a loss of an additional 5,500 jobs is possible. Nonetheless, construction jobs in 2002 will still be 5.8% of total non-farm jobs (slightly above the 1978 to 2002 average of 5.5%). Long-term, the downturn should be brief; with more major projects on the horizon.

Manufacturing

During most of the 1990s, Utah manufacturing expanded rapidly, increasing 26% from 1991 to 1998. By contrast, the United States' gain was only 2%. However, in both 1999 and 2000 about 1,200 jobs (-1%) were trimmed from manufacturing payrolls, followed

by an additional cut of 3,800 in 2001. Substantial layoffs in late 2001 should continue this trend through 2002.

Transportation/Communications/Utilities

The T/C/U division in 2001, a growth rate of 0.3%, added only 200 net new jobs. This is a sharp drop from 2000's 2.4% expansion. Most transportation-related industries achieved at least modest growth. However, this was offset by a sharp loss in communications employment. The Olympic Winter Games are expected to give this division a boost in early 2002; and growth will improve slightly from 2001's dismal mark.

Trade

Beginning in 1999, the economic slowdown sharply slowed the trade division's job growth, culminating in 2001's anemic 0.1% (400 jobs) expansion. Wholesale trade suffered a loss of 1,000 jobs; retail trade's 1,400-job gain was led by growth in department stores and restaurants but offset by losses in most other categories of retail trade. In 2002, portions of the trade division will benefit from the Games, but the start of economic recovery will provide a much stronger lift. The division should generate about 3,000 new jobs, growing by about 1%, in 2002.

Finance/Insurance/Real Estate

Sparked by rapid employment expansion in personal credit institutions, banks/credit unions, and security brokers; the finance, insurance, and real estate division posted a 2,900-job, 5% growth in 2001. Growth, however, will probably slow to less than half that pace in 2002.

Services

In 2001, most industries within Utah's services division demonstrated respectable employment gains. Notable were health services' 2,700 (4%), amusement/recreation services' 1,200 (7%), and engineering/management services' 1,300 (5%). On the other hand, business services lost 4,000 jobs (personnel supply lost 3,100 and computer/data processing lost 1,800). The division's growth rate of 2.2% for 2001 was the slowest in several decades. For 2002, far fewer business services cuts are anticipated, and the Olympic Winter Games will stimulate thousands of temporary jobs. With modest expansion in most industries, the division should generate 10,000 net new jobs, a growth rate of 3%.

Mining

Utah's mining division lost about 150 jobs in 2001. However, this net loss obscures some disparate gains and losses in the component industries. Oil and gas extraction activities added about 550 jobs, but these were more than offset by cutbacks of 400 in coal mining, 200 in metal mining, and nearly 100 in nonmetallic minerals mining. For 2002, coal mining should stabilize, metal mining may continue to slide, and oil and gas extraction could peak and start declining; yielding a projected net loss of 200 jobs.

Public Sector (government)

In both 2000 and 2001, government employment in Utah expanded more rapidly than usual. Federal job growth was due to 1) the 2000 Census (temporary jobs) and 2) new defense assignments at Hill Air Force Base. In addition, the non-education side of local government has grown rapidly, especially in 2001. Total government in 2001 grew by about 5,900 jobs (3.2%). The public sector should return to more typical growth in 2002, which means overall growth of about 4,800 jobs and 2.5%.

Wages

In 2001, Utah's average annual nonagricultural pay was $29,700—up 3.1% from the 2000 average. This is the seventh year in a row that average wage increases in Utah have outpaced increases in inflation, as measured by the U.S. Consumer Price Index (CPI-U), but they are still only 83% of the U.S. average. The loss of high-paying mining and metals-producing jobs in the early and mid-'80s helped contribute to the decline. However, Utah's demographics also play a part. Utah has a large percentage of young people in the labor market and a relatively young labor force. Young people are usually paid less than older workers. In addition, Utah has a higher proportion of part-time workers than the U.S. in general, which also tends to pull the average wage down. Shortages of workers from 1996 through 2000 are thought to have been a factor in the relatively rapid wage increases of those years, but average annual pay in 2002 will likely slow with the economy.

Major Employers

With about 22,000 employees, the State of Utah ranks as the largest employer. IHC, a large health-care organization with several hospitals and clinics, ranks number two, also with about 22,000 jobs. Six of the next nine top employers provide educational services. The University of Utah (including the University Hospital) and Brigham Young University each have roughly 17,000 employees. Granite, Jordan, and Davis school districts and Utah State University each have between 6,500 and 8,500 workers. Hill Air Force Base, with 11,000 civilian jobs, occupies the number five rank. Convergys, a multi-county telemarketing company employing roughly 8,500, is in sixth place. Department store and grocery store chains, the U.S. Postal Service, and the Internal Revenue Service, are prominent employers. Salt Lake County government, other major retail chains, additional large school districts, Autolive ASP, and Delta Airlines each also have a strong presence in Utah's economy.

2002 Winter Olympic Games

The 2002 Olympic Winter Games will generate significant economic impacts in Utah between 1996 and 2003. The total amount of spending directly related to the Olympics is estimated to be approximately $2.1 billion. There are five main sources of Olympic related spending:

- Salt Lake Olympic Organizing Committee (SLOC): $1,240 million
- Infrastructure investment: $435 million
- Visitor spending during the Olympic Games: $348 million
- spending to broadcast the Games: $99 million
- Direct federal funds to state government for Olympics operations: $17 million

Only $1.3 billion, however, actually impacts the Utah economy, because much of the value of the goods or services used to host the Olympics is generated out of state; e.g.,

most of the airfare visitors will pay to fly to Salt Lake goes to support airline operations outside Utah. The total employment impact is estimated to be 35,424 job years. Employment grows from 1,148 in 1997 to 25,070 during February 2002; almost doubling from 7,317 during 2000 to 12,590 during 2001, doubling again during the Games, before falling off to an average of 6,409 for 2002. Trade and construction in the services sector, including SLOC employees, follow the largest employment impacts. Employment growth rates in 2001 and 2002 would be much lower were it not for the Winter Olympics.

Net Migration

Population growth should slow in the months after the Olympics as construction slows and many of those helping to host the Games leave the state. The post-Games lull could be accentuated by a national/global recession that lasts longer than mid-2002. During 2001 Utah's net migration remained strong at 14,166. During 2002, however, the number of in-migrants is expected to exceed the number of out-migrants by only 3,000. Still, with an expected record number of births, population will grow 1.7% in 2002.

Source: http://dced.utah.gov/BIRS/state/STATESUM.htm accessed on January 28, 2004

Identifying Hazards

The risk assessment shall include an] overview of the type … of all natural hazards that can affect the State…

Disaster History

The initial list of identified hazards was completed by the UPDMPC in conjunction with the State Hazard Mitigation Team. Several associations of government added hazards to the list based on input from local jurisdictions. To identify hazard the UPDMPC pursued the following:

Past Presidential Disaster Declarations

Utah's past presidential disaster declarations were examined. After being the first state in the nation to receive a presidential Utah has had very few declarations, one of lowest in the country. What follows is a brief history and explanation of the presidential declarations:

1983 Statewide flooding

The floods of April 10-June 25, 1983, affected 22 counties, or more than three-fourths of the State. On April 10, a landslide caused by precipitation dammed the Spanish Fork River, which then inundated the community of Thistle. The landslide, which resulted in damage totals of about $200 million and a Presidential disaster declaration, was the most costly geologic phenomenon in Utah's history and the most costly landslide in US history (Utah Division of Comprehensive Emergency Management, 1985, p. 40).

Rapid melting of the snowpack with maximum-of-record water content for June 1 (U.S. Soil Conservation Service. 1983) resulted in the largest and most widespread flooding in the State's history; peak discharges had recurrence intervals that exceeded 100 years on several streams. New discharge records were set on many others, such as Chalk Creek at Coalville. On June 23, the Delta-Melville-Abraham-Deseret Dam on the Sevier River near Delta failed as a result of the flooding on June 23, 1983, and released 16,000 acre-feet of water down the river. Two bridges were washed away, and the town of Deseret was inundated by as much as 5 feet of water (Utah Division of Comprehensive Emergency Management, 1985, p. 41).

Overall damage from the April 10- June 25, 1983, floods totaled $621 million (Stephens, 1984, p. 20-36). No deaths were attributed to the floods.

1984 Statewide Flooding

The May 24, 1984, flood on the Beaver River near Beaver and other flooding during the April 17- June 20,1984, floods caused damage second in magnitude only to damage in 1983. The major cause of the flooding was much greater than average snowpack and greater than normal precipitation that continued throughout the spring. Peak discharges exceeded those in 1983 at some sites on the White, Bear, Jordan, and Beaver Rivers. Owing to severe flooding in 12 counties, a disaster was declared by the President. On

May 14, rainfall caused a mudslide near the coal-mining town of Clearcreek that killed one person and injured another. The direct impact on people was considerably less in 1984 compared to 1983 because of mitigation measures implemented during the previous year. Total damage for floods and landslides was estimated to be $41 million (Utah Division of Comprehensive Emergency Management, 1985, p. 15).

1989 Quail Creek Dam Failure

- Quail Creek Dike and facilities lost
- 30 homes, 58 apartments, and nine businesses flooded
- Loss to agriculture and livestock
- Impacts to public facilities, roads, bridges, and golf courses
- Reduce in population of Wound Fin Minnow an endangered species
- Public assistance $1,133,721 wit a federal share of $850,294

1999 Salt Lake City Tornado

- 1 death
- 80 injuries
- 300 buildings or houses were damaged
- 34 homes left uninhabitable
- 500 trees were destroyed
- A portion of Memory Grows was completely destroyed
- Total damage estimates $170 million.
- Federal assistance

Mitigation plans completed by the Association of Governments in conjunction with local jurisdictions where reviewed to see if any hazards were identified at the local level which warranted review at the state level. All seven AOG had a sit down meeting with each jurisdictions mayor or lead planner to address a survey put together by the AOG. One of the questions in this survey was to list vulnerable hazards. Radon and infestation were both identified in the Five County Association of Government plan.

Previous State Natural Hazard Mitigation Plans were reviewed to see if perceived vulnerability to hazards had changed over the years and if so how. This study of almost 20 years of plans, showed vulnerability had changed over time but the hazards had not. Following flooding in 1983 and 1984 large investments were made in mitigation. This investment reduced the vulnerability to similar flood events in some of the larger counties, yet increased population and the conversion of agricultural land to residential development still makes flooding despite the mitigation, a hazard in Utah.

Borrowing a principle from Geology " the past is the key to the future" it is important to understand past events or a states disaster history in order to foresee future problems. A chronological history was assembled for each hazard, which can occur in Utah. This work was primarily conducted by each AOG with input from the U.S. Army Corps of Engineers and DES. Disaster history's were compiled from numerous sources including but not limited to: Flood Insurance Studies, newspaper articles, the University of Utah

Seismograph Stations, interviews, surveys, past mitigation plans, libraries, microfilm, and the Utah Historical Society.

Several recent and not so recent studies, played into identifying hazards. These studies included hydrologic, meteorological, drought, and new research on seismisity, particularly along the Wasatch Front. Many of these studies have shed new light on past events; in some cases we have found, there is a higher risk then previously thought. For example a seismic study being headed by Sue Olig, on the Wasatch Fault, contain preliminary results indicating a shorter recurrence interval for events on the Wasatch Fault.

Figure I-1 Large trench dug in Mapleton as part of the earthquake recurrence interval study. Photo Bob Carey

As a result of this study the state plan addressed the following major natural hazards:

- Earthquake, including association hazards of fault rupture, liquefaction, etc.
- Flood
- Landslide, including debris flow
- Dam Failure
- Wildfires
- Drought
- Severe Weather includes winter storm, high wind, avalanche, and tornado.

Based on the hazard history and profiles of the aforementioned hazards, the recurrence interval and hazard frequency were determined (see Table I-1). The recurrence interval was calculated by dividing the number of years observed for each hazard by the number of events reported. For example, there had been 116 documented tornadoes during a 54-year period. This information provides a recurrence interval of 54/116 or 0.47. The hazard frequency was calculated by dividing the number of events observed by the number of years. For example, 53 wildfires larger than 5000 acres divided by 17 years indicates that an average of 3.12 large wildfires occur in Utah in any given year.

Table I-1 Utah Hazard Recurrence and Frequency

Hazard	Number of Events	Years in Record	Recurrence Interval (years)	Hazard Frequency and Probability/Year
Droughts*	61	109	1.787	56%
Earthquakes**	31	128	4.129	2.4%
Landslides	N/A	N/A	N/A	N/A
Floods***	14	120	8.57	12%
Tornadoes (all)	116	54	0.47	215%
Avalanches (fatalities)	70	45	0.643	156%
Wildfires	53	17	0.320	312%

(>5000 acres)				
Thunderstorms and Lightning (fatalities)	57	54	0.947	106%

*PDSI, single year events counted.
** Magnitude 5.0 or larger
*** Only large flooding events
Landslide recurrence intervals cannot be predicted because landslides often have recurrent movement with the same landslides moving each year depending on climate.

Table I-2 Utah Disaster Loss Data 1970 through 2004

Event	Injuries	Fatalities	Property Damage*	Crop Damage*
Hail	86.01	0	$2,262,500.01	$2,402,300.01
Fog	18	4	$200,000	0
Flooding	32	15.01	$82,433,999.98	$50,761,7000.04
Avalanche	12.01**	9**	$100,000.02	0
Lightning	20**	9**	$2,289,700.03	0
Tornado	92	1	$173,015,500	$507,700
Severe Snow	47.95	8.96	$5,479,000.11	$206,800
Winterweather	677.11	40.71	$62,247,001.18	$6,585,099.79
Wind	133	10.96	$54,419,633.56	$1,724,300.97
Total	1,118.08	99.64	$382,467,334.89	$62,227,900.81

Source: www.sheldus.org
* Totals are not inflation adjusted
** More accurate data exist

Table I-3 County Disaster Losses 1970 through 2004

County	Injuries	Fatalities	Property Damage*	Crop Damage*
Beaver	24.74	1.02	$4,533,485.56	$2,423,779.31
Box Elder	79.21	5.39	$10,716,346.17	$1,791,634.75
Cache	49.81	6.87	$10,165,751.11	$2,972,527.75
Carbon	23.91	1.81	$4,860,064.07	$2,436,085.16
Daggett	7.40	0.61	$1,803,129.48	$22,117.02
Davis	59.52	5.19	$16,069,948.87	$3,096,251.32
Duchesne	21.91	2.67	$5,142,583.22	$2,425,404.65
Emery	27.04	2.43	$3,241,851.90	$150,684.07
Garfield	15.90	2.58	$4,622,599.39	$2,426,136.45
Grand	7.56	3.58	$716,188.80	$23,058.78
Iron	41.18	1.52	$5,450,598.68	$3,064,261.36
Juab				

	39.71	4.98	$5,252,611.65	$2,811,389.70
Kane	14.77	2.37	$2,620,182.10	$153,884.07
Millard	30.22	1.25	$4,659,647.95	$2,796,728.03
Morgan	31.63	3.30	$5,584,571.59	$2,793,606.83
Piute	14.37	1.37	$2,032,318.46	$63,517.41
Rich	22.48	1.44	$5,346,310.39	$2,403,841.48
Salt Lake	209.40	15.26	$194,940,180.66	$4,050,253.80
San Juan	8.94	4.64	$4,786,515.09	$2,794,491.97
Sanpete	27.99	4.69	$6,121,009.13	$3,344,824.35
Sevier	14.37	1.58	$4,467,144.84	$2,849,285.17
Summit	34.37	4.76	$5,681,517.10	$2,434,604.65
Tooele	52.83	4.96	$13,350,595.71	$2,473,369.60
Uintah	11.44	0.61	$5,236,755.71	$2,404,677.82
Utah	87.75	5.43	$12,214,804.03	$3,959,320.46
Wasatch	32.16	2.76	$2,542,502.25	$40,952.27
Washington	30.21	3.37	$18,470,002.77	$2,893,836.45
Wayne	15.96	0.43	$2,076,048.11	$49,184.07
Weber	81.30	2.77	$19,762,070.10	$3,078,192.06

Source: www.sheldus.org
* Totals are not inflation adjusted

The hazards were then ranked as low, medium, or high priority (see Table I-4) based on the frequency of past occurrences, the magnitude of the impact of past events, the potential for future impact, perception of threat level, and potential to caused significant damage.

Table I-4 Utah Hazards Ranked

High Priority	Medium Priority	Low Priority
Wildfires/Urban Interface	Droughts	Volcanoes
Floods	Severe Weather	Problem Soils
Earthquakes	Landslides	Radon Gas
	Dam Failure	

Other Hazards

The identified hazards for which mitigation strategies have been outlined in the following chapters are by no means the only natural hazards, which could affect the State. Other natural hazards could possibly occur, such as volcanic activity, although the probability of such an occurrence is so slight the, UPDMPC did not fully consider them.

Man Made Hazards

In addition to the natural hazard, the state exhibits risk to a number of technological or man-made hazard, these include but are not limited to:

- Hazardous materials incidents
- Disruption of energy systems, and petroleum fuel pipelines
- Terrorism
- Civil unrest
- Disruption of transportation systems
- Weapons of Mass Destructions (WMD): conventional explosives, nuclear, biological, or chemical

Some of these hazards, such as hazardous materials incidents and disruption of energy, can occur as a secondary effect of a natural hazard event. For example a large earthquake can cause significant disruption to infrastructure systems and cause numerous hazardous materials incidents. Mitigations strategies described in this plan address a reduction in the effects of natural hazards, yet as described above regardless of the cause the emplace mitigation can still provides benefit. It is expected future revisions to the State Natural Hazard Mitigation Plan will include additional hazards such as technological and man made hazards, until at some point an all inclusive mitigation plan is created.

Problem Soils

Problem soils and rock constitute a widespread geologic hazard in Utah, covering approximately 18 to 20 percent of the state, and underlie many urbanized areas. The nine types of problem soil and rock in Utah are:

- Expansive Soil
- Collapsible Soil
- Limestone and Karst Terrain
- Gypsiferous Soil
- Soil Subject to Piping
- Dunes
- Peat
- Mine Subsidence
- Sodium Sulfate

Problem soils are not fully addressed in this mitigation plan because:

- Although problem soils cover a large geographic extent, within the State, they seldom cause wild spread damage.
- Most problems associated with problem soils are well understood and easily and often mitigated for during construction.

Examples of problems soil mitigation can be seen throughout southern Utah, roads have been elevated on top of imported fill; this process adds initial cost but must be done to prevent road failures due to expansive soils.

Radon Gas

Radon, a naturally occurring, odorless, tasteless, radioactive gas produced by the breakdown of uranium in rock and soil. It is harmlessly dispersed in outdoor air, but when trapped in buildings, can be harmful, especially at elevated levels. Radon was not considered a hazard because radon only results in an increased likely hood of developing cancer, although not everyone who is exposed to radon develops cancer. Chances increase with increasing levels of radon and length of exposure. Additionally the amount of time between exposure and onset of the disease is usually many years.

Radon is the second leading cause of lung cancer, after smoking. The U.S. Environmental Protection Agency and the Surgeon General have recommended that all residences (except those above the second floor) be tested for radon. An estimated 14,000 deaths each year can be attributed to excessive radon exposure. Radon does not cause any short-term health effects, such as shortness of breath, coughing, headaches or fever.

Radon comes from the soil surrounding and beneath the house, especially soil that contains uranium. It typically moves up through the soil into the air above and then into your home through cracks in foundations and walls, openings around sump pumps and drains, and construction joints. The highest concentrations of radon can be found in the lowest levels of the home.

Radon may also be present in well water and can be released into the air in your home when water is used for showering and other household uses. The risk of radon entering homes through water is small compared with that of radon entering through the soil. Usually, radon is not a problem with large community water suppliers, but private wells can contain high levels.

The inclusion of radon in this mitigation plan was demeaned unnecessary for the following reasons:

- Radon is a wide spread hazard which caused no property damage the only damage comes from loss of life.
- Radon would most likely not constitute a Presidential Declaration
- Easily mitigated, once identified

Radon reduction measures can vary with radon levels, but most often the measures cost no more than having a new hot water heater installed or having the house painted. The cost of a contractor fixing a home generally ranges from $500 to $2500, depending on the characteristics of the house and choice of radon reduction methods. For a list of EPA approved contractors in Utah, contact: Utah Safety Council; 5263 South 300 West, Suite 201 Salt Lake City, Utah 84107

Utah Geologic Survey has done a large amount of research on radon gas and has several publications available at the Division of Natural Resources book store or through the UGS website.

Volcanoes

Volcanoes are created when internal forces in the Earth, cause heated, melted rock (magma) to rise to the surface. First collecting in magma chambers, some of the magma eventually pushes upward through cracks (vents) to the Earth's surface. As the magma reaches the surface, it loses some of its gases and turns into lava. Volcanoes are created by the release and build-up of lava and other materials. Volcanoes have varied shapes and sizes, but are divided into three main kinds depending on the type of material that reaches the surface and the type of eruption that ensues. Utah has all three types.

1. ***Composite or Stratovolcanoes***

Composite volcanoes (stratovolcanoes) develop from repeated explosive and non-explosive eruptions of tephra (airborne lava fragments that can range in size from tiny particles of ash to house-size boulders) and lava that build up layer by layer. These volcanoes are the largest and form symmetrical cones with steep sides. Some composite volcanoes in Utah are in the Tushar Mountains (Mount Belknap, for example) in Piute County. Now extinct, they are too old (between 32 and 22 million years) to maintain the classic volcanic shape of their modern-day counterparts, such as Mount Hood and Mount St. Helens in the Cascade Range along the northwestern coast of the United States.

2. ***Shield Volcanoes***

Shield volcanoes form from "gentle" or non-explosive eruptions of flowing lava. The lava spreads out and builds up volcanoes with broad, gently sloping sides. The low-profile shape resembles a warrior's shield. In Utah a good example is the one-million-year-old Fumarole Butte in Juab County. Currently active volcanoes of this type are found in the Hawaiian Islands.

3. ***Cinder Cones***

Cinder cones build from lava that is blown violently into the air and breaks into fragments. As the lava pieces fall back to the ground, they cool and harden into cinders (lava fragments about 1/2 inch in diameter) that pile up around the volcano's vent. Cinder cones are the smallest volcanoes and are cone-shaped. Cinder cones are found in many areas of Utah including Millard, Iron,

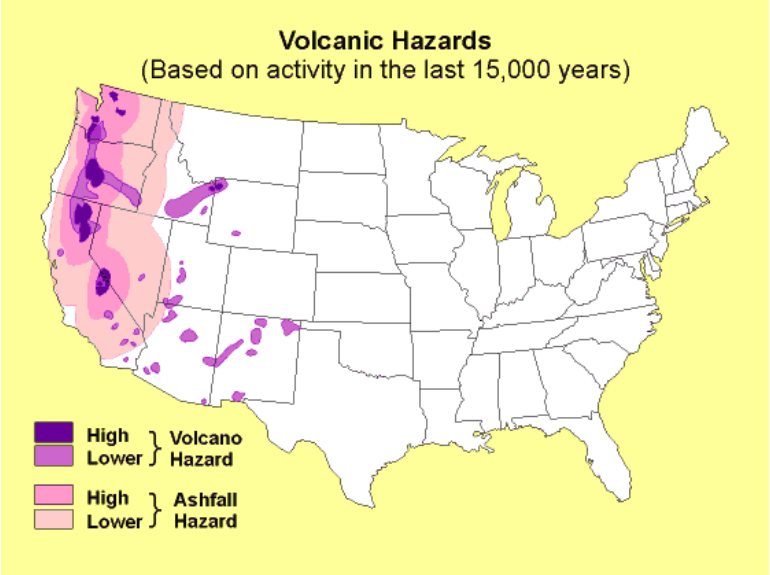


Figure I-2 US Volcanic Hazards
Source: http://www.usgs.gov/themes/map2.html

Garfield, Kane, and Washington Counties, and they vary in age. The youngest, only about 600 years old, are in the Black Rock Desert in Millard County.

There have been several major volcanic eruptions worldwide during the past 25 years. Among these were the eruption in 1980 of Mt. St. Helens in Washington State followed by the 1982 eruption of El Chichón in Mexico, the 1990 eruption of Mt. Pinatubo in the Philippines, and the 1995 eruption of the Soufriere Hills Volcano in Montserrat all generated unprecedented awareness to the potential calamitous effect of volcanic hazards. Fortunately, these events have not had any significant effect on residents of Utah.

Over 270,000 human fatalities have resulted worldwide from volcanic activity during the past 500 years. Information from the Utah Geological Survey indicates that while most of the deaths world-wide have been related to the eruptions of high-silica alkali composition volcanics, fatalities and property damage can result from basaltic and rhyolitic flows, plugs and dome, features that are typical of volcanism throughout Utah, particularly southwestern Utah.

When discussing inclusion of volcanic hazards into this mitigation plans several problems arose. Because of the intermittent nature of volcanic eruptions and lengthy recurrence intervals, people tend to minimize volcanic hazards as a threat to property and lives, which is understandable. While Geomorphically fresh features and textures, geothermal anomalies, and recent eruptive histories present convincing arguments for the continuation of volcanic events in Utah. This mitigation plan does not address volcanic risk for the reason that:

- The only current hazard would strictly be from local, small cinder cone basaltic eruptions.
- Rather than local events, remote eruptive centers present Utah's most imminent and potentially damaging volcanic hazard. Areas east of Mt. St. Helens were the recipients of ash fallout.
- Long recurrence intervals
- Advances in science have provided long warning times
- Any ash or lava event to affect Utah would be localized, a safe distance from population centers, and would likely have an advanced warning.

The active volcanic centers in Utah include the Escalante Deserts in the Basin and Range Province; the High Plateaus and adjacent areas in the Colorado Plateau Province; and the Pine Valley Mountains-St. George Basin and surrounding areas.

Vulnerability Analysis Methodology

Loss estimated provided herein used available data and the methodologies applied resulted in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Numerous uncertainties also result from approximation and simplifications that are necessary for a comprehensive

analysis these may include incomplete inventories, demographic, economic parameters, or lack of data.

A basic synopsis of the methodology utilized to meet the requirements in DMA 2000 is discussed here with a more detailed discussion in each hazard section.

Geographic Information System (GIS) software was used as the basic analysis tool to complete the hazard analysis in all seven multi-jurisdictional plans and the state plan. For most hazards a comparison was made between available digital hazard data and census 2000 demographic information. Statewide digital data was obtained from Utah's Automated Geographic Reference Center (AGRC) for the following hazards; landslides, problem soils, quaternary faults, wildfire, dam locations, and epicenter locations. Vulnerability assessment for each county estimate the number of homes, business, infrastructure and population vulnerable to each hazard and assigns a replacement dollar value to residential structures and infrastructure in the hazard area. The value of residential housing was calculated using estimated average residential housing values for each county if parcel data was unavailable. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

Earthquake

Earthquake loss and vulnerability was profiled using HAZUS MH, which is shorthand for Hazards United States. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses.

Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology.

Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

The HAZUS Model estimates building losses, numbers of shelters required for displaced households, amounts of debris generated, and numbers of causalities. A HAZUS report was completed for each of the counties covered in this plan.

Dam Failure

Unfortunately, digitizing of dam failure inundation maps was not completed in time for use in the seven regional plans. I anticipate future mitigation plans will include this information. This plan utilized the dam failure inundation maps in determining if state owned facilities are in the inundation area.

Drought

Drought vulnerability in this plan is defined by rankings, which are based solely on agricultural losses. Agriculture is typically the economic sector impacted most by a drought. Economic indicators including cash receipts per county from 1990 to 2002, personal income from farming 1970-2001, number of farms per county, and number of acres of farmland per county were both used to determine a counties vulnerability to drought. These scores were all normalized and added together to create a vulnerability rating with higher numbers having higher vulnerability.

Flood

Assessing the state's vulnerability to flooding in a quantitative matter proved quite problematic. Utah has limited mapped flood plains and with the exception of Salt Lake and Utah Counties floodplain maps have not yet been digitized. Using NFIP statistics provided limited utility in determining flood vulnerability. Much of Utah's flood risk is either not mapped, mapped as Zone D (indicating the flood risk is undetermined), the city or county does not participate in the NFIP, or because people in the state perceive there is limited flood risk and/or do not believe there is a need to purchase flood insurance. Therefore, much of Utah's flood loss goes unreported. Evidence of this can be seen in the NFIP statistics; in almost 25 years, the National Flood Insurance Program paid out only $4.7 million dollars on 714 claims.

To determined flood vulnerability for each jurisdiction, state floodplain experts were assembled to provide a qualitative vulnerability assessment, classifying each county into a high, medium, or low flood vulnerability rating. Experts included the State Flood Plain

Manager, State Hazard Mitigation Officer, the U.S. Army Corps of Engineers, and members of the State Hazard Mitigation Team. Classifications were based on population, in-place flood mitigation, age and accuracy of NFIP maps, dollar amounts of infrastructure values from HAZUS MH, past flood loss, and the potential for future flooding as a result of development pressure.

Wildfire

Wildfire risk by county was determined using the Geo-processing extension in Arc View 3.2. This utility allows the GIS user to process two data sets into one new data set. In the case of wildfire the census 2000 data for municipalities was combined with the state wildfire risk data set. The ranking of counties utilizes a total of all high and extreme wildfire risk acreage for all of the cities and town in each county. Because incorporated areas typically house the majority of the human build infrastructure only those areas were summed. This method eliminates the large amount of wildfire acreage classified as extreme or high in the county from the ranking method.

Landslide

Similar to wildfire the total acreage of city land in each county with a mapped landslide was combined eliminating the large amount of landslides on county land typically owned by the federal government. So although this is a good indictor of potential landslide vulnerability total vulnerability depends on how this land is regulated. Large portions of the mapped landslides, utilized in this analysis, were on lands often valued for development. As development pressure mounts total vulnerability will be a function of how cities and counties manage the development on sensitive lands such as those with a known landslide risk.

State Owned Faculties

One of the requirements in DMA 2000 is to assess the state owned facilities and there potential vulnerability to particular hazards. At this time the state of Utah does not have a geo-coded state owned facilities list. The current table is being geocoded but this time consuming tasked did not yield a data set usable for analysis, in this iteration of the plan.

However, Utah does have a detailed Excel database with over 5,000 state owned facilities and their insured values. This database was employed were applicable to provide best estimates of damage to state owned facilities. For example this database was used to determine the number and insured value of state owned facilities in each county.

Table I-5 State Owned Facilities and There Total Insured Value

County Name	Total # of State Owned Buildings	Total Insured Value
Beaver	45	$39,699,450
Box Elder	122	$211,708,229
Cache	516	$1,002,633,308
Carbon	136	$145,275,708
Daggett	29	$9,102,956

Davis	210	$840,516,668
Duchesne	93	$102,289,698
Emery	85	$73,636,967
Garfield	60	$36,643,566
Grand	66	$38,187,807
Iron	184	$310,039,266
Juab	62	$47,790,128
Kane	54	$36,057,015
Millard	79	$87,441,289
Morgan	58	$30,834,955
Piute	25	$11,895,352
Rich	40	$12,953,729
Salt Lake	1,495	$5,045,028,405
San Juan	106	$91,054,292
Sanpete	162	$217,449,191
Sevier	110	$111,450,042
Summit	112	$165,369,028
Tooele	87	$160,620,627
Uintah	113	$118,046,950
Utah	444	$1,435,302,412
Wasatch	140	$78,873,511
Washington	151	$380,991,528
Wayne	35	$10,205,255
Weber	298	$982,416,195

Provided in Table I-6 is a breakdown, by county, of the total estimated dollar value exposed natural hazards. This information was derived using HAZUS-MH. Estimated dollar values are provided in millions for the key occupancies classes in Utah along with the number of response facilities, schools, and hospitals.

Table I-6 Total Estimated Exposed Value Per County

County Name	Residential in Millions	Non-Residential in Millions	Schools & Hospitals	Emergency Response Facilities	Total Building Value in Millions
Beaver	$297	$35	7	3	$333
Box Elder	$1,730	$255	29	12	$1,985
Cache	$3,411	$801	33	11	$4,212
Carbon	$983	$149	15	9	$1,132
Daggett	$83	$4	3	3	$88
Davis	$10,276	$1,628	94	36	$11,905
Duchesne	$628	$152	17	3	$780
Emery	$441	$84	10	11	$526
Garfield	$311	$76	11	3	$387
Grand	$386	$89	7	5	$476
Iron	$1,469	$317	15	7	$1,786
Juab	$320	$65	7	4	$386
Kane	$388	$62	8	5	$451
Millard	$504	$95	14	7	$599
Morgan	$302	$67	3	3	$369
Piute	$83	$12	3	1	$96

Rich	$246	$10	4	5	$257
Salt Lake	$40,368	$10,496	306	48	$50,865
San Juan	$527	$82	15	8	$609
Sanpete	$893	$162	15	6	$1,055
Sevier	$821	$154	18	5	$976
Summit	$2,601	$378	16	4	$2,980
Tooele	$1,802	$231	23	11	$2,034
Uintah	$955	$544	11	6	$1,199
Utah	$13,600	$2,712	130	28	$16,313
Wasatch	$860	$111	7	3	$972
Washington	$4,144	$853	34	10	$4,997
Wayne	$148	$19	1	1	$168
Weber	$8,798	$1,566	80	16	$10,365

This ranked list of counties is based on the total building values in Table I-6:

1. Salt Lake
2. Utah
3. Davis
4. Weber
5. Washington
6. Cache
7. Summit
8. Tooele
9. Box Elder
10. Iron
11. Uintah
12. Carbon
13. Sanpete
14. Sevier
15. Wasatch
16. Duchesne
17. San Juan
18. Millard
19. Emery
20. Grand
21. Kane
22. Garfield
23. Juab
24. Morgan
25. Beaver
26. Rich
27. Wayne
28. Piute
29. Daggett

Estimated Insured Value of State Owned Facilities

For the purpose of estimating potential loss to state owned facilities due to wildfire, landslides, and dam failure the U.S. Department of Labor Occupational Safety & Health Administration's Standard Industrial Classification (SIC) number was used. SIC codes 911102, 921102, and 919900 were separated from the June 2002 Equifax Business data set purchased by FEMA Headquarters. SIC codes were used to represent the state owned facilities. This new data set contained approximately 1,600 structures, much less actual. Although, the new dataset is not complete it does contains spatial information on most critical structures.

Limitations

As with any analysis the basic limitation exist those being restricted time and funding. These prevent the development of "perfect world" data for use in the analysis utilizing Geographic Information Systems. In addition to the limits in funding and time the following items limited the accuracy in the data analysis:

- Lack of digital flood plain maps
- Utah currently does not have a geo-coded list of state owned faculties.
- County Assessor data was not made available from all 29 counties.
- Predicting future losses was not attempted because of the imperfect results achieved utilizing current methods.

- Statewide hazard data was used to complete the vulnerability analysis. Much inaccuracy exists when requesting GIS systems to perform site-specific vulnerability utilizing a statewide data set.

Future analysis

Advances in GIS data and analysis methods are starting to be use by state agencies. For example the Utah Dam Safety Section is being to digitize their dam failure inundation maps and perform analysis using county assessors information. In the future mitigation plans and revisions will include:

- Dam failure loss numbers
- Detailed state owned facilities loss information
- Potential avalanche slopes
- More detailed local specific wildfire loss information

Dam Failure

Profiling Hazard Event

The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

Dam failures result from the failure of a man made water impoundment structure, which often results in catastrophic down grade flooding. Dam failures are caused by one or a combination of the following: "breach from flooding or overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, vegetation and rodents, poor construction, lack of maintenance and repair, misuse, improper operation, terrorism, or a combination of any of these" (Eldredge 46). The Utah State Engineer has been charged with regulating non-federal dams in the State, since 1919. "In the late 1970's Utah started its own Dam Safety Section within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act (PL-92-367)" (Eldredge 46).

The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, the size, height, volume, and incremental risk/damage assessments or dams are all variables used to assign dam hazard ratings in Dam Safety's classification system. Using the hazard ratings systems developed by the Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years. There are 906 dams in Utah of those 197 have received a high hazard rating by Dam Safety.

The rankings below were compiled as part of a hazard evaluation designed by the Federal Energy Regulatory Commission FERC. The dam rankings are assigned by a priority score with takes into account numerous variables some of, which include: public access, population at risk, breach flow, inundation depth, and dam type. The listed ranking only includes those 50 dams with the highest priority score. Figure I-3, justifies only listing the top 50 as priority scores drop dramatically there after.

1. Mountain Dell
2. Little Dell
3. Utah Power & Light Cutler
4. Quail Creek
5. Salt Lake County Sugarhouse
6. Logan First Dam
7. Quail Creek South Dam
8. Utah Power & Light Electric Lake
9. Porcupine
10. Red Butte Dam
11. Sevier Bridge
12. Panquitch Lake
13. Sand Hollow North Dam

14. Sand Hollow West Dam
15. North Utah County Tibble Fork
16. Adams
17. Twin Lakes Salt Lake County
18. Settlement Canyon
19. Utah County Thistle Creek Debris
20. DMAD
21. Gunnison Bend
22. Big Sand Wash
23. Kens Lake
24. Piute
25. Smith and Morehouse
26. Millsite
27. Sand H Debris
28. Hobbs
29. Lake Mary-Phoebe
30. Salt Lake County Big Cottonwood Spencer's
31. Haight Creek Lower
32. Provo City-Rock Canyon DB
33. Provo City- Slate Canyon BD No. 3
34. Holmes
35. Huntington
36. Kennecott Mine Bingham Creek
37. Three Creeks- Beaver
38. Davis County-Barton Creek DB
39. Gunlock
40. Lloyds Lake-Monticello
41. Forsyth
42. Blanding City No. 4
43. Utah County-American Fork Debris
44. Kaysville
45. Mill Meadow
46. Grantsville
47. Ash Creek
48. Gunnison
49. Davis County-Stone Creek DB
50. Tony Grove Lake Dam

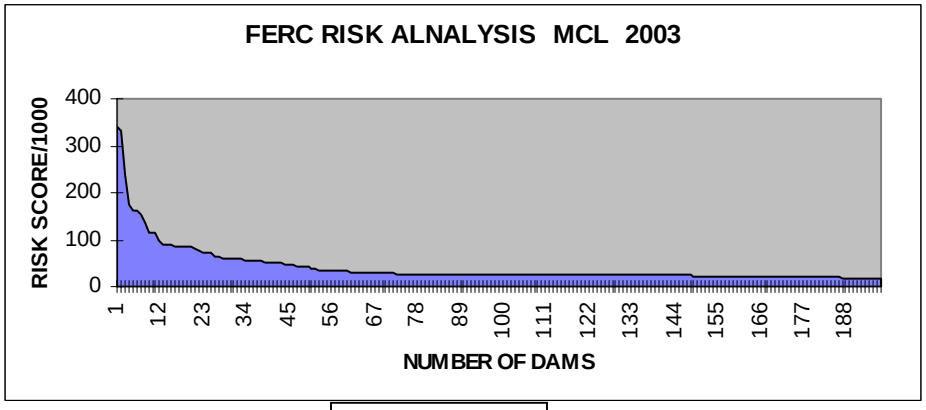


Figure I-3

Significant Dam Failure Events:

<u>Quail Creek</u>

Quail Creek dam failed on New Years Eve 1988 due to extensive foundation seepage. Failure caused approximately $12 million dollars in damage and cost approximately $8 million to rebuild. No lives were lost.

Trial Lake Dam Failure
Trial Lake Dam Failed in 1986 from piping of organics in the foundation contact. The BoR rebuilt the dam and the Corp fixed the damaged river channel

DMAD Dam Failure
DMAD Dam Failed in 1983 and a transient was killed trying to cross the flooding river on a suspended wire. The Gunnison Bend Dam was consequently breached proactively to keep it from overtopping.

Little Deer Creek
Little Deer Creek dam failed on its first filling on June 16, 1963, due to extensive foundation seepage. The catastrophic failure resulted in Utah's first dam failure fatality killing young Bradley Galen Brown a four-year-old boy.

Assessing Vulnerability by Jurisdiction

[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events…

Dam-safety and dam construction, although improving, is still and imperfect subjective discipline. Many dams still fail each year in the United States. Society decided long ago the need to store water justified the risk association with storing the water. To assess vulnerability by jurisdiction the total number of dams, classified as having a high hazard rating, in each county were used to rank the jurisdictions vulnerability. Thus, a counties risk is purely a function of the number of high hazard dams in the county. Yet, one should keep in mind many factors, which can cause a dam to fail, and all dams can fail.

Salt Lake	28	Piute	6	Juab	2
Davis	27	Summit	5	Tooele	2
Utah	21	San Juan	5	Grand	2
Washington	16	Weber	4	Rich	2
Iron	11	Garfield	4	Morgan	2
Wasatch	9	Box Elder	4	Daggett	1
Sevier	9	Emery	4	Wayne	1
Uintah	8	Beaver	4	Carbon	1
Duchesne	7	Millard	3	Kane	0
Sanpete	7	Cache	3		
Total	**197**				

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

Potential loss numbers for each jurisdiction were not completed for dam failure in the multi-jurisdictional plans. This task was not accomplished because during the planning process digitized high hazard dam inundation areas had not yet been completed.

With high hazard dam inundation areas digitized all future mitigation plans will include a section on potential losses. A mitigation strategy in this plan is to utilize the newly digitized inundation maps to better understand dam failure vulnerability.

Assessing Vulnerability by State Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

A state owned facilities data set created by pulling state owned facilities out of the June 2002 Equifax Business dataset based on OSHA SIC codes was overlaid on top of dam failure inundation areas. Using the "select by theme" feature in ArcView 3.x all of the vulnerable structures intersecting the dam failures inundation areas were selected. The selected items were then saved as a theme, whose table was joined with the county FIPS codes to determine which structures are in each county.

Table I-7 Total Number of State Owned Facilities in Dam Failure Inundation Areas

County	Total Vulnerable Structures
Beaver	4
Box Elder	0
Cache	1
Carbon	0
Daggett	0
Davis	11
Duchesne	0
Emery	0
Garfield	0
Grand	19
Iron	15
Juab	0
Kane	0
Millard	6
Morgan	0
Piute	0
Rich	0

Salt Lake	111
San Juan	0
Sanpete	1
Sevier	18
Summit	1
Tooele	26
Uintah	2
Utah	57
Wasatch	6
Washington	8
Wayne	0
Weber	14
Total	**300**

Estimating Potential Losses by State Facilities

[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

Estimating values for state owned facilities in dam failure inundation areas was determined by multiplying the average insured value of state owned facilities in each county by the total number of vulnerable building in each county. Average insured value of state facilities per county was provided by State Risk Management a section of the State Department of Administrative Services.

Table I-8 Total Value of State Owned Facilities in Dam Failure Inundation Area

County	Total Vulnerable Structures	Estimated Insured Value
Beaver	4	$3,528,840.00
Box Elder	0	0
Cache	1	$1,943,087.81
Carbon	0	0
Daggett	0	0
Davis	11	$44,027,063.52
Duchesne	0	0
Emery	0	0
Garfield	0	0
Grand	19	$10,993,459.66
Iron	15	$25,274,940.15
Juab	0	0
Kane	0	0
Millard	6	$6,641,110.56
Morgan	0	0
Piute	0	0
Rich	0	0
Salt Lake	111	$374,580,704.34
San Juan	0	0

Sanpete	1	$1,342,278.96
Sevier	18	$18,237,279.60
Summit	1	$1,476,509.18
Tooele	26	$48,001,566.60
Uintah	2	$2,089,326.54
Utah	57	$184,261,796.13
Wasatch	6	$3,380,293.32
Washington	8	$20,184,981.60
Wayne	0	0
Weber	14	$46,153,780.96
Total	**300**	**$792,117,018.93**

Drought

Profiling Hazard Event

The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

Drought is a normal recurrent feature of climate, although many, in Utah, erroneously consider it a rare and random event. It occurs in virtually all-climatic zones, while its characteristics vary significantly from one region to another. Droughts, simple put, are cumulative hazards, which result from long periods of below normal precipitation. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. The impacts of successive years of drought on reservoir storage are visible in Figure I-4.

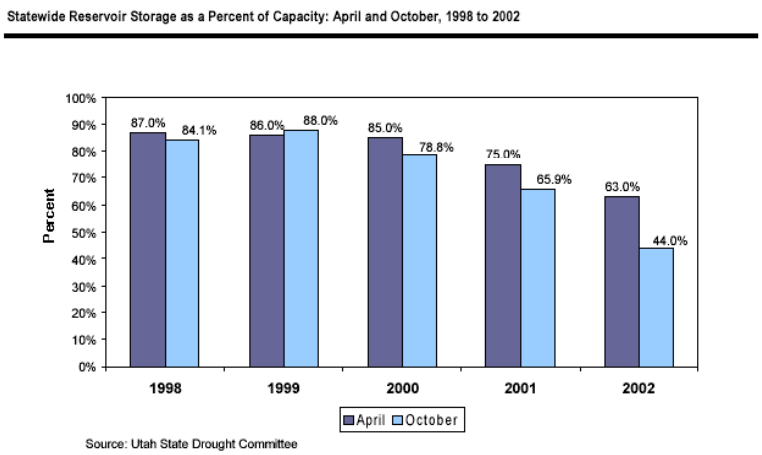
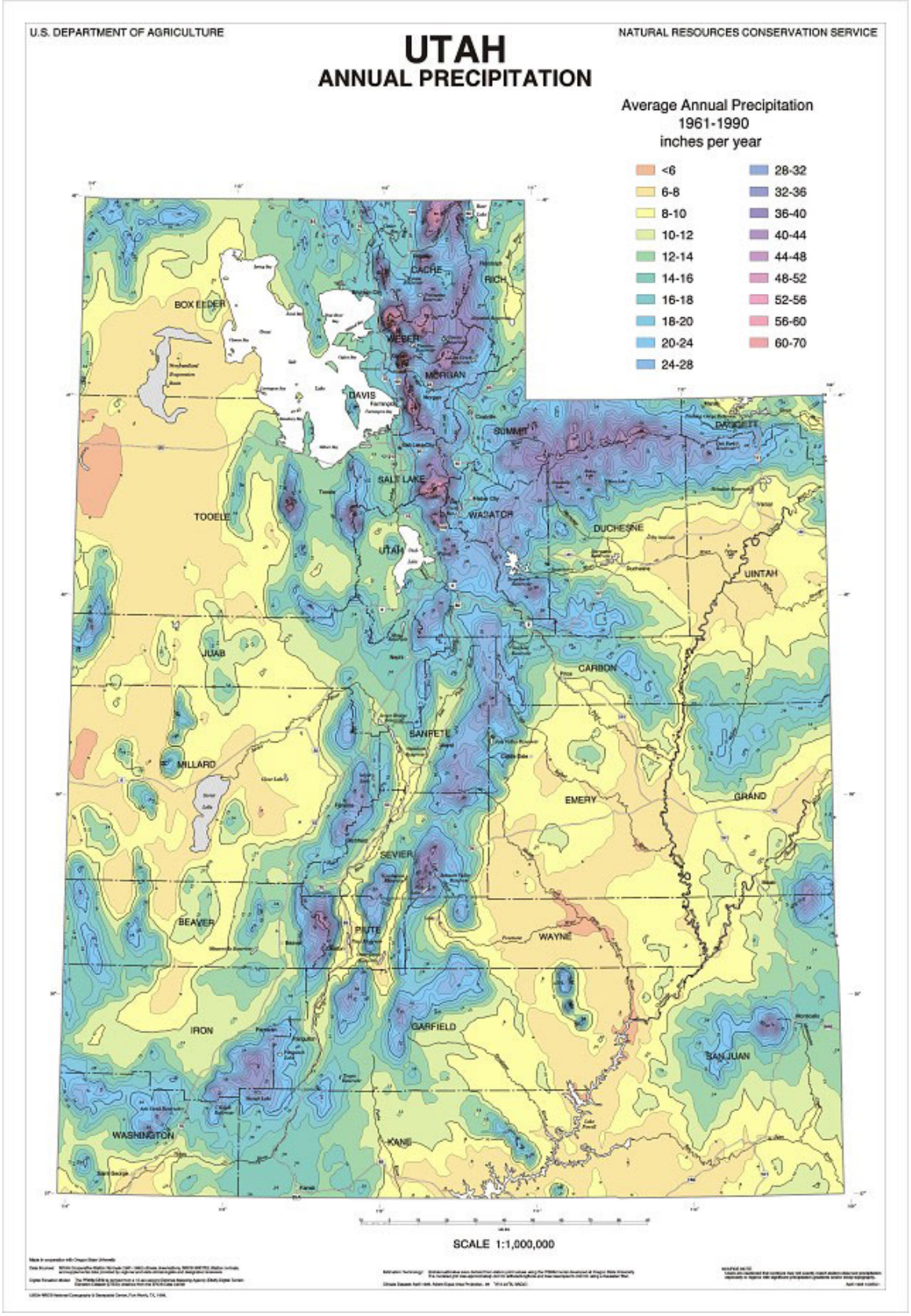


Figure I-4 Reservoir Storage

Droughts are frequently classified into one of the following four types:

1. Meteorological
2. Agricultural
3. Hydrological
4. Socio-economic

<u>Meteorological droughts:</u> are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time.
<u>Agricultural droughts:</u> relate common characteristics or drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors like soil water deficits; water needs based on differing stages of crop development and water reservoir levels.
<u>Hydrological drought:</u> is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use can alter the hydrologic characteristics of a basin.
<u>Socioeconomic drought:</u> is the result of water shortages that limit the ability to supply water dependent products in the marketplace.


U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
UTAH
ANNUAL PRECIPITATION
Average Annual Precipitation
1961-1990
inches per year
<6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-24
24-28
28-32
32-36
36-40
40-44
44-48
48-52
52-56
56-60
60-70
CACHE
RICH
BOX ELDER
WEBER
MORGAN
DAVIS
SUMMIT
DAGGETT
SALT LAKE
TOOELE
WASATCH
DUCHESNE
UTAH
UINTAH
JUAB
CARBON
SANPETE
MILLARD
EMERY
GRAND
SEVIER
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
SAN JUAN
WASHINGTON
KANE
SCALE 1:1,000,000

Map I-1

Impacts of Drought

Economic

- Decreased land prices
- Loss to industries directly dependent on agricultural production (machinery and fertilizer manufactures, food processors, dairies, etc)
- Unemployment from drought related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capitol shortfalls)
- Revenue losses to federal, state, and local governments from reduced tax base.
- Reduction of economic development.
- Rural population loss and relocation to larger cities.
- Loss to recreation and tourism industry
- Energy related effects
- Water suppliers revenue shortfalls
- Higher cost of water transport
- Decline in food production causes increase in food prices and increase in importation of food

Social

- Mental and physical stress
- Health related low flow problems including cross-connection contamination diminished sewage flows, increased pollutant concentrations, and reduced fire-fighting capabilities.
- Loss of human life
- Public safety concerns caused by increased threat of forest and range fires
- Increases in conflicts of water users.
- Changes lifestyles of those living in rural areas.
- Reduction of modification of recreation activities.
- Public dissatisfaction with government drought response plan

Environmental

- Damage to animal species
- Reduction and degradation of fish and wildlife habitat
- Increased contact of wild animals with agricultural producers.
- Loss of biodiversity
- Lower water levels in reservoirs and lakes
- Reduced stream flow.
- Loss of wetlands
- Increased ground water depletion, land subsidence, reduced recharge.
- Increased number and severity of wild fires.
- More dust and pollutants in the air.
- Visual and landscape qualities diminished.

The State or Utah, uses the Palmer Drought Severity Index referred to as the (PDSI) to quantify the existence of a drought. Using the PDSI, drought is expressed as a negative number. Much of the basis, used by the State, to determine drought years, or drought periods, comes from the PDSI. In addition, the State Climatologist, the National Geophysical Data Center of NOAA, and the National Drought Mitigation Center use the PDSI. Further information on the Palmer Drought Severity Index can be found in Appendix F.

For the most part droughts no longer affect the availability of drinking water, thus no longer place peoples lives at risk, the same can not be said for a persons livelihood. Numerous water projects throughout the state have placed enough water in storage to insure the supply of drinking water. Yet, prolonged droughts still have a significant affect on agricultural and agribusinesses, within the state dependent on irrigation water. Droughts have significant impact on the natural world. Species over time adapt to the natural world in which they live, becoming depended on constant factors, one of those being a certain amount of water. The flora and fauna of a given area have an ability to adjust to a certain amount of environmental change but as drought conditions persist mortality rates across the ecosystem begin to rise. Prolonged droughts place a tremendous burden on wildlife habitat, causing mortality in plant species and heightening the risk of wildfire, as habitat is lost or changed, those animals depended on it, are also lost or must relocate.

According to Utah's annual PDSI averages, Utah has experienced as many as 60 years of drought out of the past 100 years, and several of these have been multi-year droughts. A more detailed look at Utah's drought is available in each of Utah's seven multi-jurisdictional Pre-Disaster Mitigation plans. These plans contain charts illustrating the Palmer Drought Severity Index for each of Utah's seven climate regions. Each chart covers the period of time from 1895 to 2003.

Table I-9 Multi-Year Droughts in Utah

1896-1905	Affected entire state
1930-1936	Dust Bowl Period; affected entire state
1939-1940	Affected entire state
1950-1951	Affected southern half of Utah
1953-1956	Affected entire state
1958-1964	Affected entire state
1970-1972	Affected southwest Utah, then entire state
1976-1979	Affected entire state
1985-1992	Affected northern Utah; then entire state
1995-1996	Affected entire state
1998-2003	Affected entire state

Droughts typically affect Utah in two ways 1) results from water shortages within reservoirs affecting irrigation and eventually culinary water supplies, if the drought lasts more than two years. 2) Soil moisture drought, where dry farmers lose their crops.

Public safety threats do no usually become visible in communities until the third year of drought, when culinary water supplies are low.

Drought Recovery

It is human nature to want to return too normal as quickly as possible. Therefore, after a prolonged drought, we look at a return to normal precipitation as the end of the drought. Indicators such as a green pasture or a full reservoir are often erroneously used to determine the end of the drought. But the effects of drought linger for several years following a return to normal precipitation. For example, we do not see, after several years of drought, that even though a plant is green it lacks vigor and that the overall biomass of the site has been reduced, therefore, land use may have to continue at a reduced level for a period following a drought. In addition soil moisture may be low inhibiting plant recovery, springs are slow to recover, and wildlife and livestock births are often reduced.

Existing Mitigation

The Department of Natural Resources Division of Water Resources plays a central role in drought mitigation and contingency planning for drought. The Division of Water Resources hosts a multi-agency governors drought advisory committee.

The Division of Water Resources also maintains the State of Utah Drought Response Plan. This plan found in Appendix G contains a comprehensive list of federal drought assistance programs and state drought-related assistance programs, as the state does not maintain a specific drought assistance program.

Assessing Vulnerability by Jurisdiction

[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events…

Drought vulnerability rankings are based solely on agricultural, typically the economic sector hit hardest by a drought. Economic indicators including cash receipts per county from 1990 to 2002, personal income from farming 1970-2001, number of farms per county, and number of acres of farmland per county were used to determine a counties vulnerability to drought. These scores were all normalized and added together to create a vulnerability rating with higher numbers having higher vulnerability.

1. Box Elder
2. Utah
3. Cache
4. Uintah
5. Sanpete
6. Millard
7. Duchesne
8. San Juan
9. Weber
10. Beaver
11. Iron
12. Sevier
13. Summit
14. Davis
15. Salt Lake
16. Rich
17. Tooele
18. Morgan
19. Emery
20. Juab
21. Washington
22. Wayne
23. Wasatch
24. Garfield

25. Piute
26. Kane
27. Carbon
28. Grand
29. Daggett

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

The Governors Office of Planning and Budget compiled drought loss numbers from 2002, for the 2003 Economic Report to the Governor. The Economic Report to the Governor suggests the current drought has reduced employment change by 0.4%. During 2002, job change was –1.0%. Without the drought, job change might have been –0.6%, 0.4% higher than what actually occurred. Best estimates are that livestock sales are down $100 million due to the drought; hay sales are down $50 million; and, because of drought related fires, tourism sales are down $50 million. The combined effects of the drought in these three sectors resulted in a loss of over 6,100 jobs during 2002, and over $120 million in lost income.

The hardest hit sector was agriculture, where 2,600 jobs and almost $40 million in income were lost. The sectors serving tourists (retail trade and services) were the next hardest hit sectors. Services lost about 1,300 jobs and $25 million in income. Retail trade lost 1,000 jobs and almost $15 million in income.

It is expected droughts in the future will have similar losses. Basing future losses on past losses on the Counties of Box Elder, Utah, Cache, Uintah, Sanpete, Millard, Duchesne, San Juan, Weber, and Beaver will suffer the largest economic losses in future droughts. Drought is a compounding event, with economic losses getting larger as drought conditions persist. Utah is currently experiencing its fifth year of drought, with indicators such as snow pack, soil moisture, and weather showing no signs of relief.

Assessing Vulnerability of State Owned Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

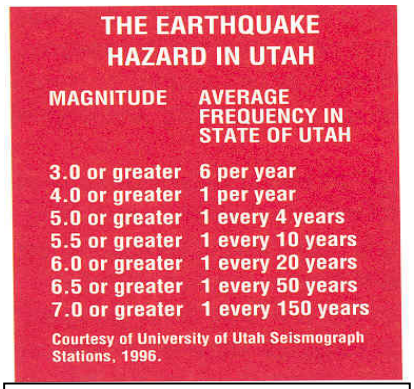
Although state owned facilities are seldom threatened by drought directly, drought does increase the likelihood of wildfire. Thus, facilities at risk to wildfire are also at risk to drought as prolonged drought can heighten the wildfire risk. Drought also as an effect on the budgets of many state parks and the tourism industry relying on water based recreation such as river running and water skiing.

Earthquakes

Profiling Hazard Event

The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks, when they can no longer withstand the stresses, built up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. When rocks break, they produce seismic waves that are transmitted through the rock outward producing ground shaking. Earthquakes are unique multi-hazard events, with the potential to cause huge amounts of damage and loss. Secondary effects of a sudden release of seismic energy (earthquake) include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, slope failure, and various types of flooding.



THE EARTHQUAKE HAZARD IN UTAH

MAGNITUDE	AVERAGE FREQUENCY IN STATE OF UTAH
3.0 or greater	6 per year
4.0 or greater	1 per year
5.0 or greater	1 every 4 years
5.5 or greater	1 every 10 years
6.0 or greater	1 every 20 years
6.5 or greater	1 every 50 years
7.0 or greater	1 every 150 years

Courtesy of University of Utah Seismograph Stations, 1996.

Figure I-5 Earthquake Frequency

<u>The Intermountain Seismic Belt</u>

The Intermountain Seismic Belt (ISB), is a zone of pronounced earthquake activity up to 120 miles wide extending in a north south direction 800 miles from Montana to northern Arizona. The Utah portion of the ISB trends from the Tremonton Cache Valley area south through the center of the state, along the Wasatch Front, and the southwest through Richfield and Cedar City concluding in St. George. "The zone generally coincides with the boundary between the Basin and Range physiographic province to the west and the Middle Rocky Mountains and Colorado Plateau physiographic provinces to the east" (Eldredge 6).

Earthquake Threats

The major secondary effects of earthquakes include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, avalanches, rock fall, slope failure, and various types of flooding. Other sections discuss landslides and flooding therefore, they will not be discussed here as an effect of earthquakes yet importance needs to be given to the fact that earthquakes can increase the likelihood of flooding and landslides.

<u>Ground Shaking</u>

Ground shaking causes the most impact during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated by earthquakes.

Earthquakes produce both vertical and horizontal ground shaking illustrated in figure I-6. The primary or P waves are compressional; the secondary or S waves have a shear

motion. These body waves radiate outwards from the fault to the ground surface where they cause ground shaking. The fast moving P waves are the first waves to cause the vibration of a building. The S waves arrive next often causing a structure to vibrate from side to side. Surface waves, characterized as Rayleigh (R) and Love (L) waves, arrive last, mainly causing low-frequency vibrations. Surface waves are more likely than P and S waves to cause tall buildings to vibrate.

Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves cause more damage to short stiff structures, were as low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). The PGA measures the rate in change of motion relative to the established acceleration due to gravity.

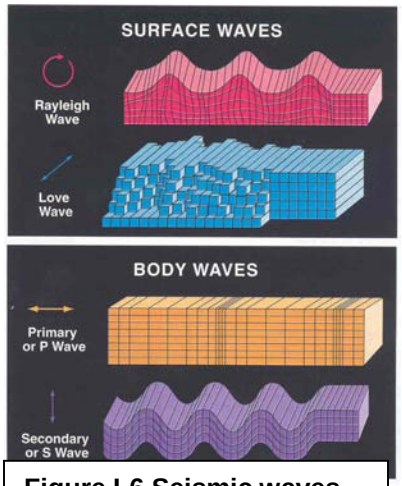


Figure I-6 Seismic waves

Local geologic conditions such as depth of sediment and sediment type, affect earthquake waves. Deep valley sediments, like those found in the Salt Lake Basin, increase the amplitude of seismic of certain frequencies relative to bedrock. In general, ground shaking increases with increased thickness of sediments" (Eldredge 8). Findings in recent geologic research done by Ivan Wong et al indicate an earthquake in Salt Lake County would produce higher PGA values than previously expected near faults and areas of near surface bedrock.

Surface Fault Rupture

During a large earthquake, fault movement may propagate along a fault plane to the surface, resulting in surface rupture along the fault. The Wasatch fault is a normal (mountain building) fault with regards to movement, meaning the footwall of the fault moves upward and the hanging wall moves in a down direction. Thus, faulting at the surface is on a steeply dipping plane, which results in the formation of large fault scarps. Surface fault rupture along the Wasatch fault is expected for earthquakes with magnitudes of 6.5 or larger. The largest probable earthquake that could strike Utah is anticipated to be an earthquake with an estimated magnitude between 7.0 and 7.5, and would most likely occur on the Wasatch Fault. An earthquake of this magnitude, based on current research, would create surface fault rupture with a displacement of around 6 to 10 feet in height and 20-40 miles long. In historic time surface fault rupture has only occurred once in Utah; the 1934 Hansel Valley earthquake with a magnitude 6.6 produced 1.6 feet of vertical offset.

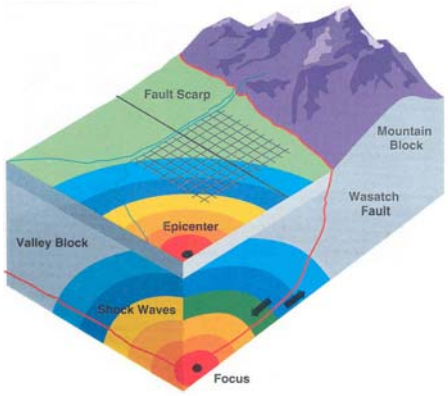


Figure I-7 Wasatch Fault block model

Surface fault rupture presents several hazards. Anything built on top of the fault or crossing the fault has a high potential of being destroyed by the event of displacement. Foundations will be cracked, building torn apart, and roads, utility lines, pipelines, or any other lifelines crossing the fault. It is almost impossible to design anything within reasonable cost parameters to withstand an estimated displacement of 6 to10 feet.

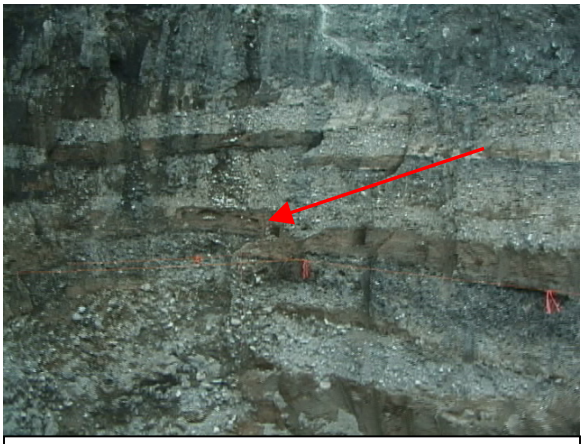


Figure I-8 Displacement in excavation

Surface fault rupture does not occur on a single distinct plane; instead, it occurs over a zone often several hundred feet wide known as the zone of deformation. The zone of deformation occurs mainly on the downthrown side of the main fault trace. Antithetic faults moving in the opposite direction of the main fault, create grabens (down dropped blocks) within the zone of deformation.

Liquefaction

Soil liquefaction occurs when water-saturated cohesionless sandy soils are subject to ground shaking. When liquefaction occurs soils behave more like a viscous liquid (quicksand) and lose their bearing capacity and shear strength. Two conditions must be met in order for soils to liquefy: (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy. The loss of shear strength and bearing capacity due to liquefaction causes buildings to settle or tip and light buoyant structures such as buried storage tanks and empty swimming pools to float upward. Liquefaction can occur during earthquakes of magnitude 5.0 or greater.

Lateral Spread

Soils, once liquefied, can flow on slopes with angles of .5 to 5 percent. This movement of liquefied soils is known as lateral spread. "The surficial soil layers break up and sections move independently, and are displaced laterally over a liquefied layer" (Eldredge 10). Liquefaction can cause damage in several way, with lateral spreading being one of the most common. Displacement of three (3) or more feet may occur and be accompanied by ground cracking and vertical displacement. Lateral spreading causes roads, buildings, buried utilities, and any other buried or surface structure to be pulled apart.

Various Flooding Issues Related to Earthquakes

Earthquakes could cause flooding due to regional lowering and tilting of the valley floor (tectonic subsidence), dam failure and seiches in lakes and reservoirs. Flooding can also result from the disruption of rivers and streams. Water tanks, pipelines, and aqueducts may be ruptured, or canals and streams altered by ground shaking, surface faulting, ground tilting, and landsliding.

RM	MMI	
2	I	NOT FELT EXCEPT BY A VERY FEW UNDER ESPECIALLY FAVORABLE CONDITIONS.
	II	FELT ONLY BY A FEW PERSONS AT REST, ESPECIALLY ON UPPER FLOORS OF BUILDINGS. DELICATELY SUSPENDED OBJECTS MAY SWING.
3	III	FELT QUITE NOTICEABLY BY PERSONS INDOORS, ESPECIALLY ON UPPER FLOORS OF BUILDINGS. MANY PEOPLE DO NOT RECOGNIZE IT AS AN EARTHQUAKE. STANDING MOTOR CARS MAY ROCK SLIGHTLY. VIBRATION SIMILAR TO THE PASSING OF A TRUCK. DURATION ESTIMATED.
4	IV	FELT INDOORS BY MANY, OUTDOORS BY A FEW DURING THE DAY. AT NIGHT, SOME AWAKENED. DISHES, WINDOWS, DOORS DISTURBED; WALLS MAKE CRACKING SOUND. SENSATION LIKE A HEAVY TRUCK STRIKING BUILDING. STANDING MOTOR CARS ROCKED NOTICEABLY.
	V	FELT BY NEARLY EVERYCNE; MANY AWAKENED. SOME DISHES, WINDOWS BROKEN. UNSTABLE OBJECTS OVERTURNED. PENDULUM CLOCKS MAY STOP.
5	VI	FELT BY ALL, MANY FRIGHTENED. SOME HEAVY FURNITURE MOVED; A FEW INSTANCES OF FALLEN PLASTER. DAMAGE SLIGHT.
	VII	DAMAGE NEGLIGIBLE IN BUILDINGS OF GOOD DESIGN AND CONSTRUCTION; SLIGHT TO MODERATE IN WELL-BUILT ORDINARY STRUCTURES; CONSIDERABLE DAMAGE IN POORLY BUILT OR BADLY DESIGNED STRUCTURES; SOME CHIMNEYS BROKEN.
6	VIII	DAMAGE SLIGHT IN SPECIALLY DESIGNED STRUCTURES; CONSIDERABLE DAMAGE IN ORDINARY SUBSTANTIAL BUILDINGS WITH PARTIAL COLLAPSE. DAMAGE GREAT IN POORLY BUILT STRUCTURES. FALL OF CHIMNEYS, FACTORY STACKS, COLUMNS MONUMENTS, WALLS. HEAVY FURNITURE OVERTURNED.
7	IX	DAMAGE CONSIDERABLE IN SPECIALLY DESIGNED STRUCTURES; WELL-DESIGNED FRAME STRUCTURES THROWN OUT OF PLUMB. DAMAGE GREAT IN SUBSTANTIAL BUILDINGS, WITH PARTIAL COLLAPSE. BUILDINGS SHIFTED OFF FOUNDATIONS.
	X	SOME WELL-BUILT WOODEN STRUCTURES DESTROYED; MOST MASONRY AND FRAME STRUCTURES DESTROYED WITH FOUNDATIONS. RAILS BENT.
8	XI	FEW, IF ANY (MASONRY) STRUCTURES REMAIN STANDING. BRIDGES DESTROYED. RAILS BENT GREATLY.
	XII	DAMAGE TOTAL. LINES OF SIGHT AND LEVEL ARE DISTORTED. OBJECTS THROWN INTO THE AIR.

Figure I-9 Comparison between MMI and RM

Seiches

Standing bodies of water are susceptible to earthquake ground motion. Water in lakes and reservoirs may be set in motion and slosh from one end to the other, much like in a bathtub. This motion is called a seiche (pronounced "saysh"). A seiche may lead to dam failure or damage along shorelines.

Earthquake Measurement

An earthquake's size is measured in two ways. One is by their magnitude, which is a measure of the amplitude of the seismic waves, the second is by their intensity, a measure of the damaged caused by the quake. The Richter Magnitude scale, a logarithmic scale where every whole number increase represents a ten-fold increase in recorded ground motion, is used to measure magnitude. The Modified Mercalli Intensity Scale (MMI) is used to measure intensity. Developed in 1902 by an Italian scientist named G. Mercalli this scale is based on observations of damage. Figure I-9 illustrates the relationship between the Richter Magnitude and the Modified Mercalli Intensity.

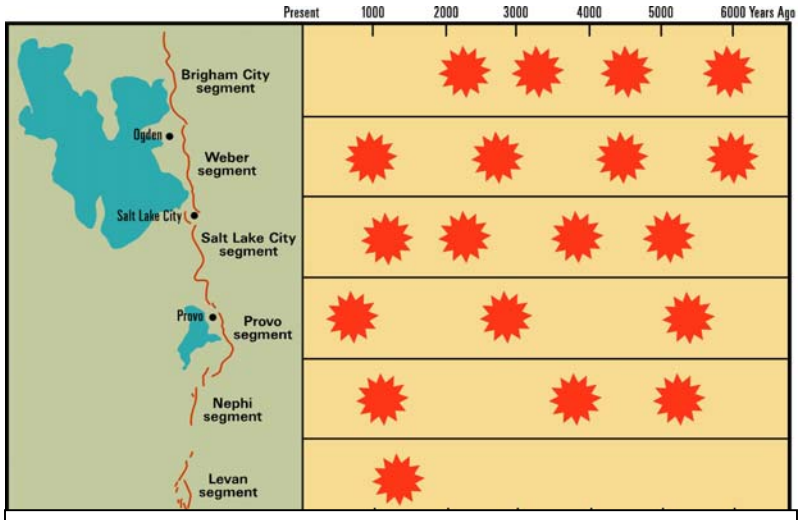


Figure I-10 Movement along each segment of the Wasatch Fault

Significant Earthquakes:

Every year, seismograph stations record about 700 earthquakes occurring in Utah. Most of these are too small to even be felt. Figure I-5 demonstrates the average frequency of

earthquakes in Utah. Utah has numerous active faults throughout the state, capable of causing damage, but due to the number of people residing along the Wasatch Front and the amount of infrastructure, an event on the Wasatch Fault would cause the most damage. The last known movement of each segment of the Wasatch Fault is shown in figure I-10. Table I-10 provides a timeline of all earthquakes larger then 5.0 magnitude, occurring in Utah from 1876 to present.

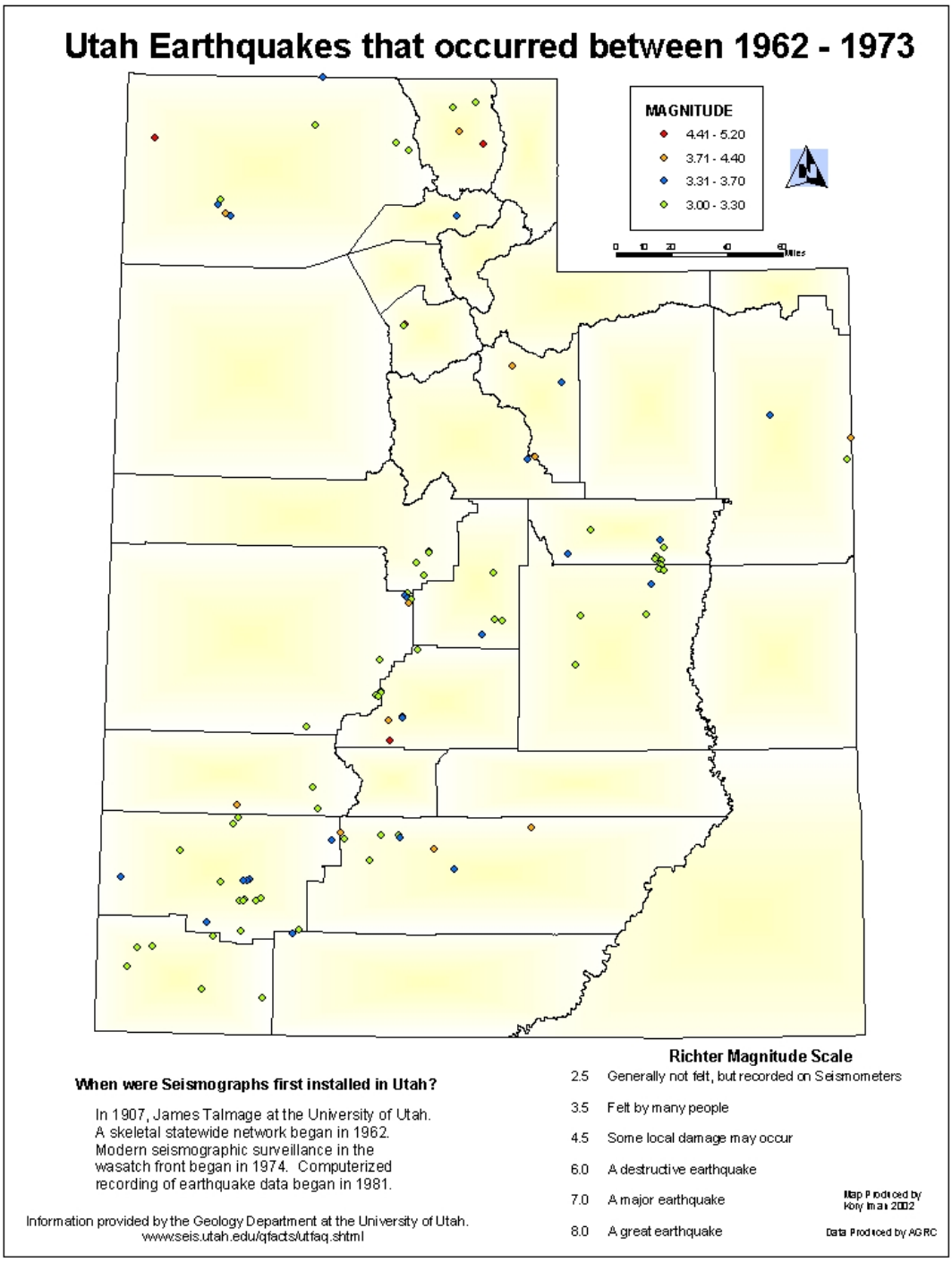
Illustrated in maps I-2, 3, and 4 are the location of earthquakes from 1962 through 1992 larger than 3.0, while slightly dated these maps provide spatial reference to seismically active areas.

Table I-10 Significant Utah Earthquakes

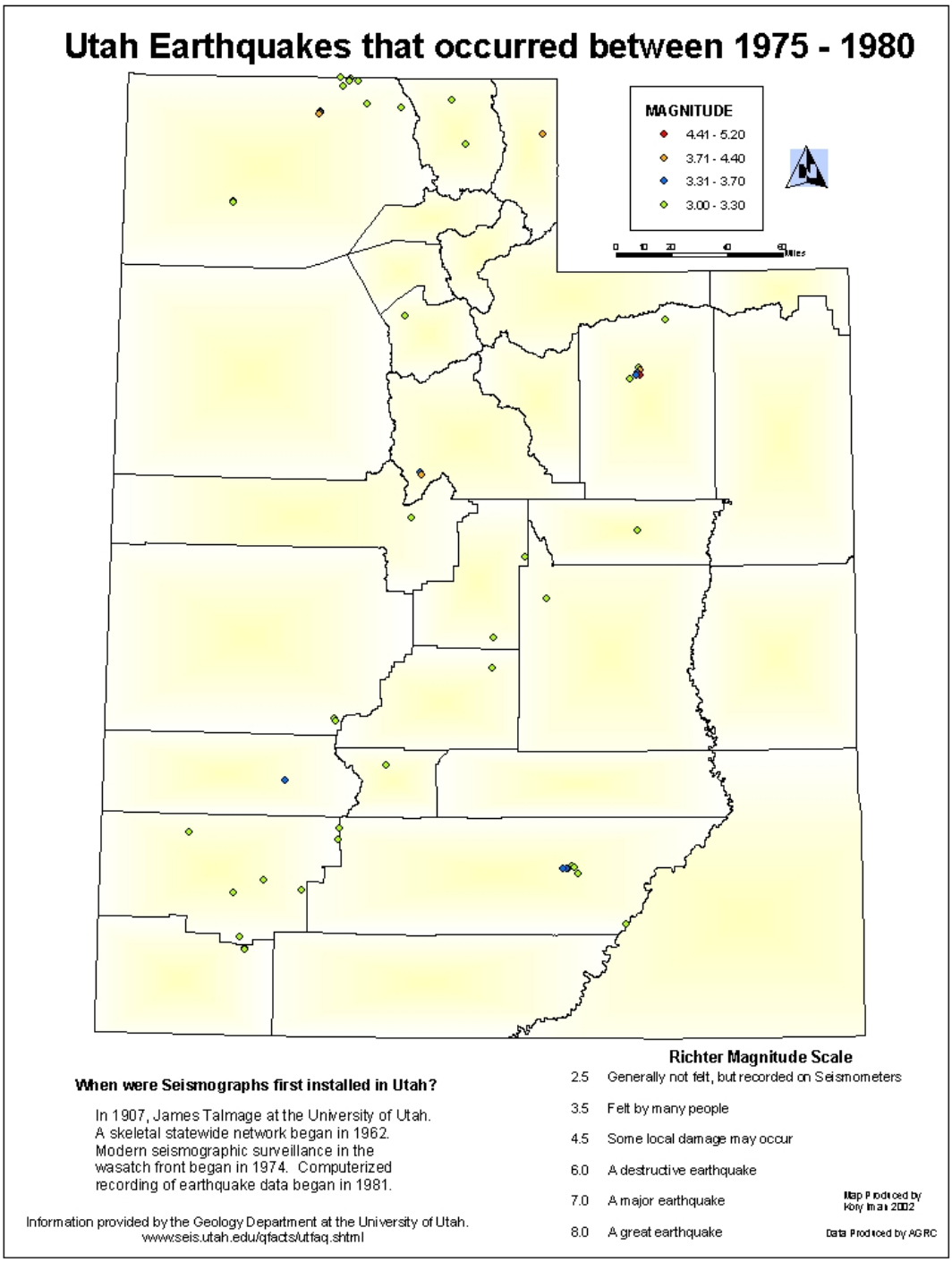
Date	Name	Magnitude
March 22, 1876	Moroni	5.0
December 5, 1887	Kanab	5.7
April 20, 1891	St. George	5.0
July 18, 1894	Ogden	5.0
August 1, 1900	Eureka	5.0 +/- .5
November 13, 1901	Southern Utah	6.0 +/- .5
November 17, 1902	Pine Valley	6.0
April 15, 1908	Milford	5.0
October 5, 1909	Hansel Valley	6.0
January 10, 1910	Elsinore	5.0
May 22, 1910	Salt Lake City	5.5
May 13, 1914	Ogden	5.0 +/- .5
July 15, 1915	Provo	5.0
September 29, 1921	Elsinore	6.0
January 20, 1933	Parowan	5.0
March 12, 1934	Hansel Valley	6.6
August 30, 1942	Cedar City	5.0
September 26, 1942	Cedar City	5.0
February 22, 1943	Magna	5.0
November 17, 1945	Glenwood	5.0
March 6, 1949	Salt Lake City	5.0
February 13, 1958	Wallsburg	5.0
February 27, 1959	Panquitch	5.0
July 21, 1959	Southwest	5.7
April 15, 1961	Ephraim	5.0
August 30, 1962	Cache Valley	5.7
September 5, 1962	Magna	5.2
October 4, 1967	Marysvale	5.2
August 14, 1988	San Rafael Swell	5.3
January 29, 1989	Wasatch Plateau	5.4
September 2, 1992	St. George	5.8

*Occurred in Idaho felt in throughout northern Utah

Table derived form information provided by the University of Utah Seismograph Stations.


Utah Earthquakes that occurred between 1962 - 1973
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
0 10 20 40 60 Miles
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfacts/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake
Map Produced by
Kory Imai 2002
Data Produced by AGRC

Map I-2


Utah Earthquakes that occurred between 1975 - 1980
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfacts/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
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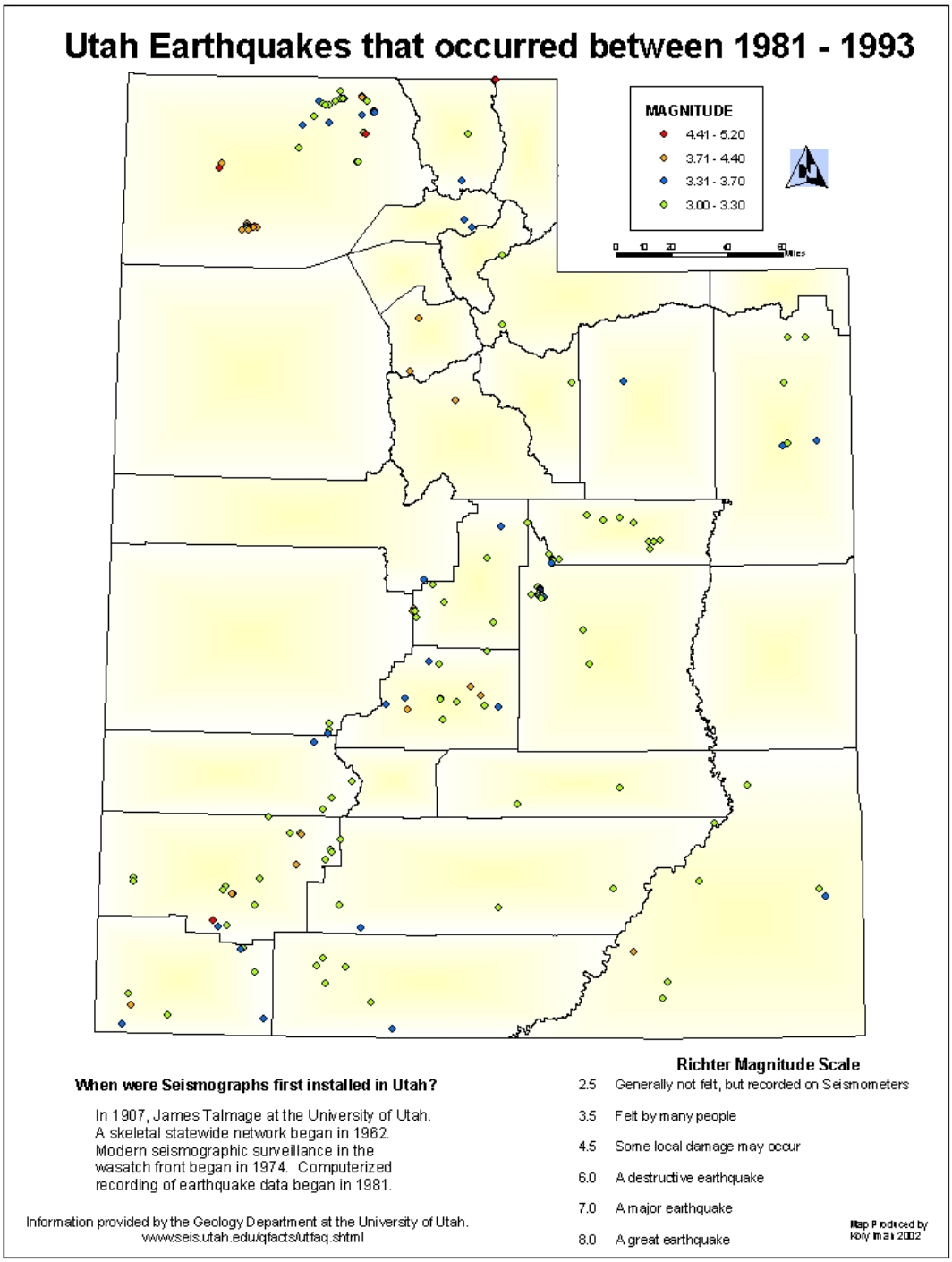
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake
Map Produced by
Kory Imai 2002
Data Produced by AGRC

Map I-3


Utah Earthquakes that occurred between 1981 - 1993
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfacts/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake

Map I-4

Assessing Vulnerability by Jurisdiction

> ***[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events…***

County vulnerability ranking is solely based on the total building related economic loss that would occur from a 2500-year seismic event in each county.

1. Salt Lake
2. Utah
3. Davis
4. Weber
5. Washington
6. Cache
7. Summit
8. Tooele
9. Box Elder
10. Iron
11. Uintah
12. Carbon
13. Sanpete
14. Sevier
15. Wasatch
16. Duchesne
17. San Juan
18. Millard
19. Emery
20. Grand
21. Kane
22. Garfield
23. Juab
24. Morgan
25. Beaver
26. Rich
27. Wayne
28. Piute
29. Daggett

Estimating Potential Losses by Jurisdiction

> ***[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…***

HAZUS MH, a model developed by FEMA to replicate earthquake loss, was used to estimate vulnerability. HAZUS MH was used to model ground-shaking levels with a 2500-year return period for each county. Compiled in table I-11 are some of the more pertinent loss values, from the HAZUS MH runs.

Table I-11 County Earthquake Loss Value from HAZUS MH

County Name	Building Related Economic Losses Residential in Millions	Building Related Economic Losses Non-Residential in Millions	Total Casualties Estimates for 2AM	Fatalities 2AM	Total Building Related Economic Losses in Millions
Beaver	$56.63	$14.08	51	2	$70.71
Box Elder	$413.68	$134.7	514	25	$548.37
Cache	$641	$340.27	816	39	$981.26
Carbon	$121.15	$46.2	3	0	$167.35
Daggett	$6.38	$0.67	2	0	$7.06
Davis	$3,009.21	$1,036.15	3680	183	$4,045.36
Duchesne	$40.56	$11.52	35	1	$52.09
Emery	$78.24	$25.43	88	3	$103.67
Garfield	$65.97	$40.51	54	2	$106.48

County Name	Building Related Economic Losses Residential in Millions	Building Related Economic Losses Non-Residential in Millions	Total Casualties Estimates for 2AM	Fatalities 2AM	Total Building Related Economic Losses in Millions
Grand	$14.16	$6.84	1	0	$21
Iron	$349.54	$139.43	370	17	$488.96
Juab	$45.03	$25.96	54	3	$70.98
Kane	$41.75	$17.29	34	1	$59.04
Millard	$46.69	$21.5	48	2	$68.19
Morgan	$38.7	$20.4	41	2	$59.09
Piute	$18.31	$5.48	15	1	$23.78
Rich	$34.05	$3.36	14	1	$37.41
Salt Lake	$12,978.45	$7,252.62	15310	756	$20,231.07
San Juan	$10.18	$2.38	8	0	$12.57
Sanpete	$132.25	$87.6	153	7	$181.49
Sevier	$124.92	$50.91	127	5	$175.83
Summit	$374.94	$136.76	209	10	$511.7
Tooele	$236.74	$76.01	258	11	$312.75
Uintah	$72.38	$33.42	60	2	$105.8
Utah	$3,491.86	$1,568.72	168	11	$5,060.58
Wasatch	$96.68	$33.23	75	3	$129.91
Washington	$613.58	$279.54	621	25	$893.12
Wayne	$13.31	$3.54	8	0	$16.85
Weber	$2,451.35	$1,004.53	2957	149	$3,455.87
Total	$25,617.69	$12,419.05	25774	1261	$37,998.34

Assessing Vulnerability by State Facilities

> [The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

When assessing the vulnerability of state owned facilities, or all facilities for that matter, an understanding of the building code, to which the building was designed, is of extreme importance. Utah building codes began to address seismic design as early as 1976 although the state did not adopt building codes fully addressing seismic safety until 1989. It is a fairly safe assumption that buildings constructed prior to 1976 will not perform in an earthquake as well as those building constructed following 1976. An increased understanding of seismic events coupled with advances in building design has greatly increased our ability to design and construct buildings, which perform better in earthquakes. Safer buildings are a result of scientific gains in the fields of geoscience and structural engineering, being accepted and put in practice through building codes. Thus, buildings constructed today will have a superior performance in an earthquake than those constructed in the past.

Earthquakes are regional hazards effecting multi-county areas, and because almost the entire state could experience a seismic event, all of the state owned buildings exhibit

some degree of risk due to the event. The degree of risk is determined by several factors none more important than the likelihood and potential magnitude of the earthquake, although when discussing potential building damage regardless of location, building design is a key factor. Vulnerability of state owned facilities was determined through age of construction with those buildings built before 1976 considered having a higher risk. Shown in table E-3 is the number of state buildings in each county built prior to1976 and those built post 1976.

Table I-12 Number of State Owned Facilities per County Built pre and post 1976

County Name	Number of state owned buildings consider high risk pre 1976 construction date	Number of state owned buildings consider to have a lower risk post 1976 construction date
Beaver	17	27
Box Elder	53	71
Cache	245	270
Carbon	54	82
Daggett	10	19
Davis	74	136
Duchesne	29	64
Emery	34	51
Garfield	28	32
Grand	29	37
Iron	57	127
Juab	17	45
Kane	17	37
Millard	24	56
Morgan	22	36
Piute	9	16
Rich	14	26
Salt Lake	571	924
San Juan	29	77
Sanpete	38	125
Sevier	36	74
Summit	17	96
Tooele	23	64
Uintah	42	71
Utah	165	279
Wasatch	38	102
Washington	39	112
Wayne	20	14
Weber	151	147
Total	1,902	3217

Estimating Potential Losses by State Facilities

[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

To estimate the potential losses a seismic event would cause to state owned facilities, age of construction was again a central element. This time the construction date of a building was utilized to determine the value or expected damage as based on the building's insured value. To determine the value of vulnerable state-owned facilities, the state-owned building database was queried to identify the number of buildings, age of building construction, and insured value of those buildings for each county. The insured value was then used to determine estimated building damage that would result from an event with ground motion of 0.25 and 0.55 PGA. Loss estimation tables from FEMA publication 386-2 "Understanding Your Risk - identifying hazards and estimating losses" were utilized to obtain the percentage of damage expected at the two different PGA values. Rather than determine the building type of all 5119 state-owned facilities the values in Table E-4 are for reinforced masonry structures. We assumed moderate building code construction for those structures built after 1976 and pre-code construction for those structures build before 1976. Values in table E-4, assume damage estimates of 3.9 and 12.4 percent at 0.25 PGA and 27.7 and 53.1 at 0.55 PGA. Content values were not figured into table I-13, as they are most likely included in the insured value. This may have slightly increased the expected damage because as a rule content valued is one half of the expected building damage.

For example, building damage for pre-code construction with a ground motion event of 0.55 PGA has an estimated percent damage of 53.1. One would estimate that the contents damage would be 26.55 percent of the building's replacement value.

Table I-13 Potential Damage to State Owned Facilities

County Name	Insured value	Expected building damage at 0.25 PGA (g)	Expected building damage at 0.55 PGA (g)
Beaver	$26,371,416	$ 1,028,485.22	$ 7,304,882.23
Pre 1976	$13,328,034	$1,652,676.22	$7,077,186.05
Box Elder	$75,837,338	$2,957,656.18	$21,006,942.63
Pre 1976	$135,870,891	$16,847,990.48	$72,147,443.12
Cache	$371,855,177	$14,502,351.90	$103,003,884.03
Pre 1976	$630,778,131	$78,216,488.24	$334,943,187.56
Carbon	$4,068,120	$158,656.68	$1,126,869.24
Pre 1976	$83,112,148	$10,305,906.35	$44,132,550.59
Daggett	$5,034,836	$196,358.60	$1,394,649.57
Pre 1976	$4,068,120	$504,446.88	$2,160,171.72
Davis	$366,764,486	$14,303,814.95	$101,593,762.62
Pre 1976	$473,752,182	$58,745,270.57	$251,562,408.64
Duchesne	$34,473,051	$1,344,448.99	$9,549,035.13
Pre 1976	$67,816,647	$8,409,264.23	$36,010,639.56

County Name	Insured value	Expected building damage at 0.25 PGA (g)	Expected building damage at 0.55 PGA (g)
Emery	$33,360,826	$1,301,072.21	$9,240,948.80
Pre 1976	$35,387,341	$4,388,030.28	$18,790,678.07
Garfield	$19,465,471	$759,153.37	$5,391,935.47
Pre 1976	$17,178,095	$2,130,083.78	$9,121,568.45
Grand	$15,553,531	$606,587.71	$4,308,328.09
Pre 1976	$22,634,276	$2,806,650.22	$12,018,800.56
Iron	$199,172,583	$7,767,730.74	$55,170,805.49
Pre 1976	$110,866,683	$13,747,468.69	$58,870,208.67
Juab	$40,790,927	$1,590,846.15	$11,299,086.78
Pre 1976	$6,999,201	$867,900.92	$3,716,575.73
Kane	$20,349,221	$793,619.62	$5,636,734.22
Pre 1976	$15,707,794	$1,947,766.46	$8,340,838.61
Millard	$65,663,568	$2,560,879.15	$18,188,808.34
Pre 1976	$21,777,721	$2,700,437.40	$11,563,969.85
Morgan	$15,202,016	$592,878.62	$4,210,958.43
Pre 1976	$15,632,939	$1,938,484.44	$8,301,090.61
Piute	$3,878,328	$151,254.79	$1,074,296.86
Pre 1976	$9,939,684	$1,232,520.82	$5,277,972.20
Rich	$5,407,528	$210,893.59	$1,497,885.26
Pre 1976	$7,546,201	$935,728.92	$4,007,032.73
Salt Lake	$2,681,862,908	$104,592,653.41	$742,876,025.52
Pre 1976	$2,363,165,497	$293,032,521.63	$1,254,840,878.91
San Juan	$42,398,548	$1,653,543.37	$11,744,397.80
Pre 1976	$48,655,744	$6,033,312.26	$25,836,200.06
Sanpete	$171,819,118	$6,700,945.60	$47,593,895.69
Pre 1976	$45,630,073	$5,658,129.05	$24,229,568.76
Sevier	$71,018,002	$2,769,702.08	$19,671,986.55
Pre 1976	$40,432,040	$5,013,572.96	$21,469,413.24
Summit	$158,254,746	$6,171,935.09	$43,836,564.64
Pre 1976	$7,114,282	$882,170.97	$3,777,683.74
Tooele	$80,451,484	$3,137,607.88	$22,285,061.07
Pre 1976	$80,169,143	$9,940,973.73	$42,569,814.93
Uintah	$71,050,468	$2,770,968.25	$19,680,979.64
Pre 1976	$46,996,482	$5,827,563.77	$24,955,131.94
Utah	$869,253,106	$33,900,871.13	$240,783,110.36
Pre 1976	$566,049,306	$70,190,113.94	$300,572,181.49
Wasatch	$43,178,642	$1,683,967.04	$11,960,483.83
Pre 1976	$35,694,869	$4,426,163.76	$18,953,975.44
Washington	$291,174,090	$11,355,789.51	$80,655,222.93
Pre 1976	$89,817,438	$11,137,362.31	$47,693,059.58
Wayne	$2,105,608	$82,118.71	$583,253.42
Pre 1976	$8,099,647	$1,004,356.23	$4,300,912.56
Weber	$338,871,627	$13,215,993.45	$93,867,440.68
Pre 1976	$643,544,568	$79,799,526.43	$341,722,165.61
Total	$11,772,451,947	$939,185,665.98	$4,695,501,544.28

Damage estimates utilized tables from FEMA 386-2. Values following the county name are for buildings constructed post 1976.

Flooding

Profiling Hazard Event

The risk assessment shall include an overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

Flooding is a temporary overflow of water onto lands not normally inundated by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss, and interruption of business. Floods also increase the likelihood of hazard such as transportation accidents, contamination of water supplies, and health risk increase after a flooding event.

Several factors determine the severity of floods including rainfall intensity, duration and rapid snowmelt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having, impermeable surfaces such as large parking lots, paved roadways, or post burned areas with hydrophobic soils. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs during a particular season or in regions where annual flooding is due to spring melting of winter snow pack, areas at risk may be inundated nearly every year.

Utah, in recent years has seen a new kind of flood risk emerge, that of canal failures and flooding and debris flows related to watersheds damaged by wildfire. This type of flooding is distinctly different from the floods normally dealt with. As Utah continues the move from rural predominantly farmland to urban areas large amounts of land traditionally used for framing is being converted to residential development. This development, occurring in a patchwork fashion, is leaving irrigation canals in place to transport water to undeveloped farms. This is placing residential development near and often below un-engineered irrigation canals. Irrigation canals have a history of breaching, yet development pressure has now put homes at the base of many of these canals.

Post fire related flooding results from enhanced runoff from fire damaged watershed. As fires burn they destroy vegetation and often leave soils in a hydrophobic state, this alters the hydrology of the watershed, producing greater peak flows. It takes the human built environment to turn a natural event into a natural disaster. Development on the foothill all along the Wasatch Front is occurring, at rapid rates. Foothill property is considered prime real estate and is more often than not in URWIN areas on step slopes. This serious

problem of debris flows and the elevated risk of debris flow following a wildfire; is discussed further in the landslide section.

Conditions which my exacerbate floods

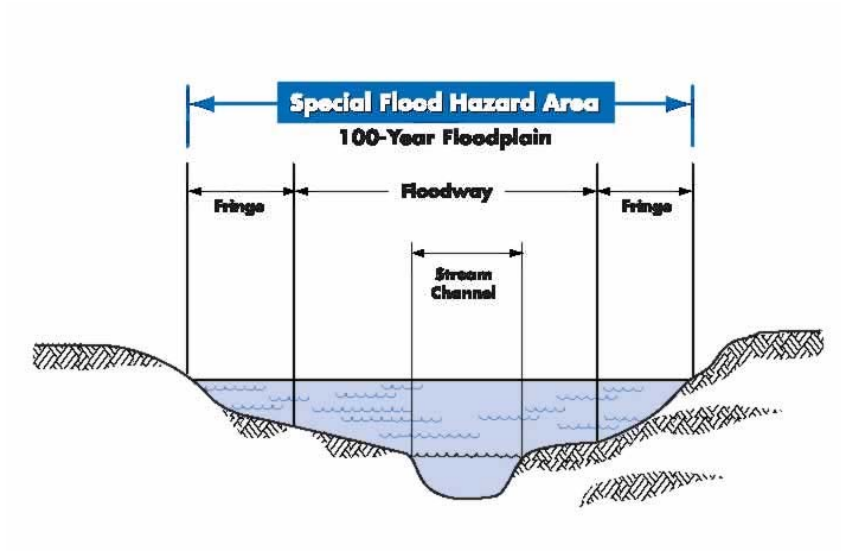
Impermeable surfaces	Debris
Steeply sloped watersheds	Contamination
Constrictions	Soil saturation
Obstructions	Velocity

Source: http://www.fema.gov/nfip

Explanation of Common Flood Terms

FIRM: Flood Insurance Rate Map

Fringe:
The portion of the 1-percent-annual-chance (100 year) floodplain that is not within the regulatory floodway and in which development and other forms of encroachment may be permitted under certain circumstances.



Stream Channel:
A naturally or artificially created open conduit that periodically or continuously contains moving water or which form a connecting link between two bodies of water

100-year flood: Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100-year-flood is also referred to as the base flood.

Base Flood: Is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

Special Flood Hazard Area (SFHA): Is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

Flood Recurrence	Chance of occurrence in any given year
10 year	10%
50 year	2%
100 year	1%
500 year	0.20%

Floodway: Is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising that water surface elevation by more than one foot.

Major Floods in Utah

Major floods are those that are extensive and have large recurrence intervals (greater than 25 years). These major events and additional floods of a more local nature are listed chronologically in Table F-1. Stream flow records from six stream flow-gauging stations depict major floods in Utah. The selected gauging stations are on streams that represent natural runoff in Utah's principal river basins. Data from the gauging stations are collected, stored, and reported by water year (a water year is the 12-month period from October 1 through September 30 and is identified by the calendar year in which it ends).

Many other floods in Utah have been severe locally and have affected considerably smaller areas than the areas of those floods identified in Table I-14. Some of these local floods have caused substantial loss of life and property damage.

Table I-14 Chronology of major and other memorable floods in Utah, 1884-1988

Flood	Date	Area Affected	Recurrence Interval (in years)	Remarks
Flood	July 4, 1884	Colorado River	>100	Probably snowmelt combined with rainfall
Flood	Aug. 13, 1923	Tributaries to Great Salt Lake between Ogden and Salt Lake City.	Unknown	Locally intense thunderstorms. Deaths, 7; damage, $3,000,000
Flood	Apr. 28-June 11, 1952	Strawberry, upper Price, upper San Rafael, Ogden, Weber, Provo, and Jordan Rivers; Blacksmith Fork, and Spanish Fork; upper Muddy and Chalk Creeks.	25 to >100	Melting of snowpack having maximum-of-record water content for Apr. 1. Disaster declared. Deaths, 2; damage, $8.4 million.
Flood	June 16, 1963	Duchesne River	>100	Dam failure
Flood	June 10-11, 1965	Ashley Creek and other streams between Manila and Vernal and west of Manila.	>100	Three days of intense rainfall on thick snowpack above altitude 9,200 feet. Deaths, 7; damage, $814,000.
Flood	Dec. 6- 7, 1966	Virgin and Santa Clara Rivers.	25 to >100	Four days of light to intense rainfall of as much as 12 inches. Damage, $1.4 million.

Flood	Aug. 1- 2, 1968	Cottonwood Wash and other nearby tributaries to San Juan River.	50 to >100	Locally intense thunderstorms following 11 days of rainfall. Damage, $34,000.
Flood	Sept. 5- 7, 1970	San Juan River and tributaries from McElmo Creek to Chinle Creek.	25 to >100	Record breaking rainfall. Deaths, 2; damage, $700,000.
Flood	Aug. 27, 1972	Vernon Creek	>100	Locally intense thunderstorms.
Flood	Apr. 10- June 25, 1983	Lower Duchesne and Jordan Rivers and tributaries (including Spanish Fork); upper Price, Bear, Sevier, and San Pitch Rivers; Chalk, East Canyon, Trout, and George Creeks; Great Salt Lake and tributaries between Ogden and Salt Lake City.	25 to >100	Rapid melting of snowpack having maximum-of-record water content for June 1. Disaster declared by President. Damage, $621 million.
Flood	Apr. 17- June 20, 1984	White, upper Price, and Fremont Rivers; lower Bear and Sevier Rivers and tributaries; Beaver River; Red Butte Creek; Spanish Fork; Jordan River.	25 to >100	Runoff from greater than average snowpack for Apr. 1 and spring precipitation. Deaths, 1; damage, $41 million.
Flood	May 22, 1984	Sevier Lake	Unknown	Runoff in Sevier River from Nov. 1982 through June 1984 exceeded upstream reservoir capacity; about 1.5 million acre-feet of water conveyed to Sevier Lake. On May 22, 1984 lake reported to be as much as 35 feet deep after being nearly dry since about 1880.
Flood	June 15, 1984	Utah Lake	Unknown	Runoff from greater than normal precipitation since Sept. 1982 increased lake level to 101-year record of 5.46 feet above compromise level on June 15, 1984. Damage, $5.9 million.
Flood	June 3, 1986	Great Salt Lake	Unknown	Large runoff from greater than normal precipitation since Sept. 1982 increased lake level to 140-year record elevation of 4,211.85 feet on June 3, 1986. Damage, $268 million.

FLOODS

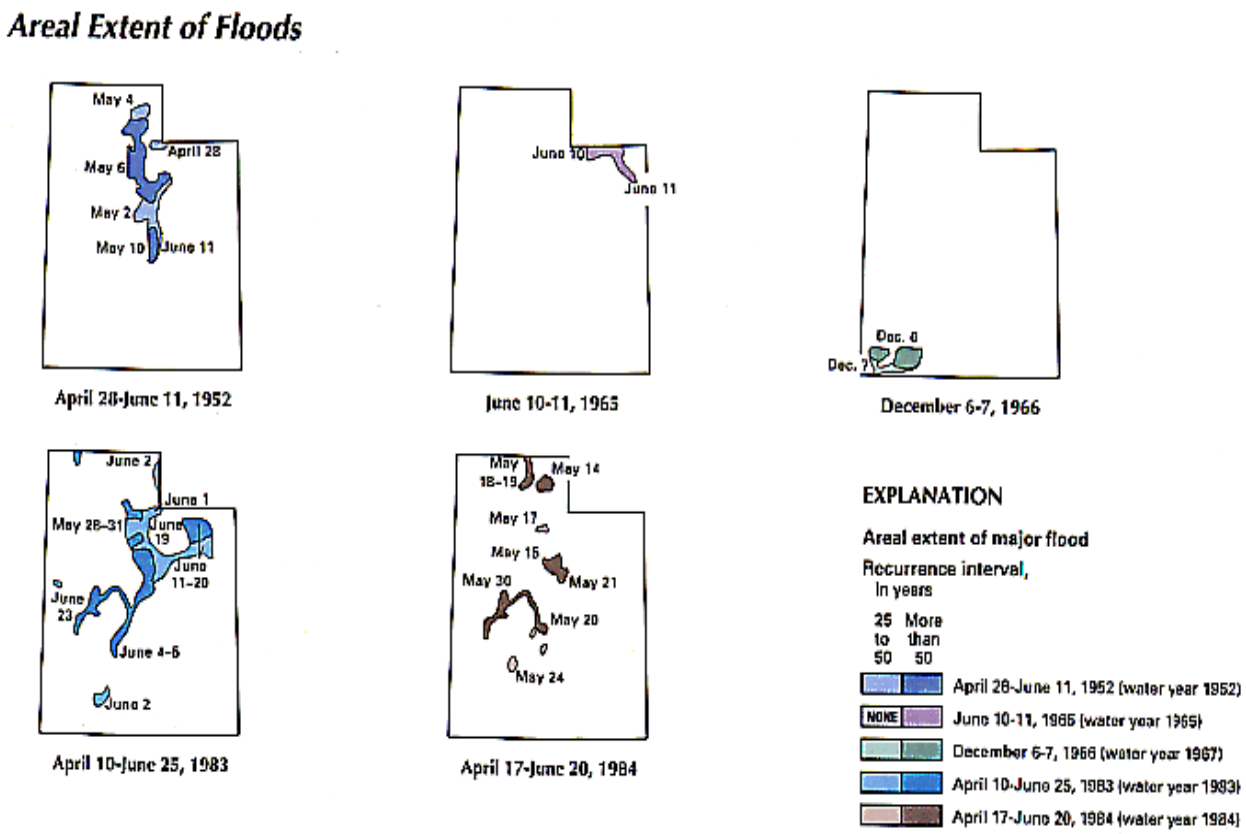


Figure I-10. Aerial Extent of Floods in Utah.

The five major floods of record occurred in 1952,1965, 1966, 1983, and 1984. The aerial extent and severity of these floods are determined from six gauging stations.

The April 28, 1952, flooding on Chalk Creek at Coalville and other flooding during the extensive April 28-June 11, 1952, floods were caused by melting, of maximum-of-record snowpack for April 1 (U.S. Soil Conservation Service, 1983). Flooding was severe in central and north-central Utah (figure I-10), and a flood disaster was declared. Two lives were lost in boating accidents on the swollen Ogden River (Wells, 1957, p. 597-613). Flood damage was $8.4 million, of which $1.9 million was in Salt Lake City.

Rainfall on melting snowpack caused the June 11,1965, flood on Ashley Creek near Vernal and the June 10-11, 1965, floods in northeastern Utah. Flooding also was severe on several other streams in the Uinta Mountains near Vernal and Manila. Areas at altitudes above 9,200 feet contributed most to the flooding. During the flood, the snowline receded from about 9,200 to 9.900 feet. Peak discharges were greater than the discharge expected to recur once in 100 years on Ashley Creek on the southern slope of the Uinta Mountains and on streams on the northern slope. On a creek southwest of

Manila, floodwaters that were the most severe in 40 years swept away and killed seven campers during the night. Within the storm area, flooding caused estimated damage of $814,000 to roads, bridges, irrigation canals, fences, and crops. (Rostvedt and others, 1970, p. E54-E57).

December 6, 1966 (water year 1967), a flood on the Santa Clara River near Pine Valley occurred. A rainstorm during December 3-6 was of unprecedented aerial coverage and intensity for extreme southwestern Utah. Rainfall in the storm area ranged from about 1 to 12 inches. Peak discharges on the Virgin and Santa Clara Rivers and other streams in the storm area had recurrence intervals that exceeded 100 years. Aerial extent of the flooding is shown in Figure F-1. Total damage to crops, fences, roads, bridges, diversion structures, cropland, forestlands, and improvements was about $ 1.4 million (Butler and Mundorff, 1970, p. A-l9).

The floods of April 10-June 25, 1983, affected 22 counties, or more than three-fourths of the State. On April 10, a landslide caused by precipitation dammed the Spanish Fork, which then inundated the community of Thistle. The landslide, which resulted in damage of about $200 million and a Presidential disaster declaration, was the most costly geologic phenomenon in Utah's history (Utah Division of Comprehensive Emergency Management, 1985, p. 40).

Rapid melting of snowpack that had maximum-of-record water content for June 1 (U.S. Soil Conservation Service. 1983) resulted in the largest and most widespread flooding in the State’s history; peak discharges had recurrence intervals that exceeded 100 years on several streams. New discharge records were set on many others, such as Chalk Creek at Coalville. On June 23, the Delta-Melville-Abraham-Deseret Dam on the Sevier River near Delta failed because of the flooding on June 23, 1983, and released 16,000 acre-feet of water down the river. Two bridges were washed away, and the town of Deseret was inundated by as much as 5 feet of water (Utah Division of Comprehensive Emergency Management, 1985, p. 41).

Overall damage from the April 10- June 25, 1983, floods totaled $621 million (Stephens, 1984, p. 20-36). No deaths were attributed to the floods.

The May 24, 1984, flood on the Beaver River near Beaver and other flooding during the April 17- June 20,1984, floods caused damage second in magnitude only to damage in 1983. The major cause of the flooding was much greater than average snowpack and greater than normal precipitation that continued throughout the spring. Peak discharges exceeded those in 1983 at some sites on the White, Bear, Jordan, and Beaver Rivers. Owing to severe flooding in 12 counties, a disaster was declared by the President. On May 14, rainfall caused a mudslide near the coal-mining town of Clearcreek that killed one person and injured another. The direct impact on people was considerably less in 1984 compared to 1983 because of mitigation measures implemented during the previous year. Total damage for floods and landslides was estimated to be $41 million (Utah Division of Comprehensive Emergency Management, 1985, p. 15).

Floods not only can cause direct loss of life and property, but also can adversely affect the use and quality of surface water, resulting in economic and environmental costs that are not apparent until the floodwaters recede. For example, floods transport large quantities of sediment and debris from eroding channels, and then deposit the material on cropland and streets and in homes, reservoirs, and stock ponds. In addition, waterfowl nesting can be disrupted when areas adjacent to lakes become flooded.

Derived from Major floods in Utah is excerpted from Paulson, R.W., Chase, E.B., Roberts, R.S., and Moody, D.W., Compilers, **National Water Summary 1988-89-- Hydrologic Events and Floods and Droughts:** *U.S. Geological Survey Water-Supply Paper 2375, 591 p.*

Assessing Vulnerability by Jurisdiction

> [The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events

Assessing the states vulnerability to flooding in a quantitative matter proved quite problematic. Utah has limited mapped flood plains and with the exception of Salt Lake and Utah Counties floodplain maps have not yet been digitized. Using NFIP statistics provided limited utility in determining flood vulnerability. Much of Utah's flood risk is either not mapped, mapped as Zone D Indicating the flood risk is undetermined, the city or county does not participate in the NFIP, or because people in the state perceive there is not flood risk and do not believe there is a need to purchase flood insurance. Therefore, much of Utah's flood loss goes unreported. Evidence of this can be seen in figure I-11. In almost 25 years, the National Flood Insurance Program as paid out only $4.7 million dollars on 714 claims.

NFIP Flood Insurance Statistics for Utah (1/1/78-12/31/02)	
Policies in-force	2,470
Insurance in-force	$363,437,700
Premiums in-force	$1,105,027
Total losses	714
Total payments	$4,788,328.59

Figure I-11 NIFP Statistics

To determined flood vulnerability for each jurisdiction, the state's floodplain experts were assembled to provide a qualitative vulnerability assessment, classifying each county into a high, medium, or low flood vulnerability rating. Experts included the State Flood Plain Manager, State Hazard Mitigation Officer, the U.S. Army Corps of Engineers, and members of the State Hazard Mitigation Team. Classifications were based on population, in-place flood mitigation, age and accuracy of NFIP maps, dollar amounts of infrastructure values from HAZUS MH, past flood loss, and the potential for future flooding as a result of development pressure. Counties classified as having a Low hazard rating can still and often do experience flooding. This flooding is most often localized doing significant damage to a small number of structures.

High
Salt Lake
Davis
Utah
Summit
Weber
Tooele
Washington

Medium	Wasatch	Sevier
Box Elder	Uintah	Grand
Cache	Sanpete	Iron
Morgan	Carbon	
Low	Juab	Piute
Rich	Millard	Wayne
Daggett	Emery	Garfield
Duchesne	Beaver	San Juan
Kane		

Limited digital data combined with NFIP statistics, which do not adequately represent the true flood vulnerability of Utah, should not be used to underscore the flood risk in Utah. Flooding in Utah is typically localized and just under the threshold of a major disaster. For example on September 12, 2002 intense rainfall triggered multiple debris flows on Dry Mountain in Utah County. These debris flows did significant damage to the City of Santaquin and the unincorporated area of Spring Lake. There was one NFIP policy in the subdivision and fifty homes were affected. On September 9, 2003, San Juan County was rocked by fall rainstorms, which caused flooding along the San Juan River and its tributaries, causing approximately $2 million dollars in damage. Flooding caused basement damage in the spring of 2004 in Weber County when an undersized storm water ditch overflowed its banks. On April 6, 2004 heavy rains caused damage to homes along the Compton Bench areas of Farmington City. These are only some of the events, which occurred over the last two years.

Utah floods are not typical the large multi-day events seen in the Midwest or along the east coast, floods are typically localized events running out of mountain or desert canyons. Individuals feel the pain of flood loss regardless of location, those damaged by flood loss in Utah suffered equal to those flooded along the Mississippi during the 1990's. Past damage shows if FEMA used a cumulative threshold to determined the need for a Presidential declaration chances are Utah would receive one every year, not every ten as the statistics indicate

In the past Utah has received two Presidential declarations for flooding one in 1983 the other in 1984. The lack of Presidentally declared disasters speaks volumes to the nature of Utah's flood vulnerability and to the nature of Utah's "go it alone" philosophy on mitigation. Following the events of 1983-84 an enormous amount of mitigation was installed along the urban areas of the Wasatch Front, which experienced flooding. As an example, Salt Lake County started a county flood control project and pumps were installed on the Great Salt Lake. Today Utah utilizes an advanced water-monitoring network of stream gauges, SNOTEL sites, and automated stream flow gates.

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

Due to the lack of digital floodplain maps it was virtually impossible to conducted a vulnerability analysis, which produced losses by jurisdiction based on dollars amounts of at risk infrastructure. This is something the state desperately wants to correct, and will as floodplain maps are digitized through the Floodplain Map Modernization Program, and as GIS loss estimation tools such as HAZUS MH become more advanced. At this time only two Utah counties have digitized flood plain maps Salt Lake County and Utah County, estimated losses for these counties are listed in Table I-15 and I-16. Understanding dollar losses is vital to performing cost effective mitigation further supporting Utah's number one flood related mitigation goal of modernizing the inventory of floodplain maps.

This plan incorporates and advocates the State "Map Modernization Program Business Case Plan" and the State "Map Modernization Prioritization Plan" as a solution to the abundant problems with the NFIP maps. Together these plan layout an achievable plan to modernize floodplain maps within the state of Utah. The need for updated floodplain maps was the number one issue being, consistently raised by locals throughout the PDM planning process and continues to be the top priority of the State Floodplain Management Program. This ties directly into Utah's inability to estimate flood losses by jurisdiction, because of lack of accurate digital flood maps.

Table I-15 Salt Lake County Estimated 100-Year Flood Plain Losses

City Name	City Area (Acres)	Acres in 100 Year Flood Plain	Number of Structures within 100 Year Floodplain		Population in Hazard Area
			Residential / Replacement Value	Commercial/ Annual Sales	
Alta	2,623	3	0	0	0
Bluffdale	10,543	179	11 / $5,628,290	1 / $100,000	35
Draper	14,187	293	172 / $48,378,260	38 / $22,400,000	550
Herriman	7,744	204	71 / $14,128,210	1 / $300,000	227
Holladay	3,235	43	19 / $14,681,820	25 / $9,600,000	61
Midvale	3,840	32	8 / $654,400	18 / $32,400,000	26
Murray	6,690	170	196 / $30,533,950	61 / $56,100,000	568
Riverton	8,044	361	210 / $43,393,200	11 / $7,400,000	609
Salt Lake City	70,938	2,975	459 / $66,013,850	353 / $941,800,000	1,331
Sandy	14,367	201	141 / $37,322,340	15 / $11,600,000	409
South Jordan	14,150	786	378 / $99,249,270	25 / $11,800,000	1,096
South Salt Lake	4,409	281	165 / $18,299,500	84 / $187,400,000	528
Taylorsville	6,963	141	93 / $22,173,160	2 / $900,000	307
West Jordan	20,448	717	287 / $77,460,590	96 / $153,200,000	947
West Valley	22,808	715	335 / $49,542,360	85 / $588,100,000	1,106
Un-Incorporated	304,953	56,806	861 / $234,634,650	92 / $159,100,000	2,238

Courtesy of WFRC

I-16 Utah County Estimated 100-Year Flood Plain Losses

City	County	Population	Households	Value	Employment
Alpine	Utah	2,970	693	$103,950,000	24
American Fork	Utah	1,407	354	$53,100,000	58
Cedar Hills	Utah	0	0	$0	
Genola	Utah	62	17	$2,550,000	
Highland	Utah	1,042	245	$36,750,000	
Lehi	Utah	3,020	821	$123,150,000	166
Lindon	Utah	1,737	398	$59,700,000	338

Mapleton	Utah	469	115	$17,250,000	
Orem	Utah	633	170	$25,500,000	473
Payson	Utah	1,649	441	$66,150,000	191
Pleasant Grove	Utah	173	40	$6,000,000	
Provo	Utah	8,438	2,409	$361,350,000	1388
Salem	Utah	604	186	$27,900,000	7
Saratoga Springs	Utah	451	123	$18,450,000	
Spanish Fork	Utah	1,157	298	$44,700,000	87
Springville	Utah	834	233	$34,950,000	51
Utah	Utah	1,795	492	$73,800,000	
Vineyard	Utah	48	16	$2,400,000	

Courtesy of Mountainlands AOG

Assessing Vulnerability by State Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

As stated above, without digital floodplain maps it is cost prohibitive to determine which flood zone if any Utah's 5,000 plus state owned facilities are located in. A floodplain study initiated by the State Department of Facilities and Management found no critical facilities owned by the state in the 100-year flood plain. In future versions of the State Hazard Mitigation Plan, it is anticipated the state will utilize digitized floodplain maps to determine and exact dollar loss amount vulnerable to flooding for each state owned facility. However, until maps, are brought into the spatial realm of GIS it will continue to be capital intensive in terms of both financial and human to grasp both the number and dollar value of those buildings in the flood plain.

Estimating Potential Losses by State Facilities

[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

In order to estimated the potential loss Utah could face due to state owned facilities in a flood zone. To have a complete analysis the state needs a database of state owned facilities, which have been assigned a spatial location and digital flood plain maps. Utah currently has neither of these. Through the Flood Map Modernization Program Utah will be receiving digital flood plain maps. To accompany these new maps Utah will digitize the state owned facilities data set, together this will supply Utah with an accurate picture of which state owned facilities are in the flood plain and allow an estimate of potential loss. As maps are completed under the Map Modernization Program they will be incorporated in to future revisions to this mitigation plan.

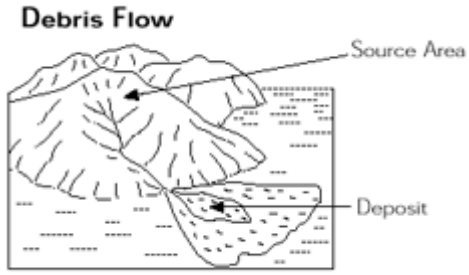
Landslides

Profiling Hazard Event

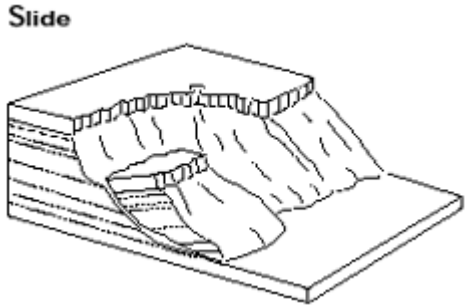
The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

Landslides are a "down slope movement of a mass of rock, earth, or debris". Landslides, often referred to as mass wasting or slope failures, are one of the most common natural disasters. (Cruden 36). Slope failures can vary considerably in shape, rate of movement, extent, and impact on surrounding areas. Slope failures are classified by they're type of movement and type of material. The types of movement are classified as falls, slides, topples, and flows. "The types of material include rock, debris (coarse grained soil) and earth (fine grained soil)" (Eldredge 17). "Types of slope failures then are identified as rock falls, rock slides, debris flows, debris slides, and so on" (Eldredge 17). Slope failures occur because of either an increase in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). "Geology (rock type and structure), topography (slope gradient), water content, vegetative cover, and slope aspect are important factors of slope stability" (Eldredge 18).

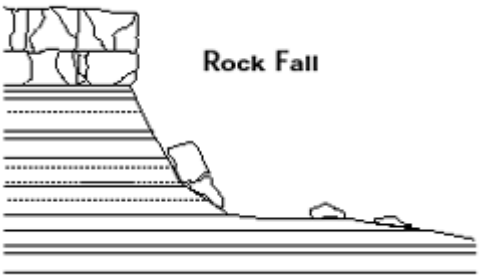
Figure I-12 Three Common Types of Landslides in Utah



Debris flows consist of sediment-water mixtures that flow down a streambed or hillside, commonly depositing sediment at canyon mouths in fan like deposits know as alluvial fans.



Slides are down slope movements of soil or rock on slopes.



Rock falls consist of rock(s) falling from a cliff or cut slope and are very common in the canyon country of southern Utah.

Conditions That Make Slopes More Susceptible to Landslides

- Discontinuities: faults, joints, bedding surfaces.
- Massive materials over soft materials.
- Orientations of dip slope: bedding planes that dip out of slope.
- Loose structure and roundness.
- Adding weight to the head of a slide such as: rain, snow, landslides, mine waste piles, buildings, leaks from pipes, sewers, and canals, construction materials fill materials.
- Ground shaking: earthquakes or vibrations.
- Increase in lateral spread caused by mechanical weathering.
- Removal of lateral support.
- Human activities: cut and fill practices, quarries, mine pits, road cuts, lowering of reservoirs.
- Removing underlying support: under cutting of banks in a river.
- Increase in pore water pressure: snow melt, rain, and irrigation.
- Loss of cohesion.

Landslide History

Nationwide, estimated losses from damaging landslides range from $1.2 to $2.4 billion annually (Schuster, 1996). In Utah, documented losses from damaging landslides in 2001 exceeded $3 million, including the costs to repair and stabilize hillsides along state and federal highway (Ashland, 2003). Total landslide dollar losses are hard to determine for past events because a standard for documenting them does not exist. Several state and local agencies track landslide losses with inconsistent formats often resulting in several different totals for a single event. The recurrent or ongoing movement at very slow rates, of some slides, results in widespread, but typically limited damage. This movement, cumulatively over several years, causes damage. Francis Ashland, of the Utah Geologic Survey discusses landslide damages in Utah as well as the difficulties of accruing accurate post movement loss numbers. His work “The Feasibility of Collecting Accurate Landslide-Loss Data in Utah, Open File Report 410” is found in appendix K of this plan.

Thistle Slide:

In 1983, the town of Thistle was destroyed by floodwaters when the Thistle landslide created a natural dam and subsequent reservoir blocking roads and rail line. The Marysvale branch line, of the railroad was never reopened, leaving a large area of central Utah without rail service. Thistle resulted in Utah's first presidential disaster declaration

and became the most costly landslide in United States history. Three reports have been issued estimating the cost of the landslide between $200 million and $337 million dollars.

Heather Drive Landslide:
In 2001 this landslide destroyed three houses and forced the relocation of three others. Total dollar losses for this event have been estimated various sources between $519,800 and $1,092,000.

Santaquin Mollie Fire Debris Flow:
In August of 2001, the 8,000+ acre Mollie Fire burned an area of the Wasatch Range known as Dry Mountain above the city of Santaquin. The bench development area of Santaquin City is located not more than 50 yards from the edge of the fire perimeter on an alluvial fan. The Mollie wildfire, caused watershed damaged elevated the debris flow risk.

At approximately 6:45 p.m. on Thursday, September 12, 2002, after nearly a week of intense thunderstorms, the charred earth of the ironically named Dry Mountain produced 10 debris flows. These flows did major damage to several houses and resulted in significant clean up costs.

Buckley Draw—Springville Fire:
The Springville fire started on June 30, 2002 at 7:19 p.m. and burned a total of 2,207 acres above dozens of homes. This burned area heightened the debris flow risk to those homes on the alluvial fans below. At the April 29, 2003 neighborhood meeting, the debris flows in Santaquin were contrasted with the conditions at the Buckley Draw. Plans for trench construction were discussed. A flag notification system and evacuation plan was put in place. A web link with updated hazard information, a phone 'hot line' with an updated message, and a notification procedure alerting the Neighborhood Chair of any changes in the hazard level were implemented. A practice evacuation drill was held on Saturday, May 10, 2003.

The 1,500 feet long trench/deflection dike was completed on July 28, 2003, by Provo City in conjunction with the NRCS and their Emergency Watershed Protection program. At approximately 3:00 a.m. on September 10, 2003, four separate debris flows were triggered. The newly finished trench routed the second largest flow. The trench finished "in a nick of time" worked as designed preventing property loss and potentially life loss. It is difficult to predict total amount of damage prevented by the trench, but at a minimum the deflection dike prevented damage equal to its construction cost. The spreader fences in the debris runout field distributed the runoff materials and completely contained this debris flow.

Assessing Vulnerability by Jurisdiction

[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with

Many factors contribute to overall landslides vulnerability; including local weather, soil moisture, duration and intensity of precipitation, wildfire history, and development pressure. County rankings below were accomplished by summing the total acreage of landslides within incorporated cities and towns. This GIS analysis used a digital landslide map compiled by Kimm Harty of landslides both historically active (1847 to present) and prehistoric landslides. This data set also included lateral spreads and shallow landslides (debris flows). Cities and towns as designated by the 2000 Census, were used to represent incorporated areas, this was done because of a large amount of land in Utah is mountainous and contains numerous landslides, but these landslides pose very little risk. Federal land management agencies have jurisdiction over the majority of unincorporated land in Utah's rural counties, thus most contain very little if any vulnerable structures or populations. City and town totals were also used because the majority of the built structures in Utah reside within an incorporated town or city.

This list represents the total acreage of city land in each county with a mapped landslide. So although this is a good indictor of landslide vulnerability total vulnerability depends on how this land is regulated. Large portions of the mapped landslides, utilized in this analysis, were on lands often valued for development. As development pressure mounts total vulnerability will be a function of how cities and counties manage the development on sensitive lands such as those with a known landslide risk.

1. Weber*
2. Davis*
3. Piute
4. Utah*
5. Cache
6. Beaver
7. Wasatch*
8. Summit*
9. Sevier
10. Salt Lake*
11. Wayne
12. Duchesne
13. Garfield
14. Carbon
15. Emery
16. Juab
17. Sanpete
18. Iron*
19. Grand
20. Tooele
21. Millard
22. Uintah
23. Kane
24. San Juan
25. Daggett
26. Rich
27. Washington*(**)
28. Box Elder
29. Morgan

The GIS layer utilized to complete the county ranking corresponds with a map compiled by Kimm M. Harty with the Utah Geological and Mineral Survey in 1991.
*Areas where recent landslide losses have occurred.
** Landslides in Washington County have not been fully digitized.

Given the number of variables in predicating landslides Francis Ashland qualitatively identified the following areas of the state as having the highest risk to landslides.
Layton City
Bountiful City
Draper City
Provo City
North Salt Lake
Spanish Fork Canyon
transportation/lifeline corridor

Figure LS-2 Landslide scarp City Creek Canyon, 1998 Courtesy of UGS.

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

Potential landslide losses for each jurisdiction in the state were compiled as part of the seven Pre-Disaster Mitigation plans completed by the seven Associations of Government. These plans are found in appendix I and are on file with the State Division of Emergency Services. The plans determined landslide vulnerability to homes, businesses, roads, power lines, and rail lines.

Assessing Vulnerability by State Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

A state owned facilities data set was created by pulling state owned facilities out of the June 2002 Equifax Business dataset, based on OSHA SIC codes. The new state owned facilities data set was overlaid on top of landslide susceptibility map created by Kimm Harty. Using the "select by theme" feature in ArcView 3.x all of the vulnerable structures intersecting the landslide susceptibility areas were selected. The selected items were then saved as a theme, whose table was joined with the county FIPS codes to determine which structures are in each county.

Table 17 Total Number of State Owned Facilities in Landslide Susceptibility Areas

County	Total Vulnerable Structures
Beaver	96

Box Elder	0
Cache	0
Carbon	0
Daggett	5
Davis	42
Duchesne	0
Emery	0
Garfield	0
Grand	0
Iron	9
Juab	0
Kane	0
Millard	0
Morgan	0
Piute	0
Rich	1
Salt Lake	1
San Juan	5
Sanpete	0
Sevier	2
Summit	4
Tooele	0
Uintah	0
Utah	3
Wasatch	0
Washington	0
Wayne	0
Weber	96
Total	**264.00**

Estimating Potential Losses by State Facilities

[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

Estimating values for state owned facilities in landslide susceptibility areas was determined by multiplying the average insured value of state owned facilities in each county by the total number of vulnerable building in each county. Average insured value of state facilities per county was provided by State Risk Management a section of the State Department of Administrative Services.

Table 18 Total Insured Value of State Owned Facilities in Landslide Susceptibility Areas

County	Total Vulnerable Structures	Estimated Insured Value
Beaver	96	$84,692,160.00

Box Elder	0	0
Cache	0	0
Carbon	0	0
Daggett	5	$1,569,475.15
Davis	42	$168,103,333.44
Duchesne	0	0
Emery	0	0
Garfield	0	0
Grand	0	0
Iron	9	$15,164,964.09
Juab	0	0
Kane	0	0
Millard	0	0
Morgan	0	0
Piute	0	0
Rich	1	$323,843.23
Salt Lake	1	$3,374,600.94
San Juan	5	$4,295,013.75
Sanpete	0	0
Sevier	2	$2,026,364.40
Summit	4	$5,906,036.72
Tooele	0	0
Uintah	0	0
Utah	3	$9,697,989.27
Wasatch	0	0
Washington	0	0
Wayne	0	0
Weber	96	$316,483,069.44
Total	**264.00**	**$611,636,850.43**

Severe Weather

Profiling Hazard Event

The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

For the purpose of this mitigation plan the term severe weather is used to represent a broad range of weather phenomena which affect Utah:

- Downbursts,
- Lightening,
- Heavy snowstorms,
- Blizzards,
- Avalanches,
- Hail, and
- Tornados.

1999 Salt Lake Tornado

Severe weather event are the most deadly type of natural disaster in Utah. More people have died in avalanches in Utah than by any other natural hazard. Between 1958 and 2003 avalanches killed 70 people, accounting for 47% of all deaths in Utah attributed to natural disasters. Since 1950, lightening has killed 57 people and injured another 139 accounting for 36 % of deaths related to natural disasters.

Downbursts

A downburst is a severe localized wind, blasting from a thunderstorm. The destruction of property may be devastating depending on the size and location of these events. Microbursts, which cover and area less than 2.5 miles in diameter, and macrobursts, which cover an area with a diameter larger 2.5 miles also have a significant impact on property

Lightening

During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightening is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes to great, there is a discharge of electricity that we know as lightning.

Lightening deaths by county from 1950 to present in alphabetical order.

Cache	2	Iron	1	Summit	6
Carbon	2	Juab	2	Tooele	2
Daggett	1	Morgan	1	Uintah	2
Davis	1	Piute	1	Utah	2
Duchesne	4	Rich	1	Wasatch	2
Emery	1	Salt Lake	7	Wayne	1
Garfield	3	San Juan	6	Weber	2
Grand	4	Sanpete	3	**Total**	**57**

Lightening related injuries by county from1950 to present in alphabetical order.

Beaver	2	Grand	3	Tooele	10
Cache	7	Morgan	2	Uintah	3
Carbon	4	Piute	1	Utah	12
Daggett	1	Salt Lake	41	Wasatch	3
Davis	3	San Juan	3	Washington	2
Duchesne	7	Sanpete	1	Wayne	1
Emery	7	Sevier	1	Weber	4
Garfield	6	Summit	13		

Total 139

Heavy Snowstorms

A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to 20° F or lower. All winter storms make driving extremely dangerous.

Blizzards

A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Avalanches

Avalanches are a rapid down-slope movement of snow, ice, and debris. Snow avalanches are a significant mountain hazard in Utah, and nationally account for more deaths each year than earthquakes. Avalanches are the result of snow accumulation on a step slope and can be triggered by ground shaking, sound, or a person. Avalanches consist of a starting zone, a track, and a run-out zone. The starting zone is where the ice or snow breaks loose and starts to slide. The track is the grade or channel down which an avalanche travels. The run-out zone is where an avalanche stops and deposits the snow.

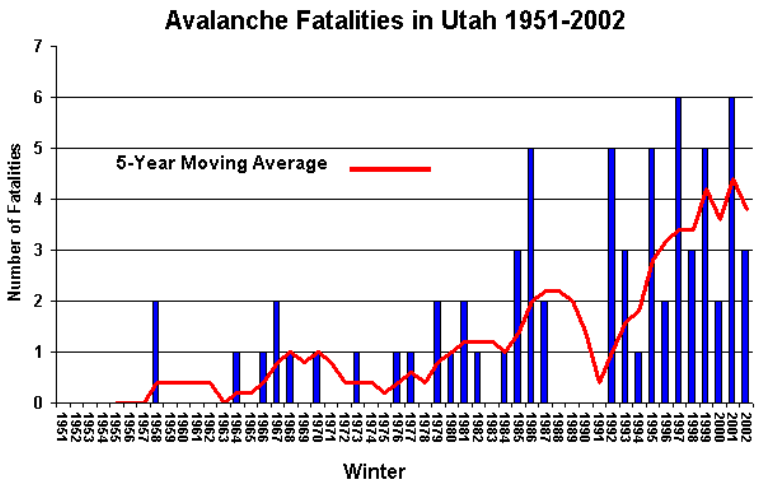
The two main factors affecting avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Additional

factors that contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

Topography plays a vital role avalanche dynamics. Slope angles between 30 to 45 degrees are optimum for avalanches with 38 degrees being the bulls-eye. Slopes with and angle above 45 degrees continually sluff eliminating large accumulation. The risk of avalanches decreases on slope angles below 30 degrees.

Types of Avalanches Common in Utah

Dry or slab avalanches: occur when a cohesive slab of snow fractures as a unit and slides on top of weaker snow, breaking apart as it slides. Slab avalanches occur when additional weight is added quickly to the snow pack, overloading a buried weaker layer. Dry snow avalanches usually travel between 60-80 miles per hour, reaching this speed within 5 seconds of the fracture, resulting in the deadliest form of snow avalanche.



Wet avalanches: occur when percolating water dissolves the bonds between the snow grains in a pre-existing snow pack, this decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour.

Table I-19 Avalanche Fatalities in Utah 1958-2003 by Activity

	Skier	Climber	Snowboarder	Snowmobiler	Recreation	Worker	Resident
1958 Season - Present	35	5	7	9	8	5	1
Past 10 Seasons	17	3	6	9	5	1	1
Past 5 Seasons	5	3	6	7	5	0	0

* Courtesy of the Utah Avalanche Forecast Center, Snow and Avalanches in Utah Annual Report 2002-2003

Hail Storms

Hailstones are large pieces of ice that fall from powerful thunderstorms. Hail forms when strong updrafts within, the convection cell of a cumulonimbus cloud carries water droplets upward causing them to freeze. Once the droplet freezes, it collides with other

liquid droplets that freeze on contact. These rise and fall cycles continue until the hailstone becomes too heavy and falls from the cloud.

Tornados

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornados often occur at the edge of an updraft or within the air coming down from a thunderstorm. Tornadoes can have wind speeds of 250 miles per hour or more, causing a damage zone of 50 miles in length and 1 mile wide. Most tornados have winds less than 112 miles per hour and zones of damage less than 100 feet wide.

Number of observed tornadoes by county in alphabetical order

		Iron	5	Summit	0
Beaver	4	Juab	1	Tooele	5
Box Elder	9	Kane	0	Uintah	5
Cache	4	Millard	3	Utah	8
Carbon	1	Morgan	1	Wasatch	0
Daggett	1	Piute	1	Washington	2
Davis	10	Rich	2	Wayne	7
Duchesne	3	Salt Lake	15	Weber	6
Emery	7	San Juan	0	**Total**	**119***
Garfield	1	Sanpete	9		
Grand	5	Sevier	4		

* Three of the above tornadoes were counted twice because they traveled across county borders. Courtesy of the National Weather Services.

Number of injuries
2 people on July 8, 1989
1 male on August 14, 1968
1 female on April 19, 1970
1 male on April 23, 1990
2 people on June 2, 1993

Number of deaths
1 male on August 11, 1999
1 female was killed on July 6, 1884.

Stated monetary damage by tornadoes:

1,200	June 1, 1955
5,000	June 16, 1955
20,000	June 3, 1963
2,000	August 28, 1964
10,000	April 17, 1966
15,000	November 2, 1967
50,000	August 14, 1968
5,000	May 29, 1987

Plastic cup logged in storefront sign as a result of the August 11, 1999 tornado.

3,000	May29, 1988
25,000	September 17, 1989
500	March 23, 2990
1,500	September 23, 2992
8,000	April 4, 1993
50,000	May 3, 1993
15,000	June 2, 1993
500,000	May 29, 1996
170,000,000+	August 11, 1999
100,000+	September 3, 1999
100,000	May 25, 2000
2,000,000	September 8, 2002
100,000	March 8, 2002
173,011,200+	total

1999 Salt Lake Tornado damage

Utah's strongest Tornadoes

F2	January 22, 1943	Young Ward
F2	June 3, 1963	Bountiful
F2	November 2, 1967	Emery
F2	August 14, 1968	West Weber
F2	May 29, 1987	Lewiston
F3	August 11, 1993	Uinta Mountains
F2	August 11, 1999	Salt Lake City
F2	September 8, 2002	Manti

Waterspout

Waterspouts are simply tornadoes that form over warm water. This typically occurs in Utah during a cold fall or late winter storms.

Scale

Tornadoes are classified by wind damage using the Fujita Scale. The National Weather Service has used the Fujita Scale since 1973. This scale uses numbers from 0 through 5 with higher numbers assigned based on the amount and type of wind damage.

Table I-20 Fujita Scale

Category F0	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lowers limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado	Severe damage. Roofs and some walls torn

	(158-206 mph)	off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobiles-size missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Assessing Vulnerability by Jurisdiction

[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events…

Assessing vulnerability and determining which counties if any are more vulnerable to the hazards grouped as severe weather is very problematic. Using the principle of the past being the key to the future is somewhat useful. For example, Salt Lake County has had the largest number of deaths attributed to lightening, one could assume, that this trend will continue into the future. Yet, this is not a certainty. Know one knows were the next bolt of lightening will strike. Additionally, Salt Lake County contains the states largest population, which has little to do with the higher number of fatalities. San Juan County has the next largest number of fatalities due to lightening and is one of Utah's least populated counties. 23 of Utah's 29 counties have experienced a lightening death, 25 of 29 counties have experienced a tornado, and all 29 counties have experienced hailstorms, blizzard, heavy snow, and downbursts.

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

It is virtually impossible to estimate potential losses by jurisdiction for the phenomena grouped into severe weather. Several factors limit determining potential losses they include:

- Lack of research on location
- Most hazards are tied to weather and can not be predicted with a location
- Limited GIS data available for the single map able hazards of avalanche,
- The entire state shares the nearly the same risk

Severe weather hazards can do extensive damage to property and crops, but with the exception of avalanche can occur at almost any time in any area of the state.

Avalanches typically occur on snow-loaded slopes between 30 and 45 degrees with 38 degrees being the optimum slope angle for avalanches. Avalanches typically do very little property damage as the often occur in forested or alpine areas outside of the human built environment. Yet, numerous residents of the state are still killed each year by avalanches, and the cost of search and rescue or body recovery is burdening county governments, typically tasked with the search and rescue effort.

When considering dollar losses as a function of potential losses and thus jurisdictional vulnerability, a key variable is the value of the human built environment and population. Therefore, the more populous counties along the Wasatch Front would rise to the top, those counties being Salt Lake, Davis, Weber, Tooele, and Utah.

Assessing Vulnerability by State Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

With the exception of avalanche and tornado these hazards typically cause very little damage to state owned facilities. The August 1999 tornado in Salt Lake City tracked just east of the state capitol doing extensive damage to several of the state owned buildings in the capitol complex, breaking windows and downing trees. All of the state owned facilities share an equal risk of being struck by a tornado, or having damage done to them by a severe weather. As with most hazards building codes adopted of late, incorporating advances in science and engineering, have resulted in newer buildings being more resistant to the forces of severe weather.

Very few building exist in known avalanche slide paths and extensive research has found no case were a state owned facility was damaged by an avalanche. Avalanches do periodically block mountain roads limiting access to ski resorts and detouring critical transportation routes.

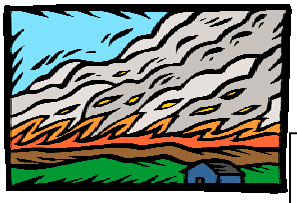
Estimating Potential Losses by State Facilities

[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

As the State of Utah remains vulnerable to severe weather, state-owned facilities are equally at risk to incur damages due to hazard occurrences. However, the state's resources, both monetary and fixed assets, depend heavily upon these facilities and there continuity. Utah has a total of 5,228 state owned facilities with an insured value of 11.8 billion dollars. To some extent all of these state owned facilities are vulnerable to severe weather. The extent to which this risk is present has to do with location, construction type, height, and age. Table I-21, is a list of all state owned facilities in each county and their total insured value.

Table I-21 Total Number of State Owned Facilities per County and Their Insured Value

County Name	Total # of State Owned Buildings	Total insured Value
Beaver	45	$39,699,450.00
Box Elder	122	$211,708,229.00
Cache	516	$1,002,633,308.00
Carbon	136	$145,275,708.00
Daggett	29	$9,102,956.00
Davis	210	$840,516,668.00
Duchesne	93	$102,289,698.00
Emery	85	$73,636,967.00
Garfield	60	$36,643,566.00
Grand	66	$38,187,807.00
Iron	184	$310,039,266.00
Juab	62	$47,790,128.00
Kane	54	$36,057,015.00
Millard	79	$87,441,289.00
Morgan	58	$30,834,955.00
Piute	25	$11,895,352.00
Rich	40	412,953,729.00
Salt Lake	1,495	$5,045,028,405.00
San Juan	106	$91,054,292.00
Sanpete	162	$217,449,191.00
Sevier	110	$111,450,042.00
Summit	112	$165,369,028.00
Tooele	87	$160,620,627.00
Uintah	113	$118,046,950.00
Utah	444	$1,435,302,412.00
Wasatch	140	$78,873,511.00
Washington	151	$380,991,528.00
Wayne	35	$10,205,255.00
Weber	298	$982,416,195.00



Wildfire

Profiling Hazards

The risk assessment shall include an] overview of the location of all natural hazards that can affect the State, including information on previous occurrences of hazard events as well as the probability of future hazard events, using maps where appropriate.

A wildfire is an uncontrolled fire spreading through vegetative fuel often exposing or consuming structures. Wildfires often begin unnoticed and spread quickly and are usually sighted by dense smoke. Wildfires are placed into two classifications Wildland and Urban-Wildland Interface. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. URWIN areas are divided into three subclasses:

- **Occluded interface**
  Occluded interface are those areas of wildlands within an urban area for example a park bordered by urban development such as homes.

- **Intermixed**
  Mixed or intermixed interface areas contain structures scattered throughout rural areas covered predominately by native flammable vegetation.

- **Classic**
  Classic interface areas are those areas where homes press against wildland vegetation along a broad front.

When discussing wildfires it is important to remember that fires are part of a natural process and are needed to maintain a healthy ecosystem. When most of America was wilderness, wildfires burned 10 times the land that is consumed today. Yet, research shows forests were much healthier and hardier then. Wildfire is a natural part of forest ecosystems and is in fact, as necessary as water or sun. Fires cleanse and regenerate forests, giving new life to soil, and providing a new canvas for biodiversity to paint a new picture. Most all forest ecosystem types evolved with fire, and some trees, like the lodgepole pine, depend on the heat of fire to open their seed cones. A study conducted in 1995 found that of 146 threatened and endangered species of plants around the country, 135 benefited from wildland fire.

Three basic elements are needed for a fire to occur (1) a heat source (2) oxygen and (3) fuel. Two of the three sources are readily available throughout Utah. Major ignition sources for wildfire are lightning and human causes such as arson, recreational activities, burning debris, and carelessness with fireworks. On average, 65 percent of all wild fires

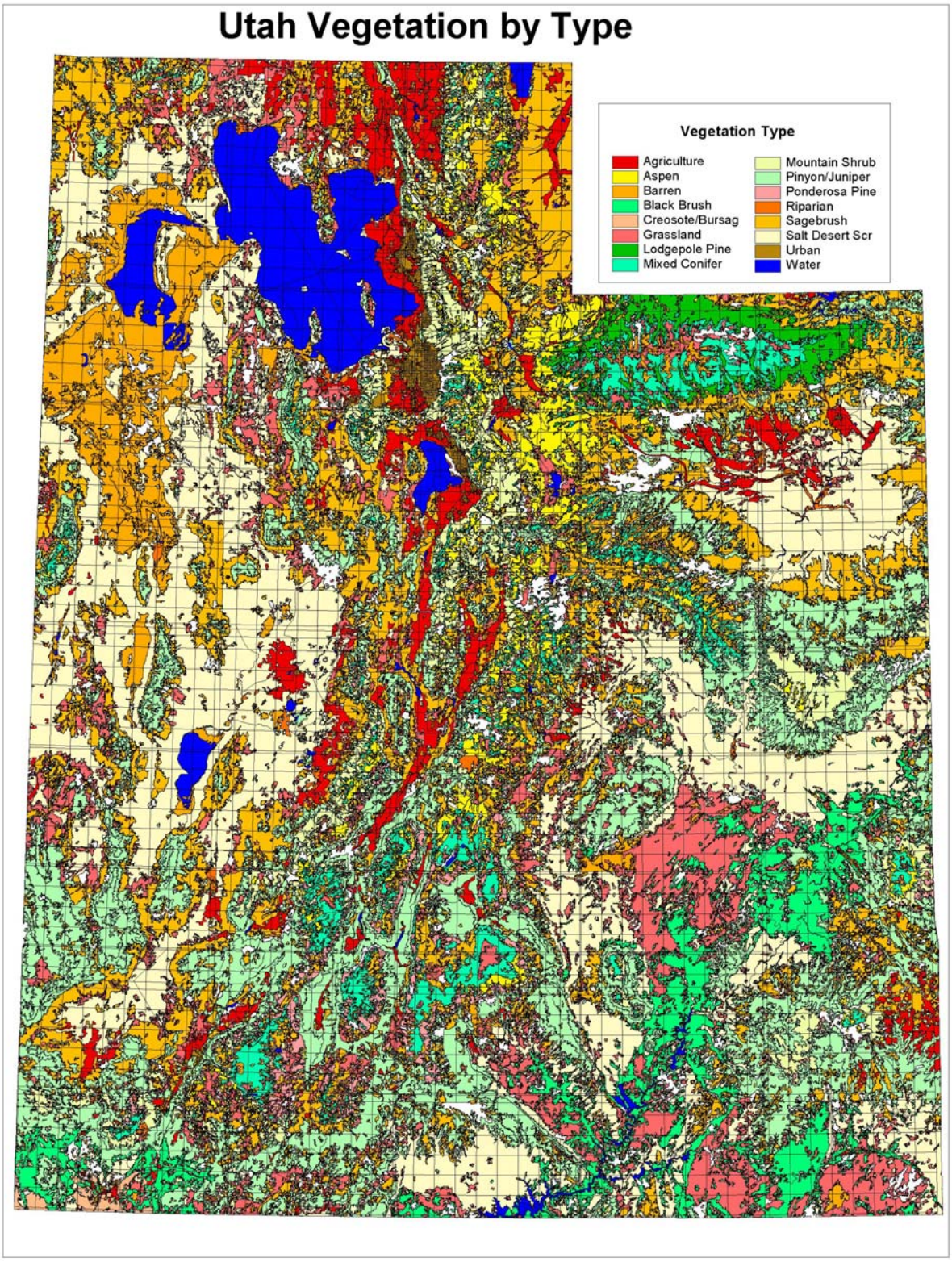
started in Utah can be attributed to human activities. Once a wildfire has started, vegetation, topography and weather are all conditions having an affect wildfire behavior.

Vegetation Within Utah as it Relates to Wildfire

Fuels within Utah are generally conducive to high rates of spread, represented by National Fire Danger Rating System fuel models "L", "K", and "C". Vegetation in with in Utah is broken into the following classifications based on fire hazard potential.

Table I-22 State Vegetation Types Classified by Hazard Rating

Vegetation Types	Description	Hazard Rating
Spruce/Fir, Mountain fir, Spruce Fir/Mountain Shrub, Mountain Fir/Mountain Shrub, Conifer/Aspen, Lodgepole Pine, Juniper, Pinyon/Juniper, Pinyon	High resistance to control, extreme intensity levels resulting in almost complete combustion of vegetation and possible damage to soils and seed sources depending on slope, rates of spread, wind speed and fuel loading.	EXTREME
Mountain Mahogany, Oak, Maple, Mountain Shrub, Sagebrush, Sagebrush/Perennial Grass, Salt Desert Scrub, Black Brush, Creosote/Bursage, Grease Wood, Ponderosa Pine/Mountain Shrub.	Moderate to high resistance to control, high to moderate intensity levels resulting in high to moderate damage to resources depending on slope, rates of spread, wind speed, and fuel loading.	HIGH
Ponderosa Pine, Grassland, Alpine, Dry Meadow, Desert Grassland	Moderate to low resistance to control, fire intensity levels would generally be low with moderate damage to resource values depending on slope, rates of spread, wind speed, fuel loading.	MODERATE
Aspen, Mountain Riparian, Lowland Riparian, Wet Meadow, Wetland	Low to moderate resistance to control, fire intensity levels would generally be low, little threat to human values and potentially beneficial to resource values depending on slope, rates of spread, wind speed, and fuel loading.	LOW


Utah Vegetation by Type
Vegetation Type
Agriculture
Aspen
Barren
Black Brush
Creosote/Bursag
Grassland
Lodgepole Pine
Mixed Conifer
Mountain Shrub
Pinyon/Juniper
Ponderosa Pine
Riparian
Sagebrush
Salt Desert Scr
Urban
Water

Map I-5

Development and Wildfire

Throughout the United States it is more and more common to see homes and other types of structures in wildland environments. This trend is greatly expanding wildland/urban interface areas, continually placing more and more structures in areas with large amounts of natural vegetation. Because of their location, these structures are extremely vulnerable to fire should a wildland fire occur in the surrounding area. Expansion into wildland areas also places wildland areas at risk, by increasing the number of ignition sources. The importance these wild areas have continues to grow with each passing year. The population of the Wasatch Front depends on water from our mountains and a wildfire can greatly impact the watershed.

Wildfire is a natural part of the ecosystems in Utah. Many of the grass, brush and tree species found in Utah have evolved with fire. Many of Utah's urban/wildland interface areas are located in our most fire prone wildland fuels. Generally, these fuels are found on drier, lower elevation sites, often very desirable for real estate development.

Families are moving into the Utah's countryside, just like they are all over the United States. They are building homes and associated buildings all through Utah's rural areas. People who live in urban areas want to "get away" from it all, even if it is only for the weekend. Developers are busy meeting their needs via summer home developments, recreational developments and other means. Use of fire prone wildland areas for homes and major recreational facilities create various threats: loss of life, homes, personal possessions, and natural resources.

Wildfire History

In 2003, Utah's most current fire season, Utah was lucky. Early spring rains promoted grass growth. Grasses dry out prior to timber and ignite quite easy. This coupled with years of drought and high mortality rates in low elevation timber and shrubs made for prime fire conditions. Even though the 2003 fire season had 635, which burned 115,798 acres things could have been much worse.

2002, was a record year in terms of numbers of wildfires and the cost of wildfire suppression. This is largely a result of the extensive drought in Utah and adjacent states. Fortunately, there have been no serious injuries or fatalities to firefighters or residents of URWIN communities. Utah Forestry Fire and State Lands UFF&SL reports that from January to August 2002, more than 613 fires burned more than 265,902 acres. Suppression costs incurred by the state were near $10 million dollars. Only five states in the nation burned more acreage in 2002 than Utah. Table I-23, details the total number of fires that have occurred in Utah since 1985, number of acres burned, and the total cost to the state of suppressing these fires.

Table I-23 Wildfire History 1985 to 2003

Year	Number of Fires	Acres Burned	Suppression Fund	Total State Cost
1985	443	47,242	Pre-Fund	

Year	Number of Fires	Acres Burned	Suppression Fund	Total State Cost
1986	457	62,042	Pre-Fund	
1987	490	63,648	Pre-Fund	
1988	605	30,819	Pre-Fund	
1989	482	46,617	Pre-Fund	
1990	415	30,093	Pre-Fund	
1991	300	12,029	Pre-Fund	$2,041,369
1992	499	40,025	Pre-Fund	$2,106,927
1993	262	13,949	Pre-Fund	$1,371,793
1994	703	165,670	Pre-Fund	$3,057,815
1995	579	88,139	Pre-Fund	$2,234,507
1996	732	519,669	Pre-Fund	$6,281,902
1997	391	27,665	Pre-Fund	$4,610,890
1998	495	80,058	$237,649	$2,089,295
1999	735	133,353	$659,704	$4,257,522
2000	841	101,924	$1,192,052	$5,268,459
2001	835	94,632	$2,609,010	$5,359,422
2002	613	265,902	$7,176,203	$9,544,574
2003	635	115,798		

Wild fire Statistics courtesy of Utah Forestry, Fire, and State Lands

Between 1984 and 2001 Utah had 9,385 fires of those 53 burned more than 5,000 acres. Listed below are those fires burning more than 5,000 acres. From 1999 to present the state has received federal assistance through the Fire Management Assistance Grant Program FMAGP or Fire Suppression Assistance Grant Program FSA for three wildfires the Mollie wildfire, Mustang Wildfire, and Causey Wildfire. The total federal fire suppression assistance received for the Mollie ($53,687.00) and Mustang wildfires ($282,119.04) was $335,806.04.

Ten Mile
Catle Rock
Topliff
Tekoi
West Mona
Pony Road
Rose Ranch South
Sand Mountain
Railroad Fire (61,009 acres)
Flat Fire
Hogup
Ripple Valley
Dog Valley Wash
Davis Knolls
Milford Bench
Golden Spike
Honey Boy
Indian Reservoir

Round Top
Milford Pass
Fool Creek
Negro Mag
Big Hollow Complex
Wide Canyon
Cedar Packetts Wash
Diamond Peak
North Stansbury Complex
Hansel Valley Mt
Ox Valley-Central
Meadow
Camp Williams
Johnson Canyon
Quincy
Uinta Flats
Sage Valley
Dry Canyon II
Sarah

Fort Ranch
Lava Ridge
Affleck Park
Davis Complex
Desert Mtn
Soldier Pass
Turkey
Antelope Island #2
Hansel Mt-Rattlesnake
Magatsu Complex
Cunningham
Black Rock
Mollie
Beef Hollow
Fort Ranch (35,600 acres)
Mustang

Assessing Vulnerability by Jurisdiction

> ***[The risk assessment shall include] an overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments... The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events…***

Geographic data mapped on the following pages was developed by the US Department of Interior, Bureau of Land Management during March of 2000. It assess wildland fire hazard based on a combination of accumulated values including population density, fire hazard potential and past fire occurrence density. DES simplified the BLM ratings, categorizing them into one of five ratings very low, low, moderate, high, and extreme. Using the Geoprocessing extension within Arc View data for individual counties was clipped from state and queried in ArcView allowing calculations of acreage to be made.

Table I-24 County Wildfire Vulnerability

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Beaver	15	130,088	576,741	951,693
Box Elder	18,143	31,684	139,114	4,116,806
Cache	965	28,076	96,335	624,061
Carbon	3,617	52,536	311,109	581,946
Daggett		67,692	204,401	189,791
Davis	933	17,606	31,088	357,372
Duchesne		10,842	569,861	1,496,416
Emery		13,363	299,881	2,612,917
Garfield	3,221	80,346	844,045	2,404,200
Grand	2,187	102,442	550,666	1,707,455
Iron	22,711	118,431	723,186	1,249,852
Juab	85	160,430	391,656	1,629,077
Kane	26	113,350	535,065	1,980,100
Millard		105,081	307,482	3,956,751
Morgan	2,301	13,650	48,613	325,762
Piute		2,638	191,489	295,296
Rich		2,410	9,971	681,892
Salt Lake	3,254	46,836	58,171	407,856
San Juan	12,186	273,592	829,697	3,958,281
Sanpete		25,521	221,920	777,393
Sevier	11,705	107,647	336,698	772,398
Summit	4,380	43,755	331,454	823,473
Tooele	3,685	228,395	461,334	3,969,466
Uintah		74,927	631,257	2,177,548
Utah	30,549	164,302	307,283	866,813
Wasatch	1,653	47,125	113,867	610,478
Washington	6,115	213,726	598,488	738,083
Wayne			125,150	1,450,008
Weber	5,430	28,709	35,506	351,883

Estimating Potential Losses by Jurisdiction

[The risk assessment shall include an] overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in local risk assessments…

As part of the Multi-Jurisdictional Mitigation plans completed by the seven Associations of Government, city-by-city potential wildfire loss totals were compiled. Electronic Appendix I, contains all seven AOG PDM plans, please review these for a detailed look at city-by-city loss. The potential exists in Utah for fires to cause significant damage to homes and other built infrastructure, to this point Utah has escaped the large devastating wildfires seen by our neighboring states. Yet, fire suppression alone, has become an ongoing and ever increasing cost to state taxpayers.

The ranking below of counties utilizes a total of all high and extreme wildfire risk acreage for all of the cities and town in each county. Because incorporated areas typically house the majority of the human build infrastructure only those areas were summed. This method eliminates the large amount of wildfire acreage classified as extreme or high from the ranking method.

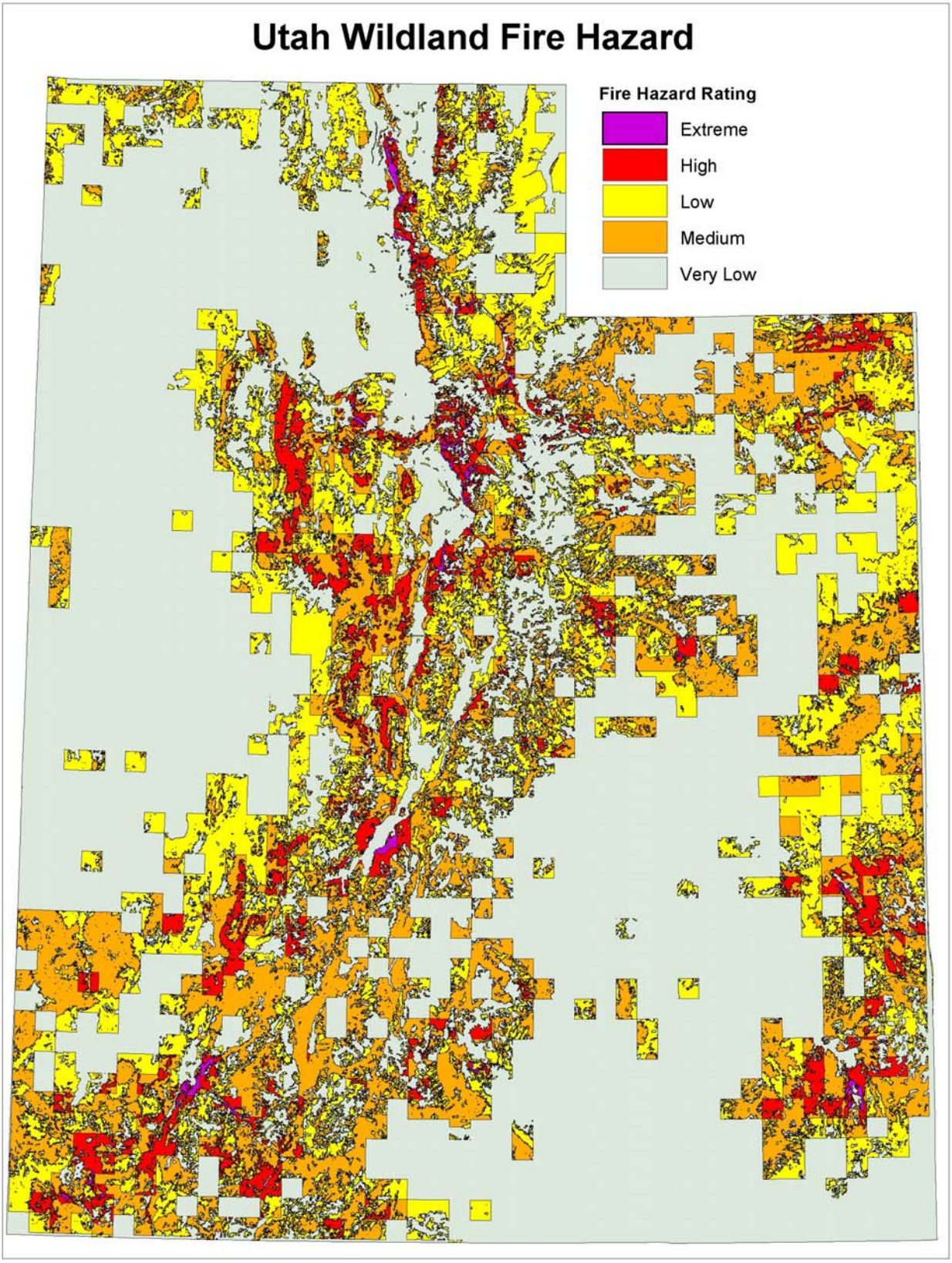
1. Washington
2. Utah
3. Salt Lake
4. San Juan
5. Summit
6. Box Elder
7. Kane
8. Iron
9. Carbon
10. Cache
11. Weber
12. Davis
13. Tooele
14. Garfield
15. Sevier
16. Grand
17. Juab
18. Emery
19. Wasatch
20. Beaver
21. Morgan
22. Rich
23. Sanpete
24. Uintah
25. Daggett
26. Piute
27. Duchesne
28. Wayne
29. Millard

Wildfire Loss Calculations

Calculating structural damage, economic loss, and deaths due to wildfire is difficult as no loss estimation tables or curves exist. FEMA publication 386-2 State and Local Mitigation Planning how-to guide Understanding Your Risks identifying hazards and estimating losses states the following under the determine the extent of damage from wildfires section:

- No loss estimation tables for wildfires
- No standard loss estimation model or table for wildfire damaged content
- No standard displacement time or functional downtime tables for wildfire
- No death or injury curves for wildfires.

Mapping was compiled to illustrate the location of each counties wildfire risk, utilizing the state wildfire risk assessment data (Maps WF-2 through WF-31). This is the same data used in the vulnerability analysis in this plan as well as in the multi-jurisdictional PDM plans assembled by the seven AOG.


Utah Wildland Fire Hazard
Fire Hazard Rating
Extreme
High
Low
Medium
Very Low

Map I-6

Assessing Vulnerability by State Facilities

[The risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in …the State risk assessment. …State owned critical or operated facilities located in the identified hazard areas shall also be addressed…

A state owned facilities data set was created by pulling state owned facilities out of the June 2002 Equifax Business dataset, based on OSHA SIC codes. The new state owned facilities data set was overlaid on top of a state wildfire risk map. The state wildfire risk map was produced as a result of the State Wide Fire Risk Assessment. Using the "select by theme" feature in ArcView 3.x all of the vulnerable structures intersecting the landslide susceptibility areas were selected. The selected items were then saved as a theme, whose table was joined with the county FIPS codes to determine which structures are in each county.

Table I-25 Total Number of State Owned Facilities in Wildfire Risk Areas

County	Total Vulnerable Structures
Beaver	4
Box Elder	1
Cache	0
Carbon	11
Daggett	7
Davis	3
Duchesne	21
Emery	8
Garfield	5
Grand	6
Iron	8
Juab	3
Kane	3
Millard	7
Morgan	0
Piute	0
Rich	2
Salt Lake	4
San Juan	19
Sanpete	2
Sevier	2
Summit	2
Tooele	7
Uintah	0
Utah	4
Wasatch	3
Washington	7
Wayne	0
Weber	4
Total	**143.00**

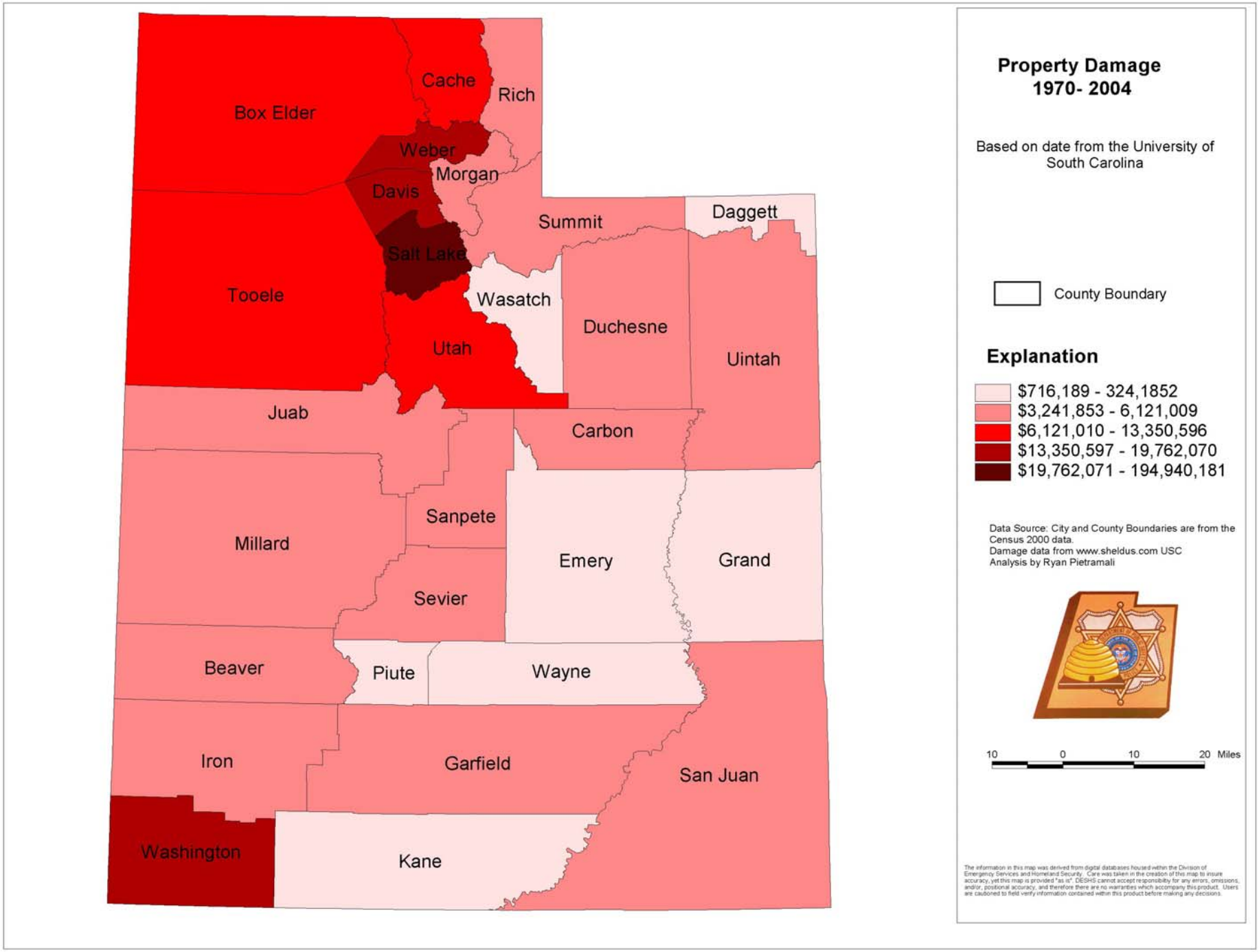
Estimating Potential Losses by State Facilities

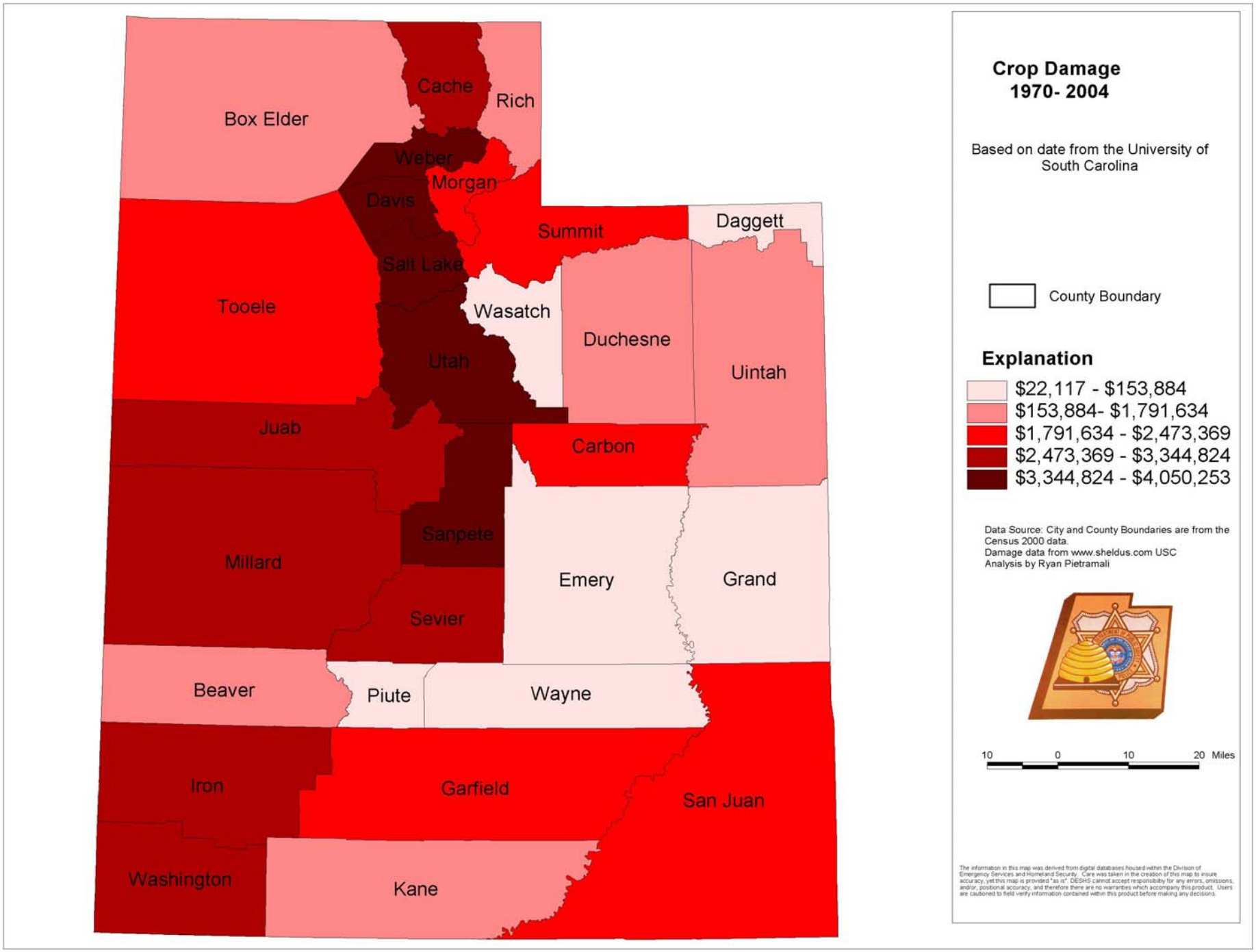
[The risk assessment shall include the following:]…[a]n overview and analysis of potential losses to identified vulnerable structures, based on estimates provided in …the State risk assessment. The State shall estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located

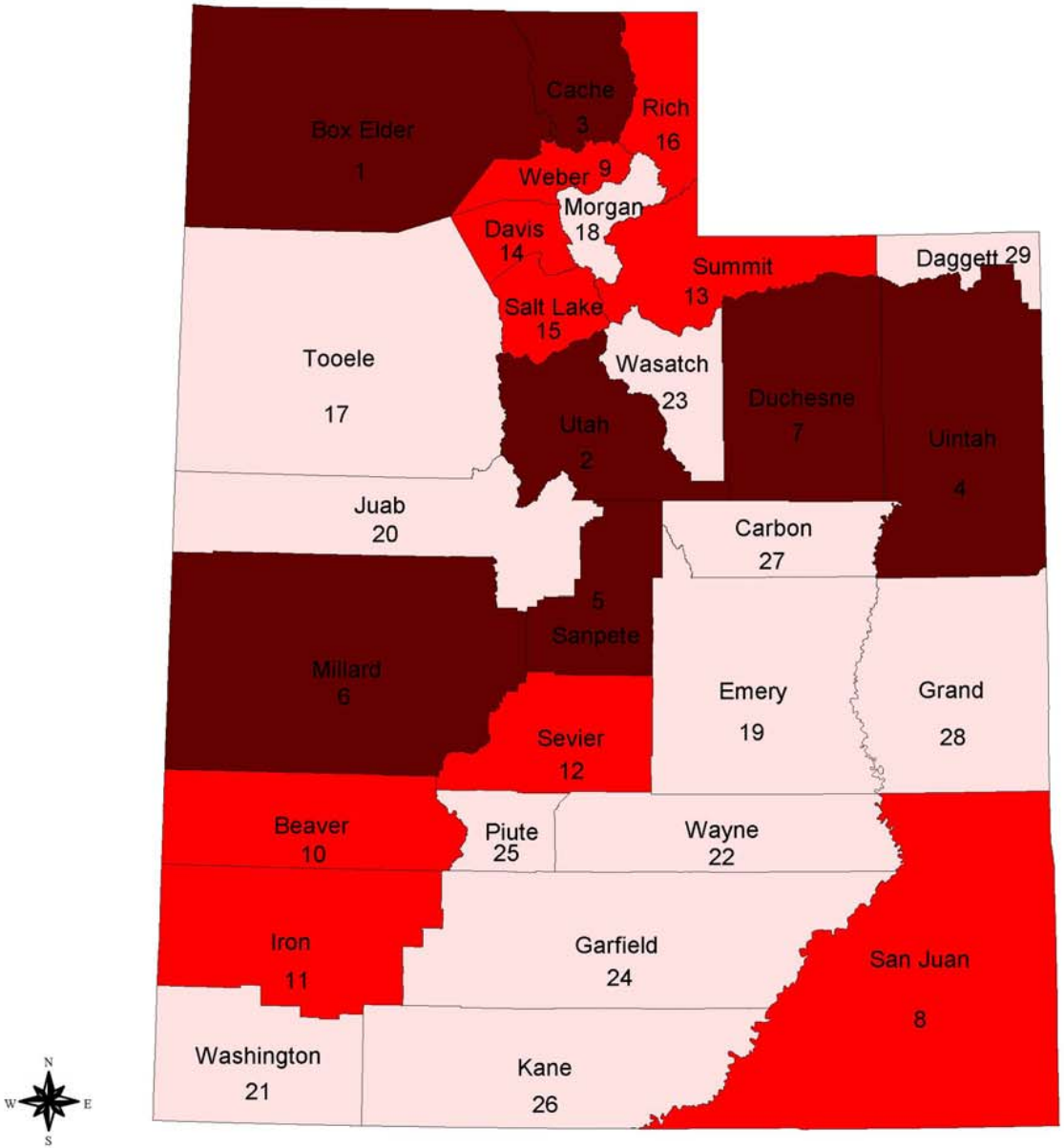
Estimating values for state owned facilities in landslide susceptibility areas was determined by multiplying the average insured value of state owned facilities in each county by the total number of vulnerable building in each county. Average insured value of state facilities per county was provided by State Risk Management a section of the State Department of Administrative Services.

Table I-26 Total Insured Value of State Owned Facilities in Wildfire Risk Areas

County	Total Vulnerable Structures	Estimated Insured Value
Beaver	4	$3,528,840.00
Box Elder	1	$1,735,313.35
Cache	0	0
Carbon	11	$11,750,241.14
Daggett	7	$2,197,265.21
Davis	3	$12,007,380.96
Duchesne	21	$23,097,673.83
Emery	8	$6,930,538.08
Garfield	5	$3,053,630.50
Grand	6	$3,471,618.84
Iron	8	$13,479,968.08
Juab	3	$2,312,425.56
Kane	3	$2,003,167.50
Millard	7	$7,747,962.32
Morgan	0	0
Piute	0	0
Rich	2	$647,686.46
Salt Lake	4	$13,498,403.76
San Juan	19	$16,321,052.25
Sanpete	2	$2,684,557.92
Sevier	2	$2,026,364.40
Summit	2	$2,953,018.36
Tooele	7	$12,923,498.70
Uintah	0	0
Utah	4	$12,930,652.36
Wasatch	3	$1,690,146.66
Washington	7	$17,661,858.90
Wayne	0	0
Weber	4	$13186795
Total	**143.00**	**$189,840,059.70**


Property Damage
1970- 2004
Based on date from the University of South Carolina
County Boundary
Explanation
$716,189 - 324,1852
$3,241,853 - 6,121,009
$6,121,010 - 13,350,596
$13,350,597 - 19,762,070
$19,762,071 - 194,940,181
Data Source: City and County Boundaries are from the Census 2000 data.
Damage data from www.sheldus.com USC
Analysis by Ryan Pietramali
10 0 10 20 Miles
Box Elder
Cache
Rich
Weber
Morgan
Davis
Summit
Daggett
Salt Lake
Tooele
Wasatch
Duchesne
Uintah
Utah
Juab
Carbon
Millard
Sanpete
Emery
Grand
Sevier
Beaver
Piute
Wayne
Iron
Garfield
San Juan
Washington
Kane


Box Elder
Cache
Rich
Weber
Morgan
Davis
Summit
Daggett
Salt Lake
Tooele
Wasatch
Duchesne
Utah
Uintah
Juab
Carbon
Sanpete
Millard
Emery
Grand
Sevier
Beaver
Piute
Wayne
Iron
Garfield
San Juan
Washington
Kane
Crop Damage
1970- 2004
Based on date from the University of South Carolina
County Boundary
Explanation
$22,117 - $153,884
$153,884- $1,791,634
$1,791,634 - $2,473,369
$2,473,369 - $3,344,824
$3,344,824 - $4,050,253
Data Source: City and County Boundaries are from the Census 2000 data.
Damage data from www.sheldus.com USC
Analysis by Ryan Pietramali
10 0 10 20 Miles



Drought Vulnerability & Rank

Drought vulnerability is estimated normalizing and summing the following per county statistics total agriculture receipts, amount of land in acres utilized for agriculture, number of farms, and personnel income from farming.

County Boundary

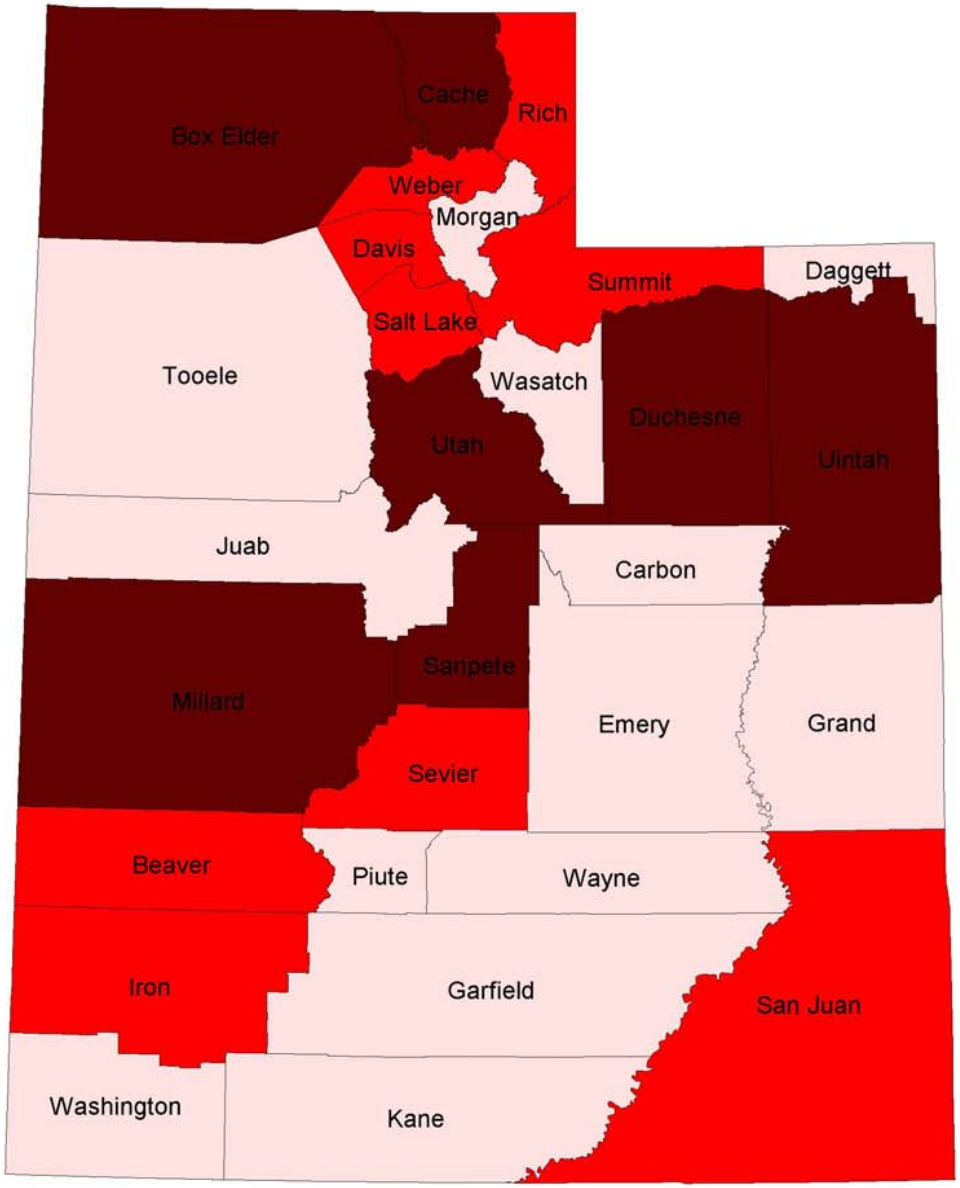
Explanation

Low
Medium
High

Data Source: City and County Boundaries are from the Census 2000 data.
2003 Economic Report to the Governor
Analysis by Ryan Pietramali

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Drought Vulnerability

Drought vulnerability is estimated normalizing and summing the following per county statistics total agriculture receipts, amount of land in acres utilized for agriculture, number of farms, and personnel income from farming.

County Boundary

Explanation

Low
Medium
High

Data Source: City and County Boundaries are from the Census 2000 data.
2003 Economic Report to the Governor
Analysis by Ryan Pietramali

10 0 10 20 Miles

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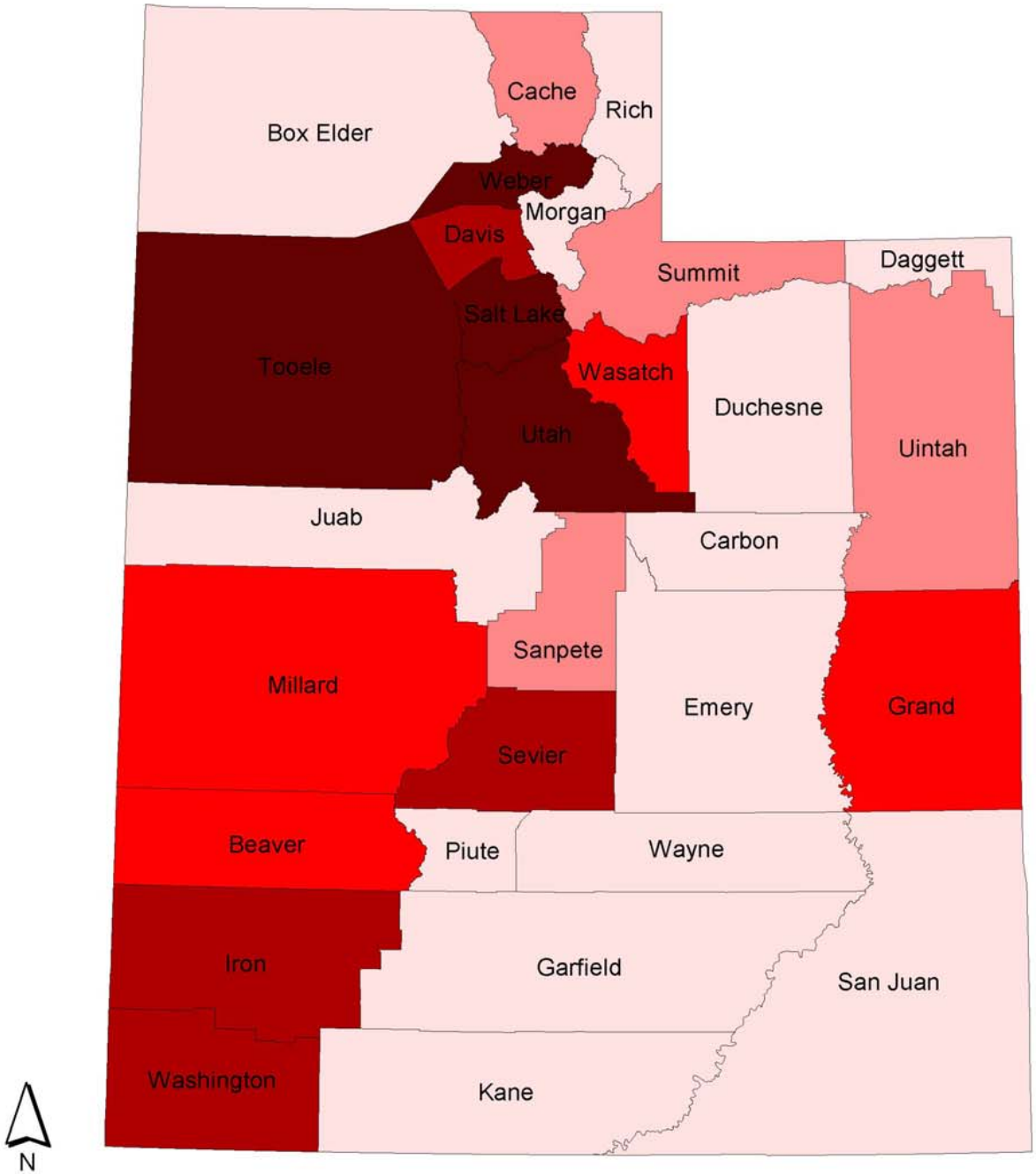


Vulnerability of State Facilities to Dam Failure Inundation

Based on insured value

County Boundary

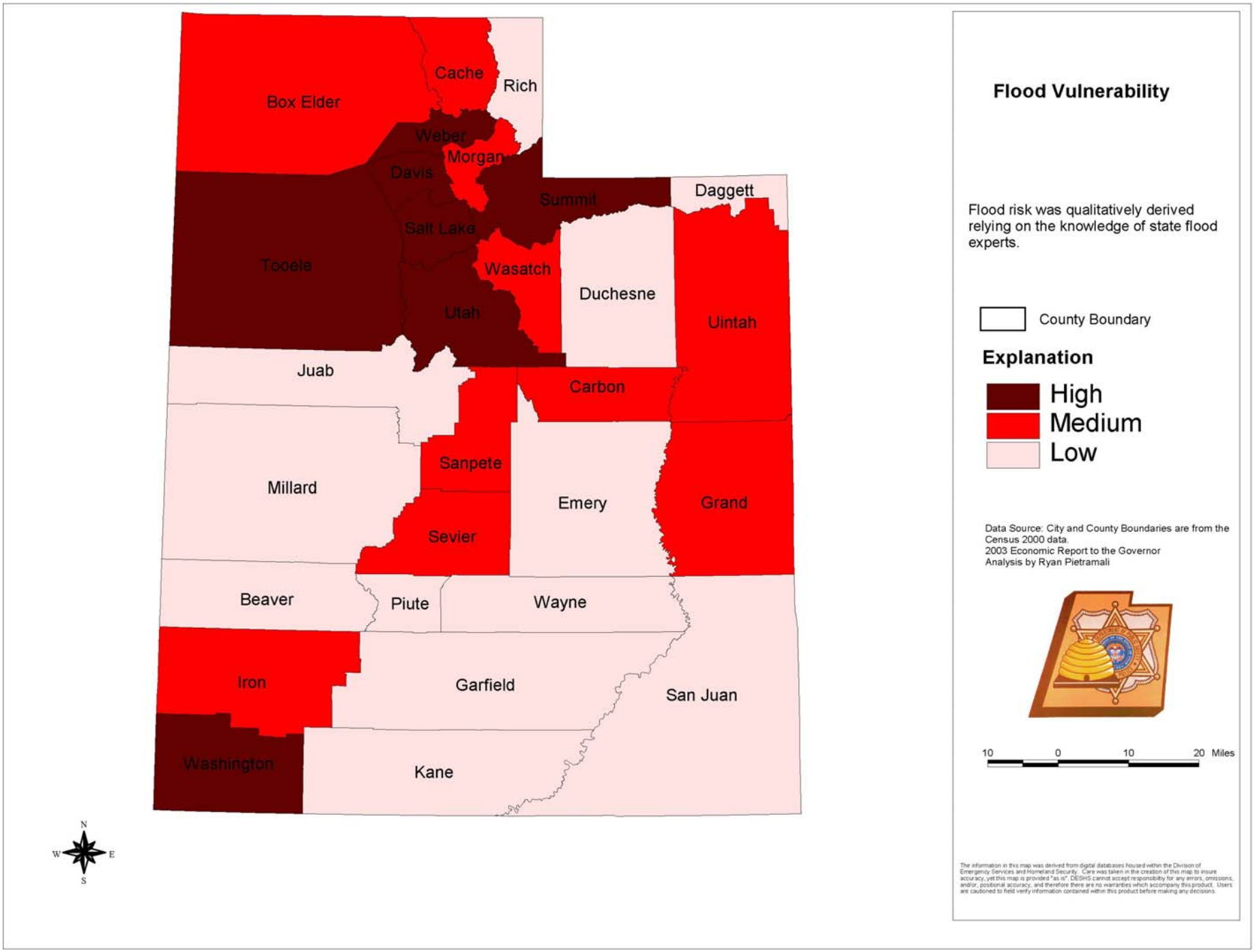
Explanation

- 0
- $1,342,278 - $2,089,326
- $3,380,293 - $10,993,459
- $18,237,279 - $44,027,063
- $46,153,780 - $374,580,704

Data Source: City and County Boundaries are from the Census 2000 data.
Facility location based on June 2002 Equifax Business dataset
Analysis by Ryan Pietramali

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.


Flood Vulnerability
Flood risk was qualitatively derived relying on the knowledge of state flood experts.
County Boundary
Explanation
High
Medium
Low
Data Source: City and County Boundaries are from the Census 2000 data.
2003 Economic Report to the Governor
Analysis by Ryan Pietramali
10 0 10 20 Miles
Box Elder
Cache
Rich
Weber
Morgan
Davis
Summit
Daggett
Salt Lake
Tooele
Wasatch
Duchesne
Utah
Uintah
Juab
Carbon
Sanpete
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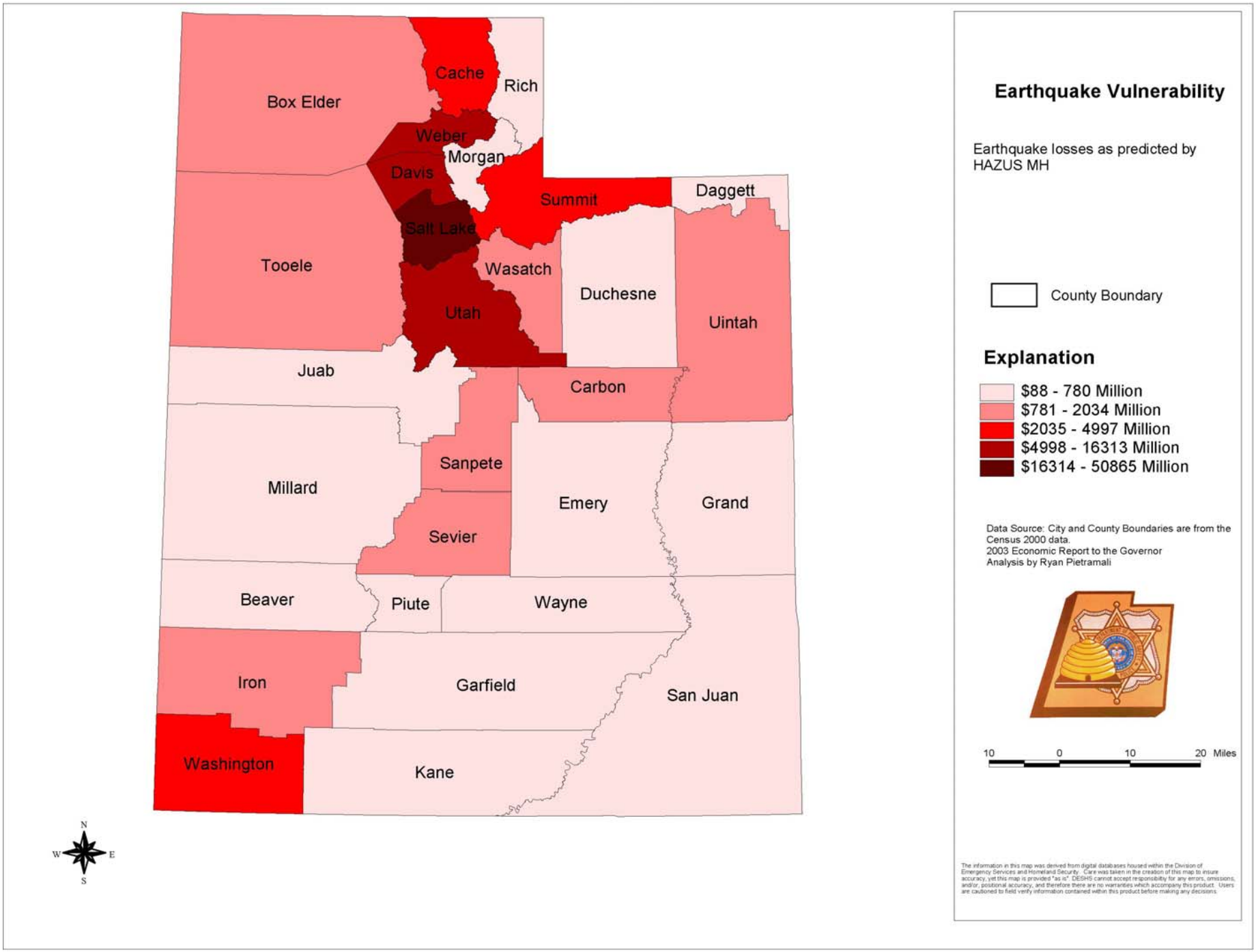
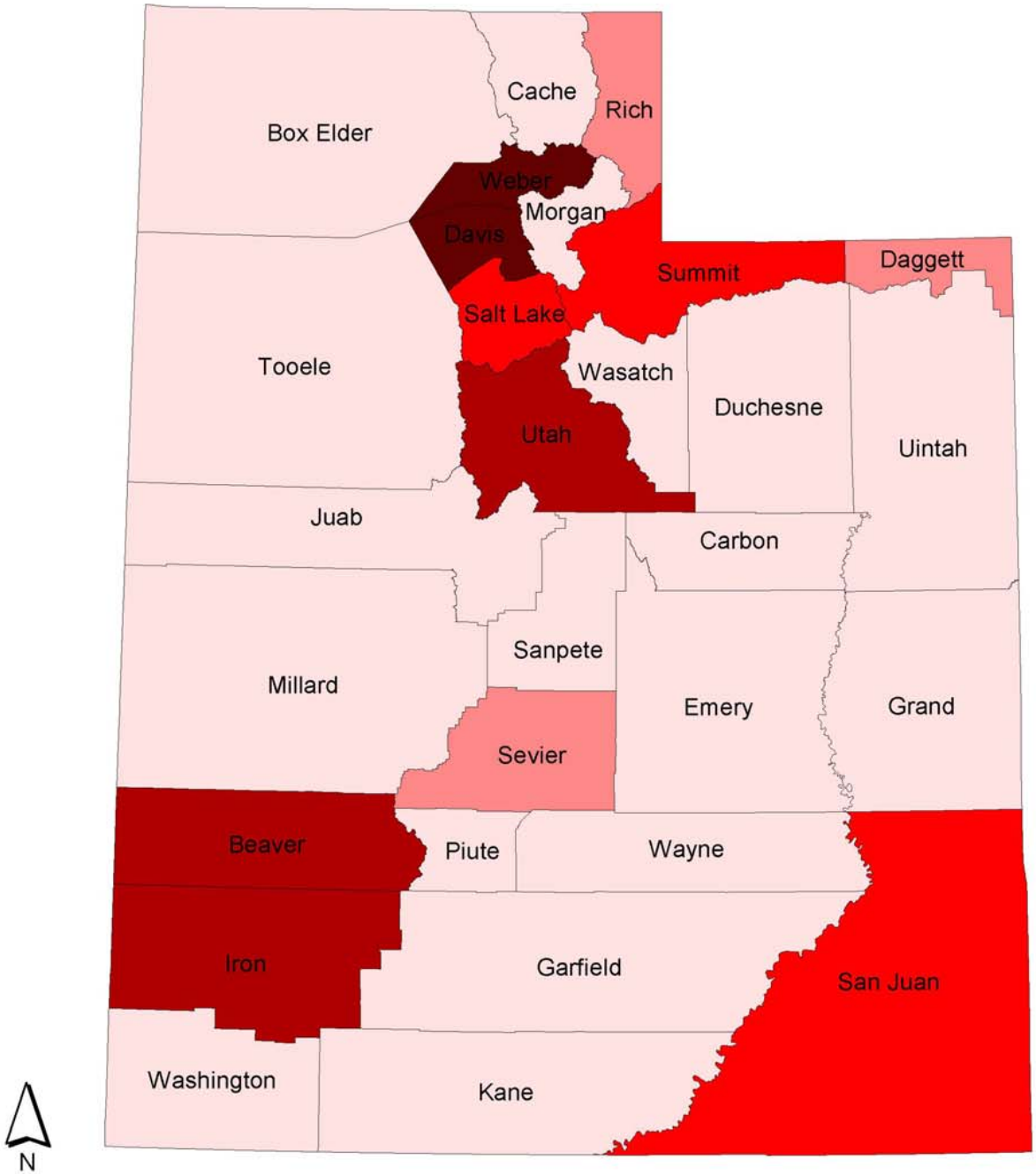
Beaver
Piute
Wayne
Iron
Garfield
San Juan
Washington
Kane
N
W
E
S


Box Elder
Cache
Rich
Weber
Morgan
Davis
Summit
Daggett
Salt Lake
Tooele
Wasatch
Duchesne
Uintah
Utah
Juab
Carbon
Sanpete
Millard
Emery
Grand
Sevier
Beaver
Piute
Wayne
Iron
Garfield
San Juan
Washington
Kane
N
W
E
S
Earthquake Vulnerability
Earthquake losses as predicted by HAZUS MH
County Boundary
Explanation
$88 - 780 Million
$781 - 2034 Million
$2035 - 4997 Million
$4998 - 16313 Million
$16314 - 50865 Million
Data Source: City and County Boundaries are from the Census 2000 data.
2003 Economic Report to the Governor
Analysis by Ryan Pietramali
10 0 10 20 Miles



Vulnerability of State Facilities to Landslide

Based on insured value

County Boundary

Explanation

- 0
- $323,843 - $2,026,364
- $3,374,600 - $5,906,036
- $9,697,989 - $84,692,160
- $168,103,333 - $316,483,069

Data Source: City and County Boundaries are from the Census 2000 data.
Facility location based on June 2002 Equifax Business dataset
Analysis by Ryan Pietramali

10 0 10 20 Miles

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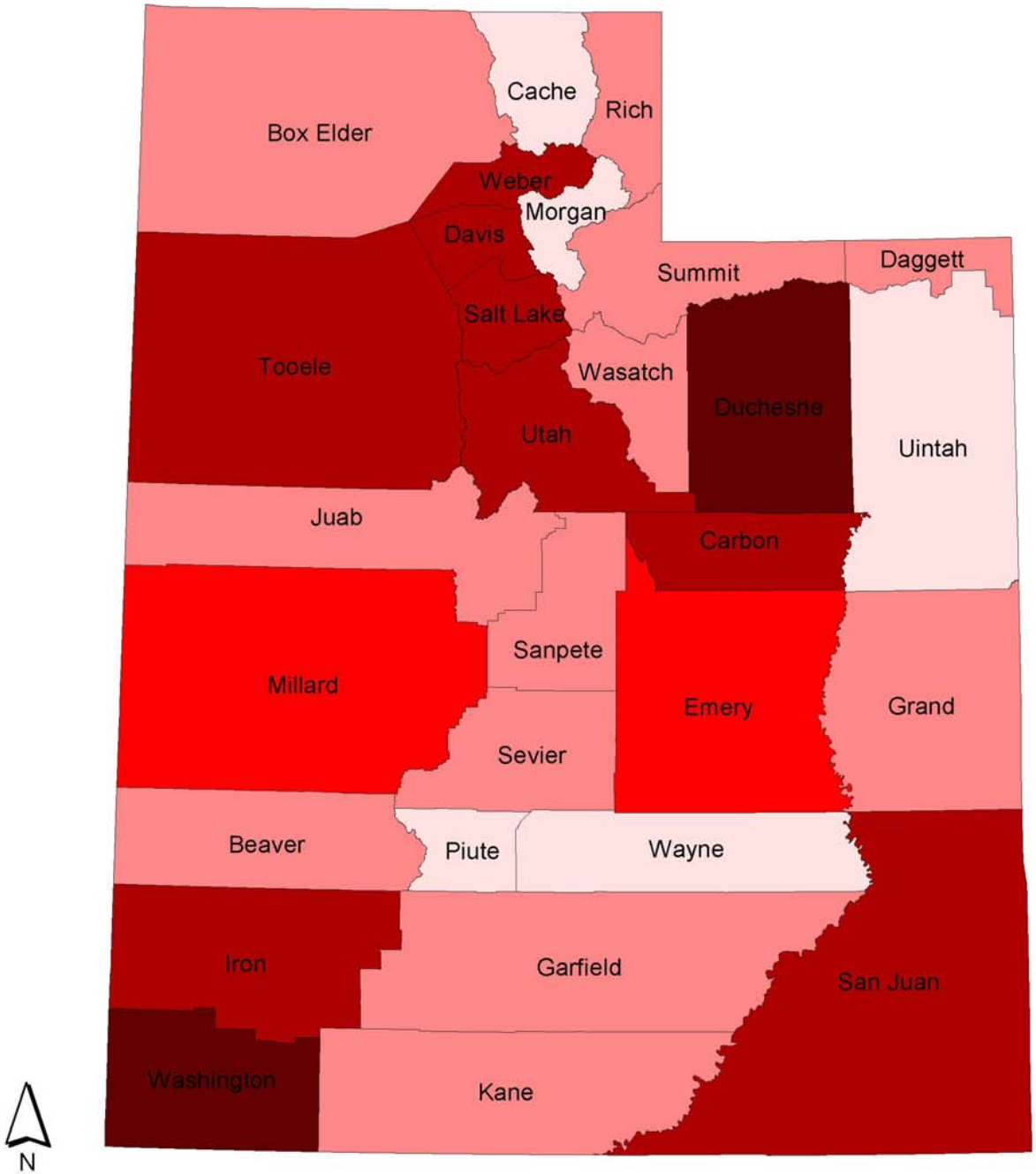


Vulnerability of State Facilities to Wildfire

Based on insured value

County Boundary

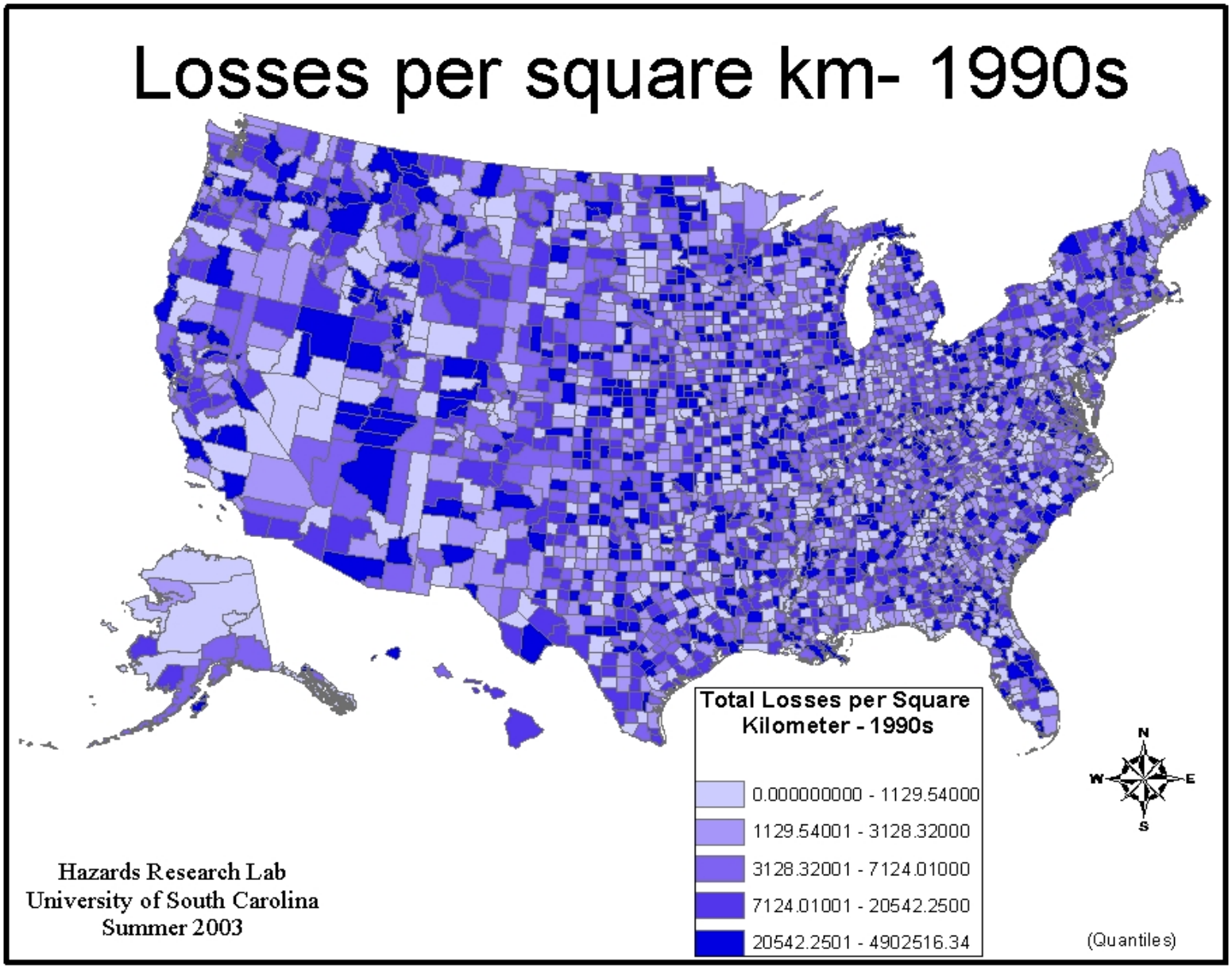
Explanation

- 0
- $300,000- $3,528,840
- $3,528,841 - $7,747,962
- $7,747,963 - $16,321,052
- $16,321,053 - $23,097,673

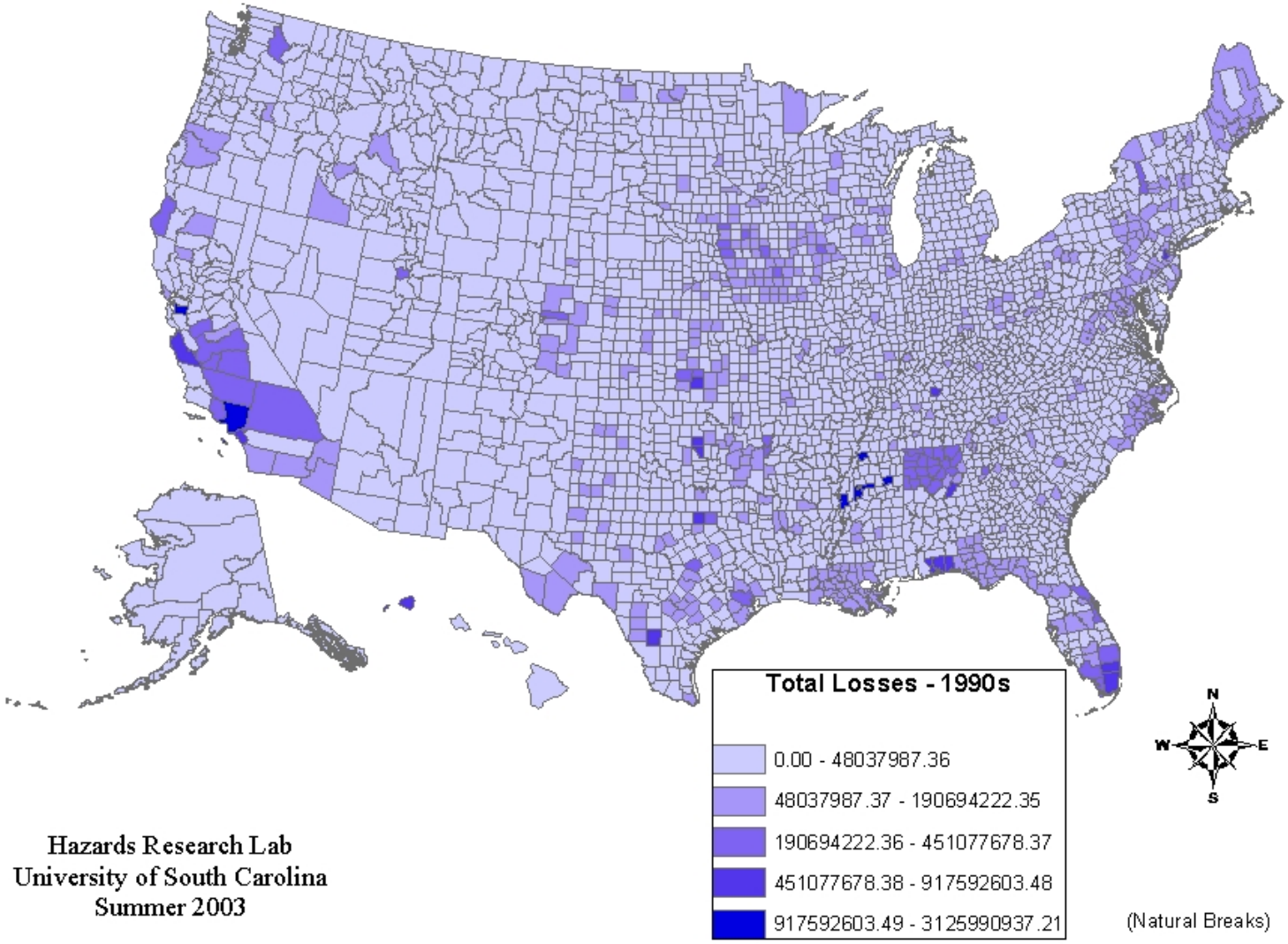
Data Source: City and County Boundaries are from the Census 2000 data.
Facility location based on June 2002 Equifax Business dataset
Analysis by Ryan Pietramali

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

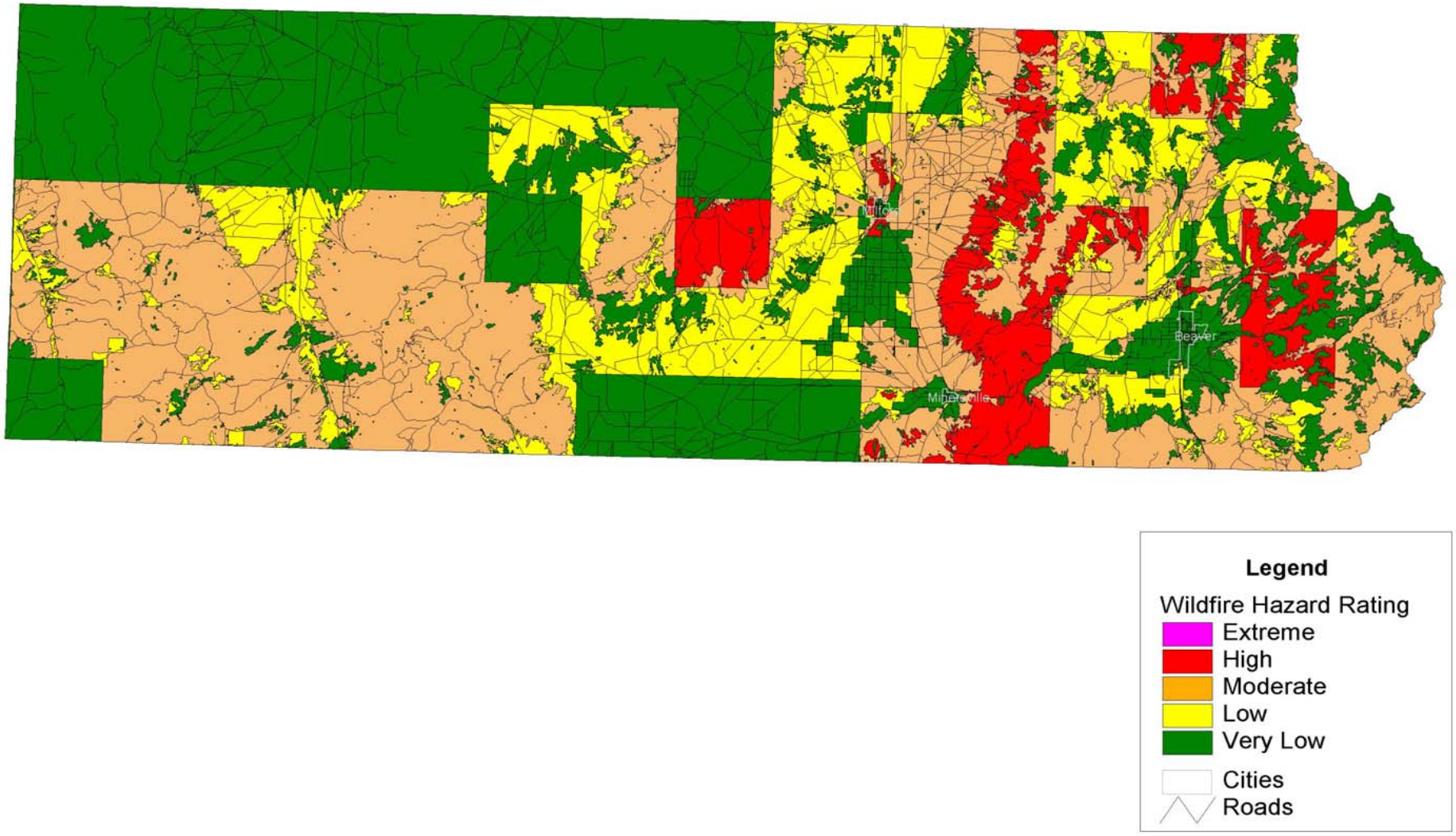

Losses per square km- 1990s
Total Losses per Square Kilometer - 1990s
0.000000000 - 1129.54000
1129.54001 - 3128.32000
3128.32001 - 7124.01000
7124.01001 - 20542.2500
20542.2501 - 4902516.34
(Quantiles)
N
W
E
S
Hazards Research Lab
University of South Carolina
Summer 2003

Total Losses - 1990s

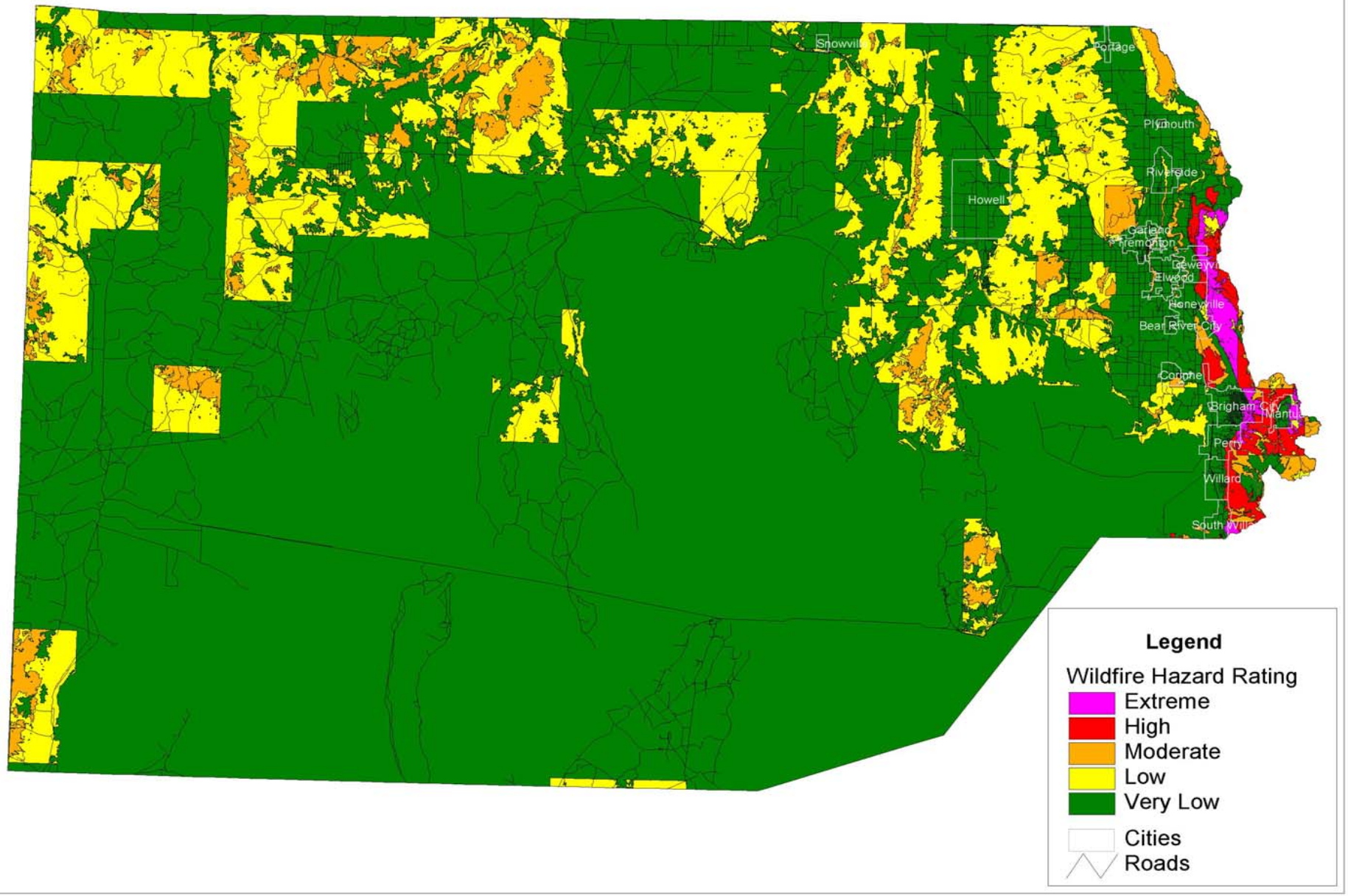


Hazards Research Lab
University of South Carolina
Summer 2003

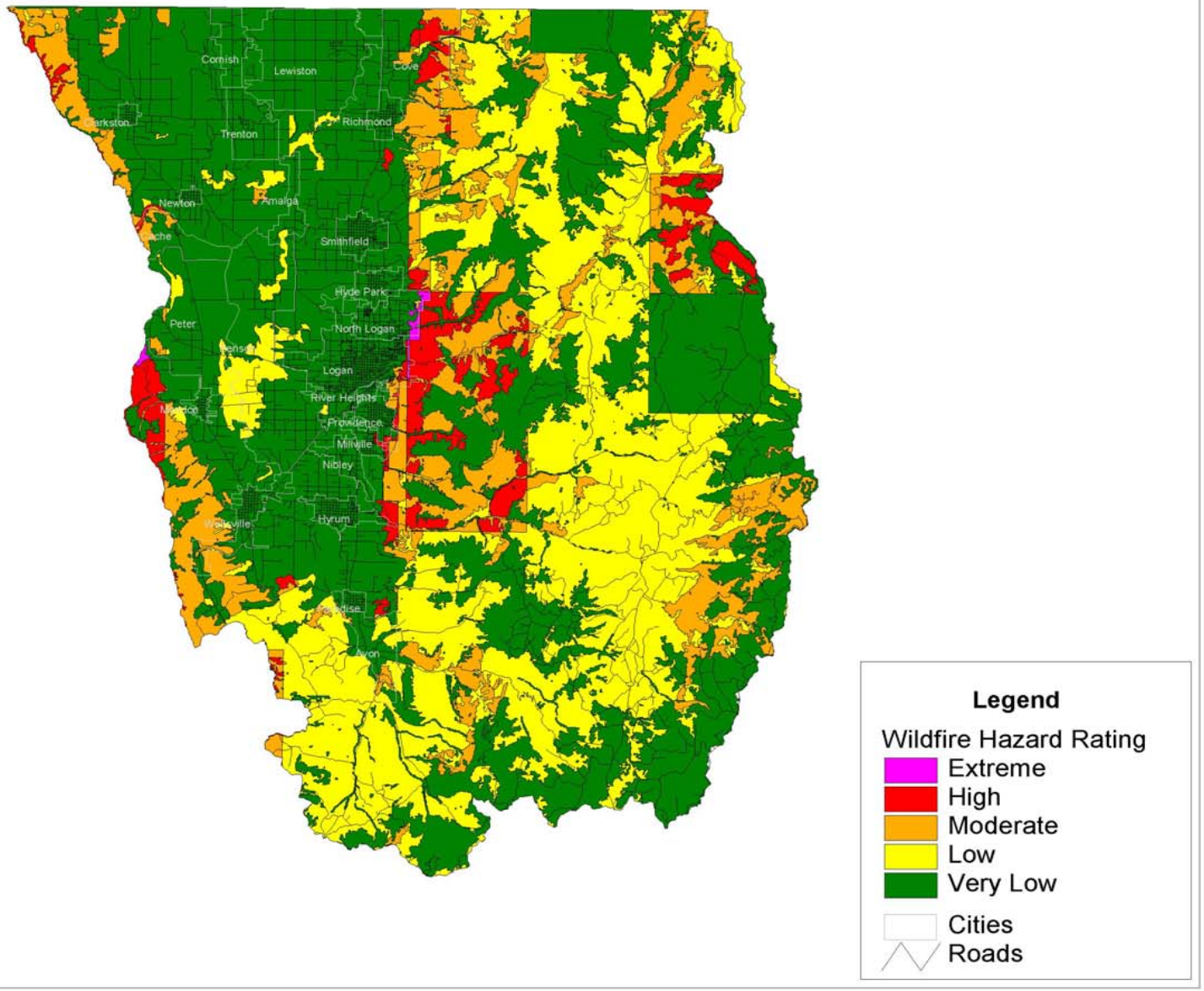
Beaver County Wildfire Risk



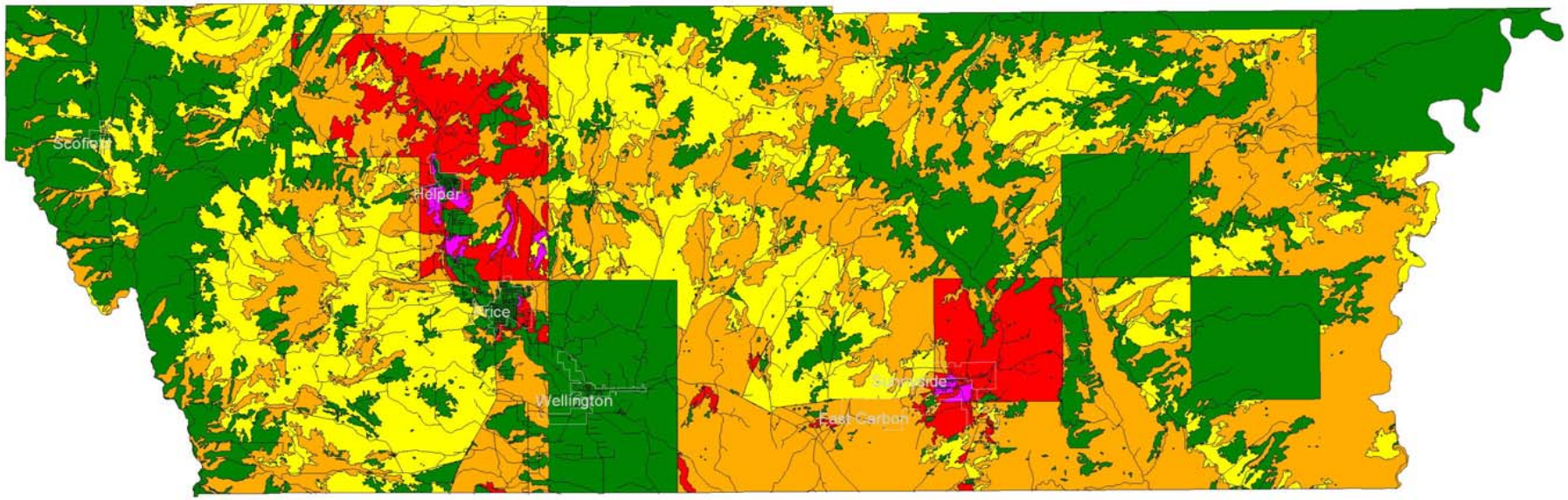
Box Elder County Wildfire Risk



Cache County Wildfire Risk



Carbon County Wildfire Risk



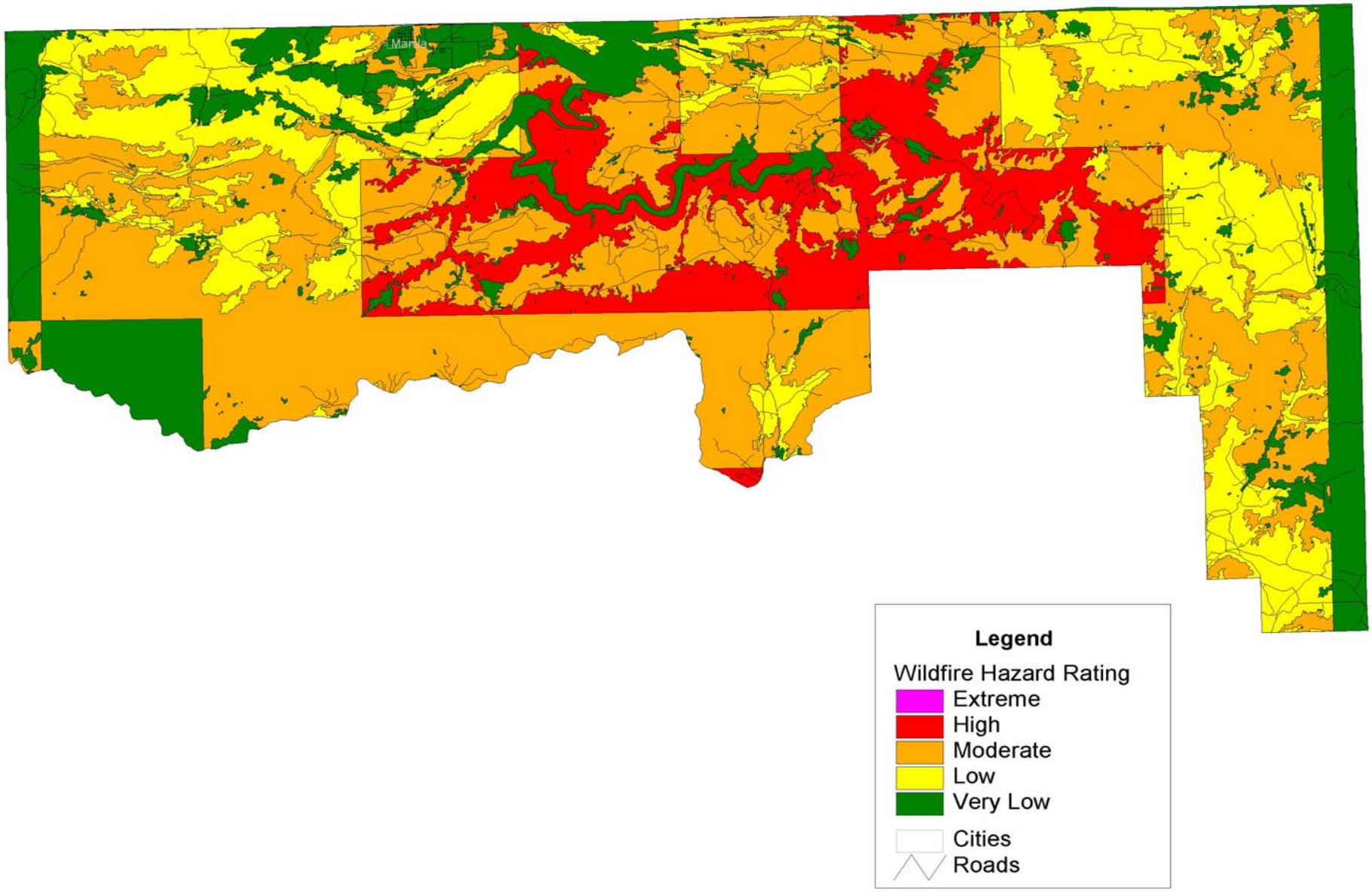
Legend

Wildfire Hazard Rating

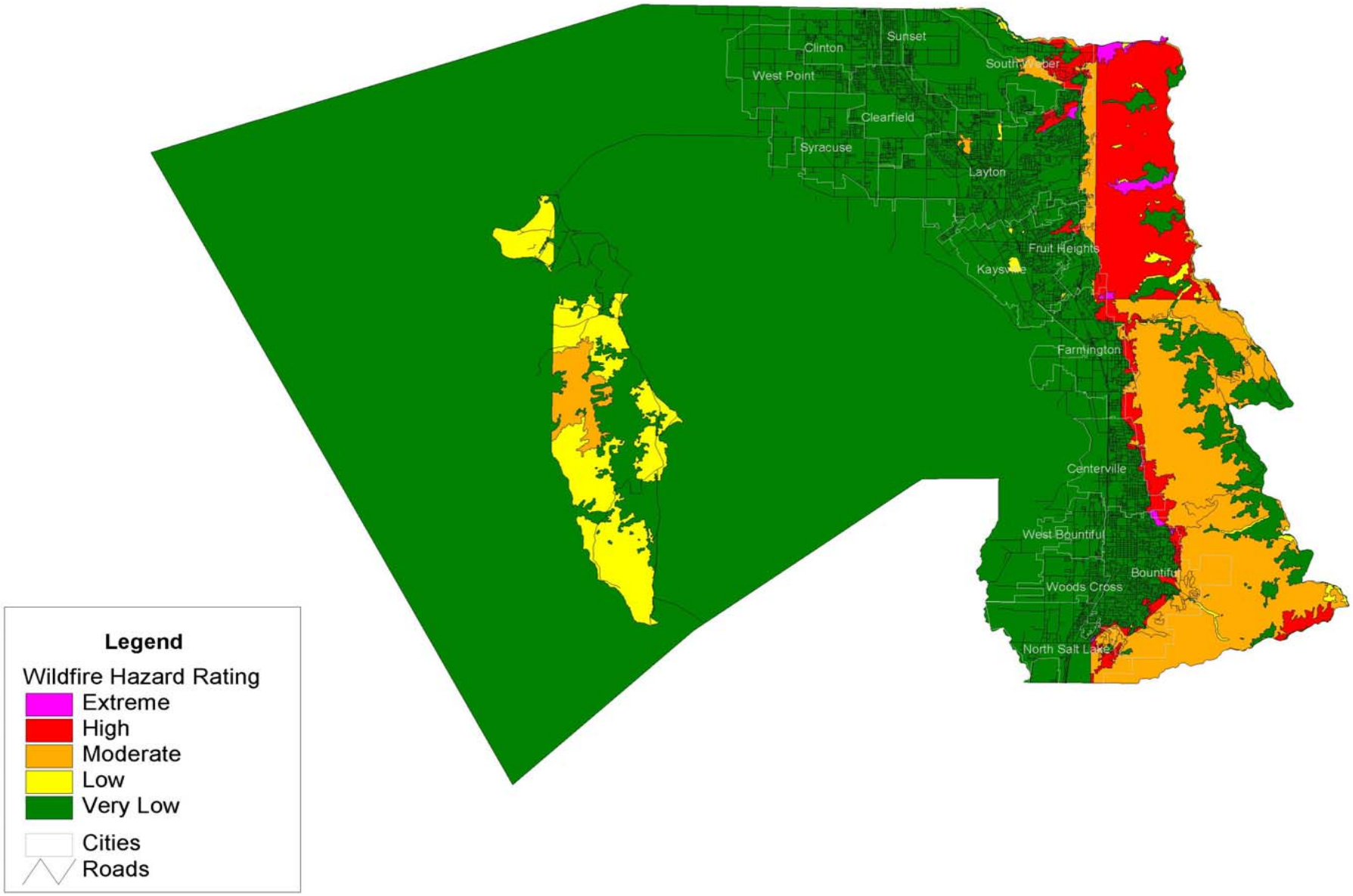
- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Daggett County Wildfire Risk



Davis County Wildfire Risk



Duchesne County Wildfire Risk

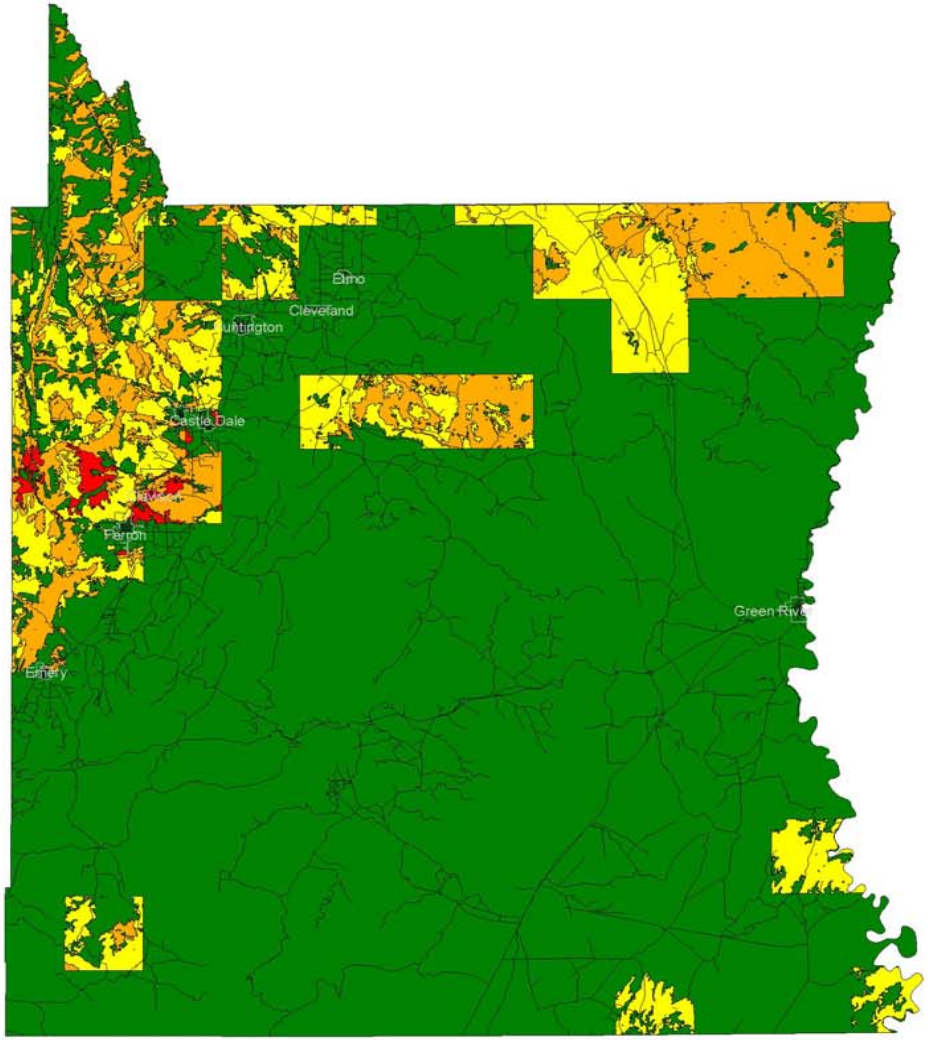
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Emery County Wildfire Risk



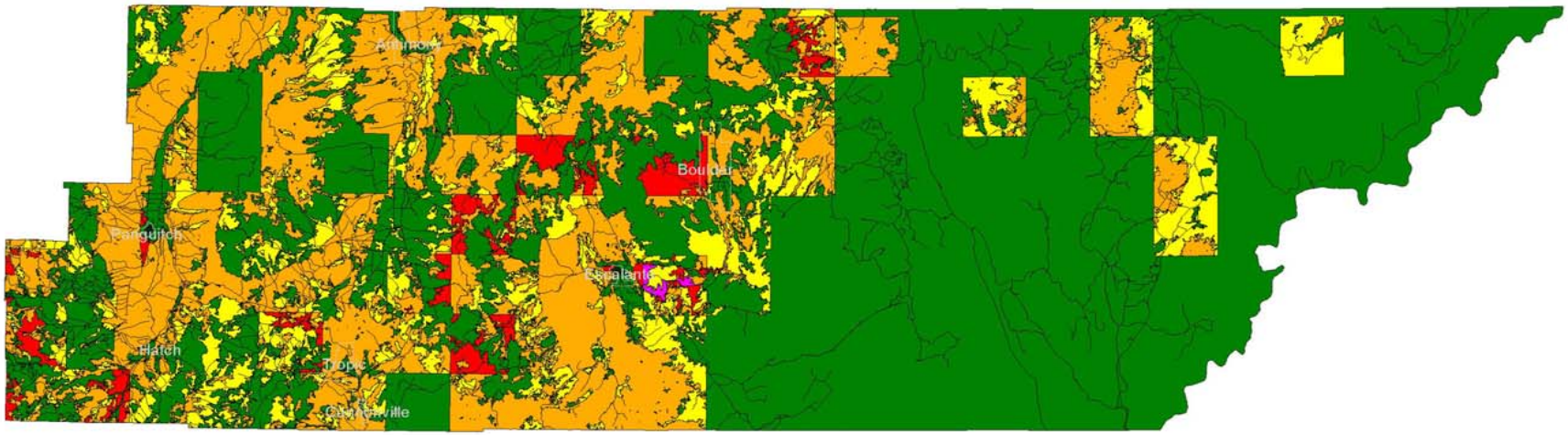
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Garfield County Wildfire Risk



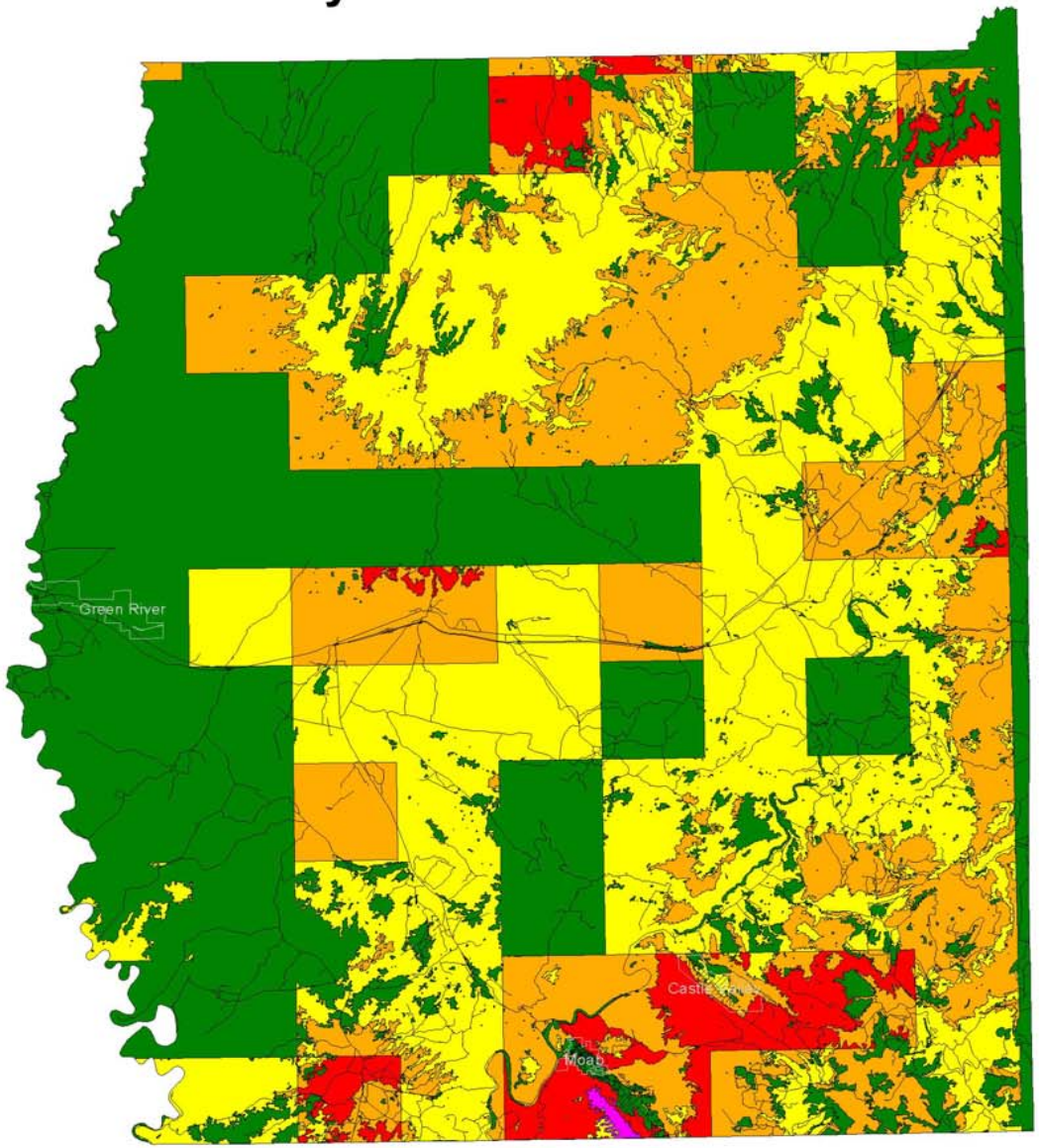
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Grand County Wildfire Risk



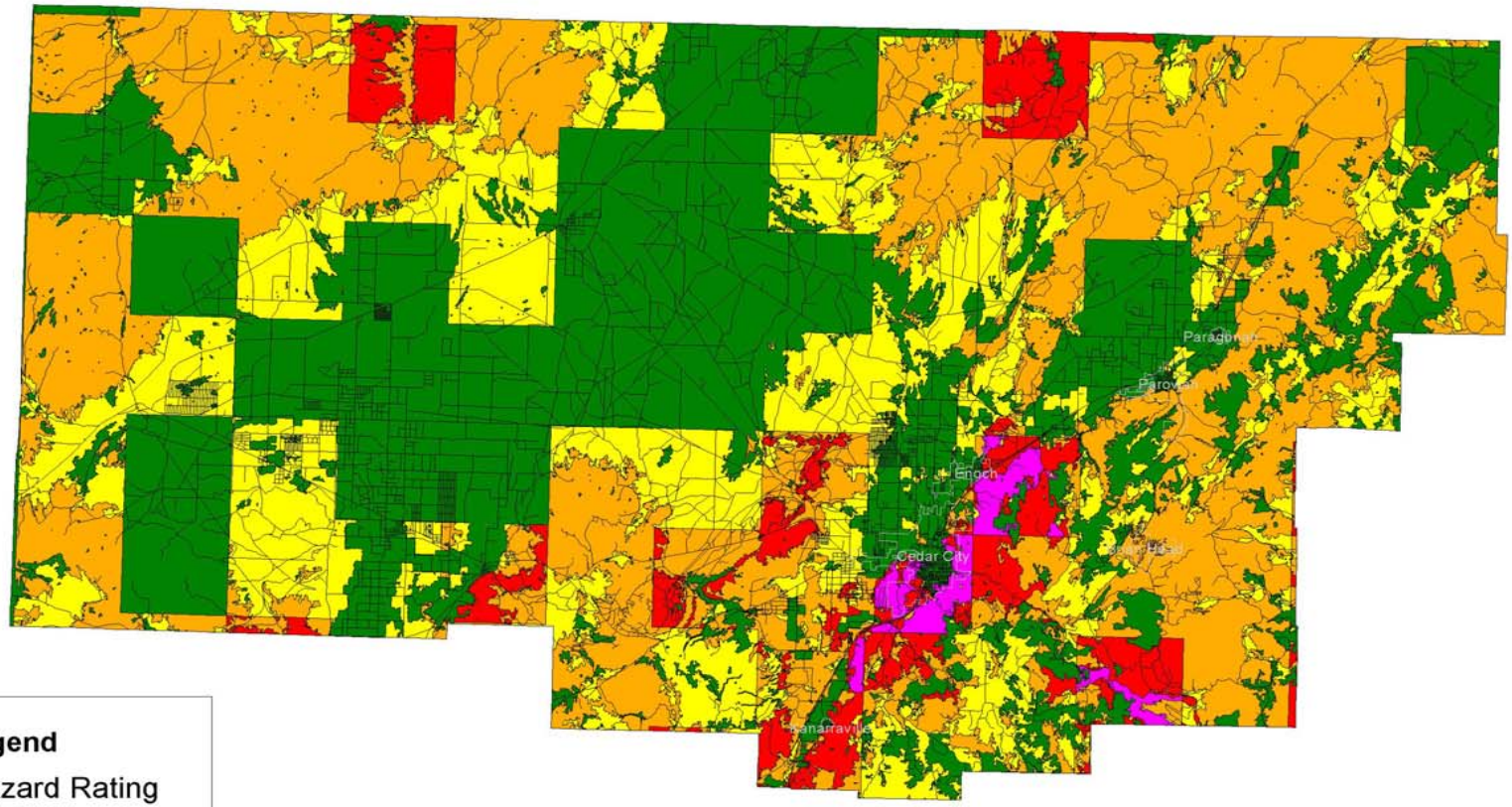
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Iron County Wildfire Risk



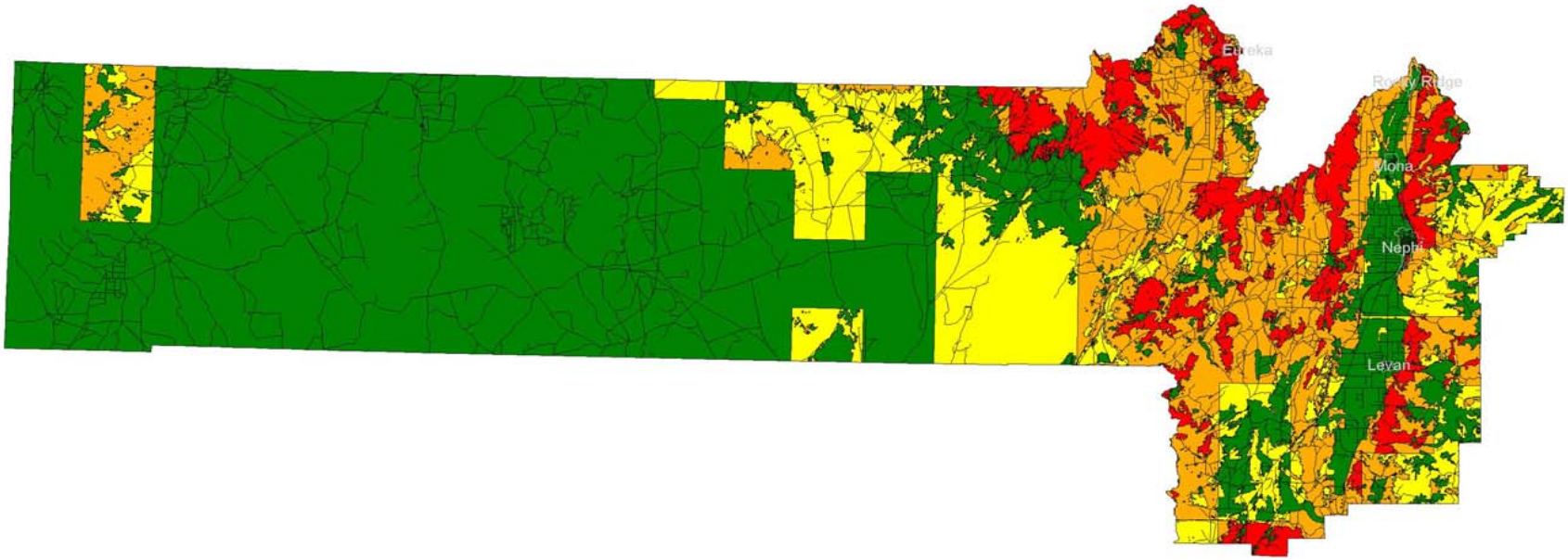
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Juab County Wildfire Risk



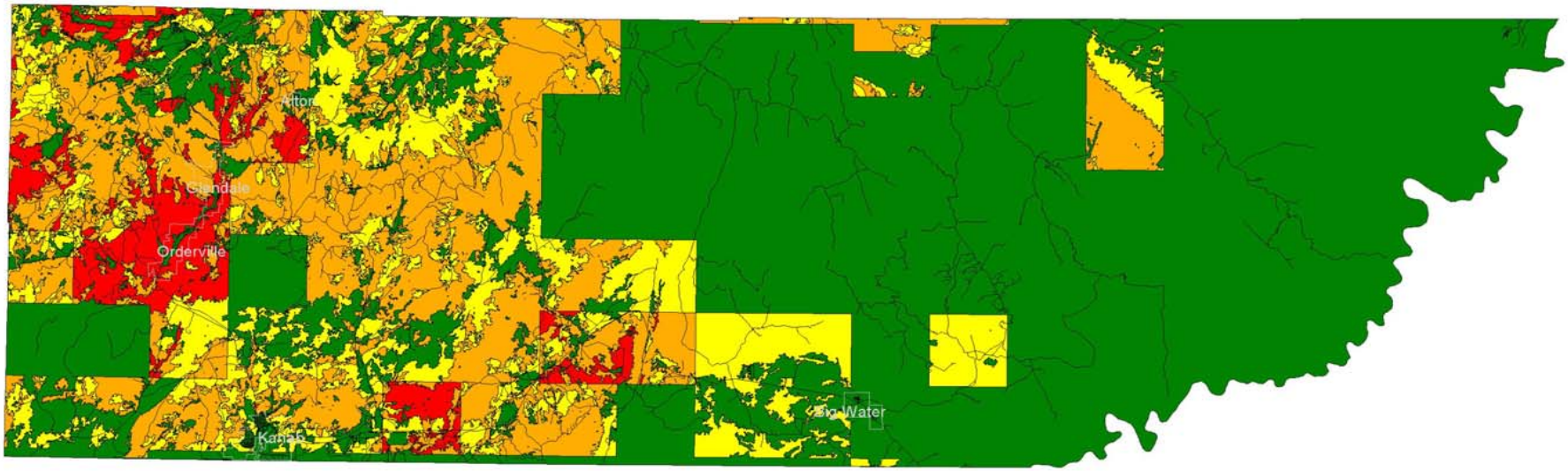
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Kane County Wildfire Risk



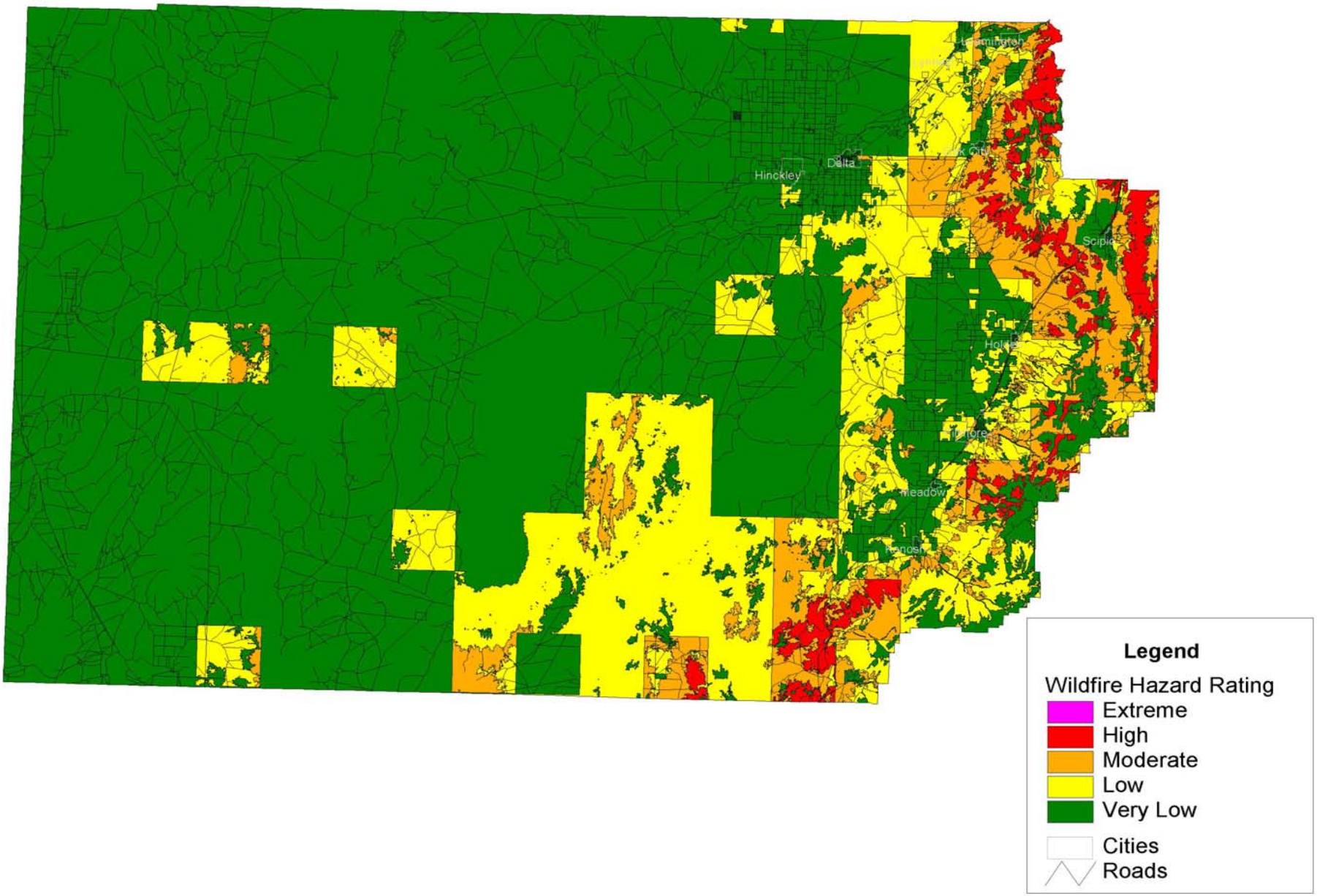
Legend

Wildfire Hazard Rating

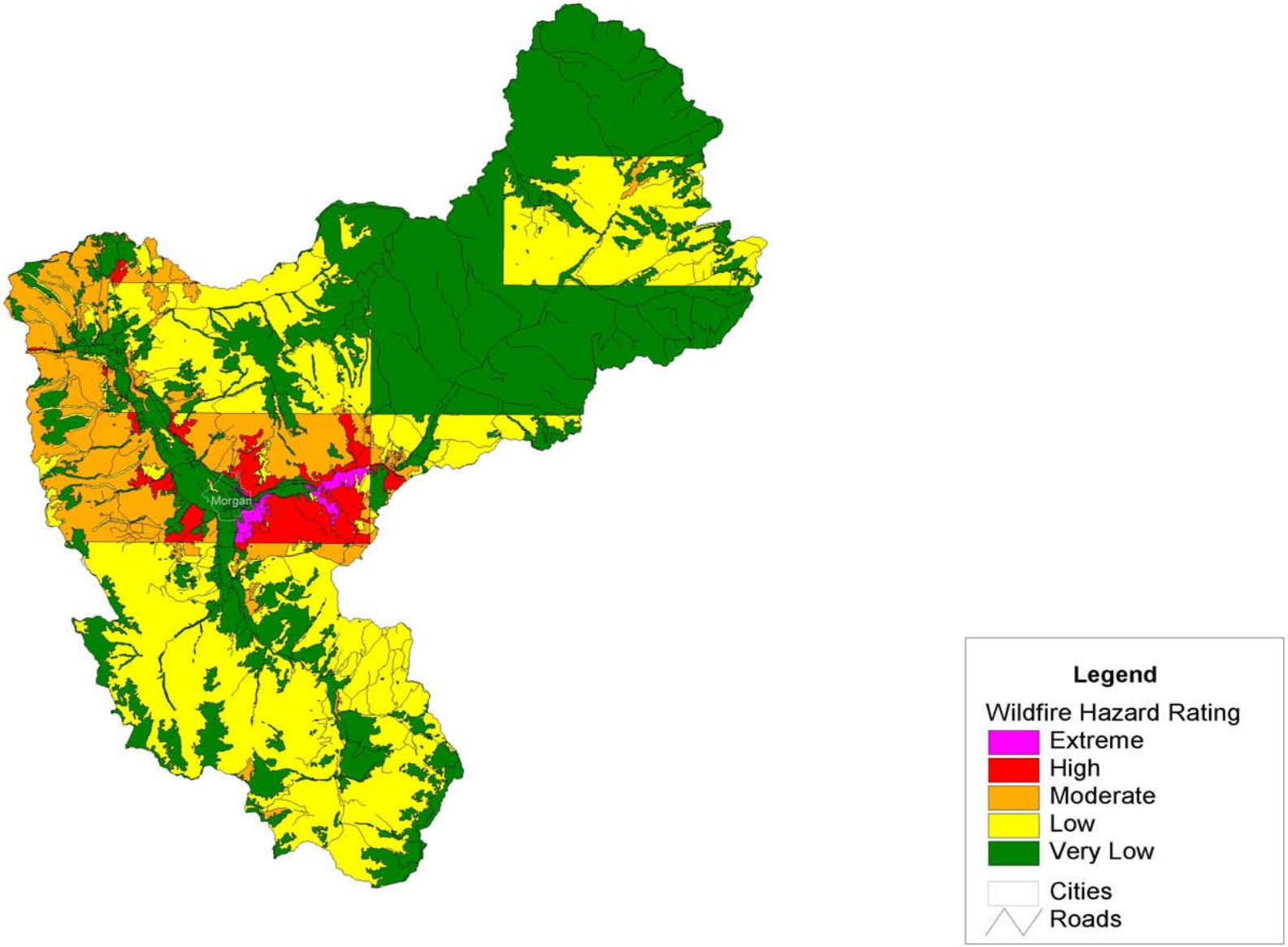
- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

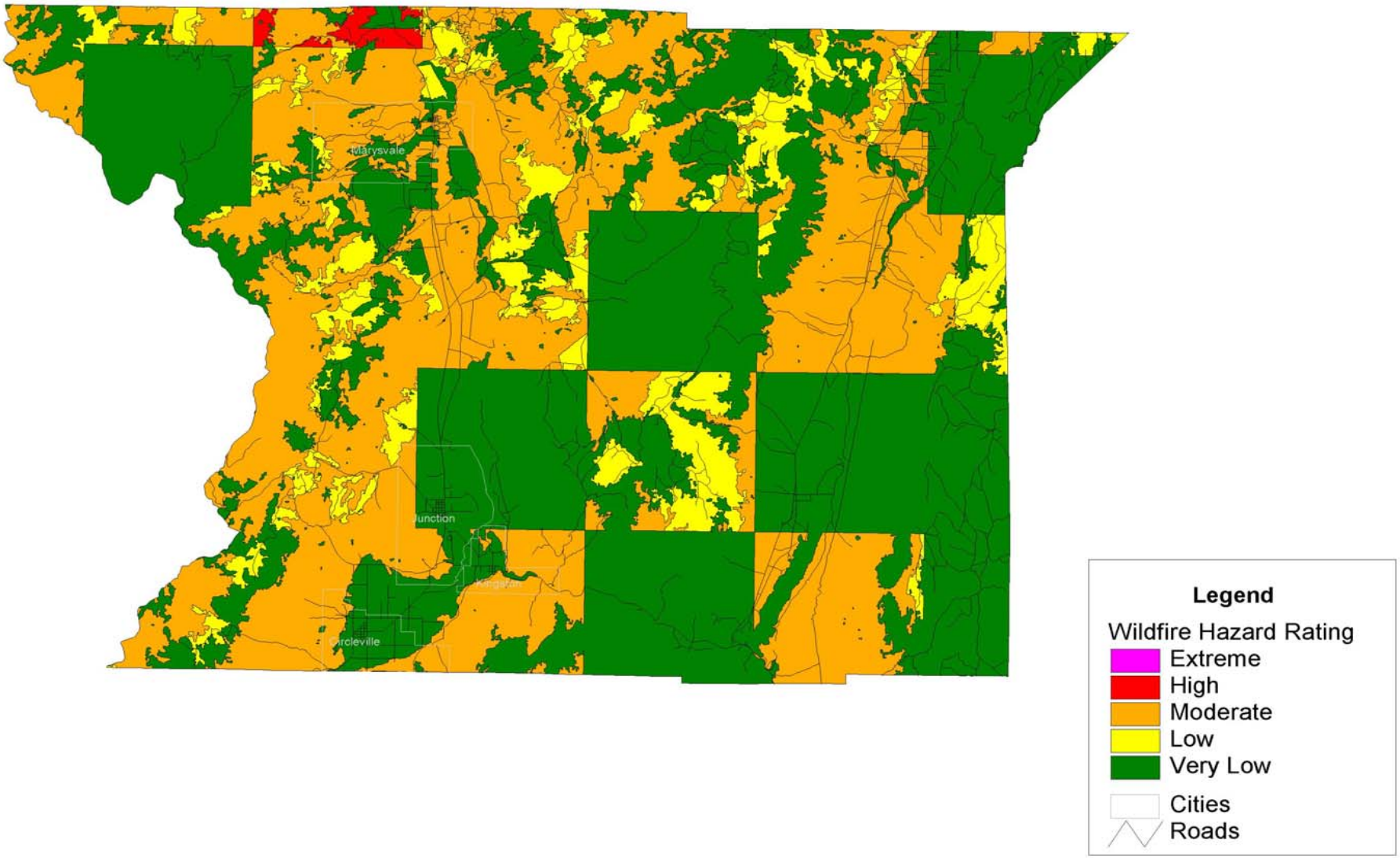
Millard County Wildfire Risk



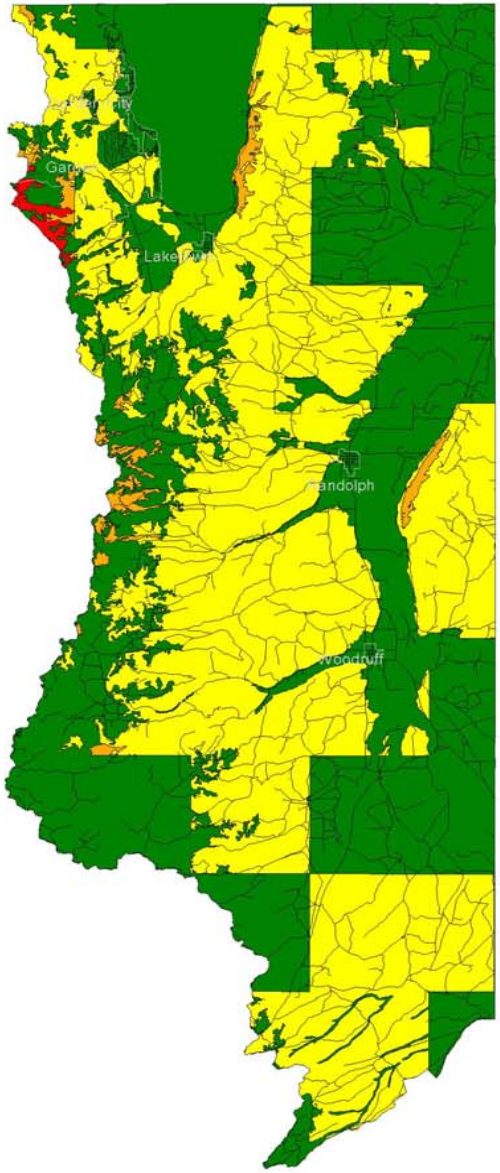
Morgan County Wildfire Risk



Piute County Wildfire Risk



Rich County Wildfire Risk



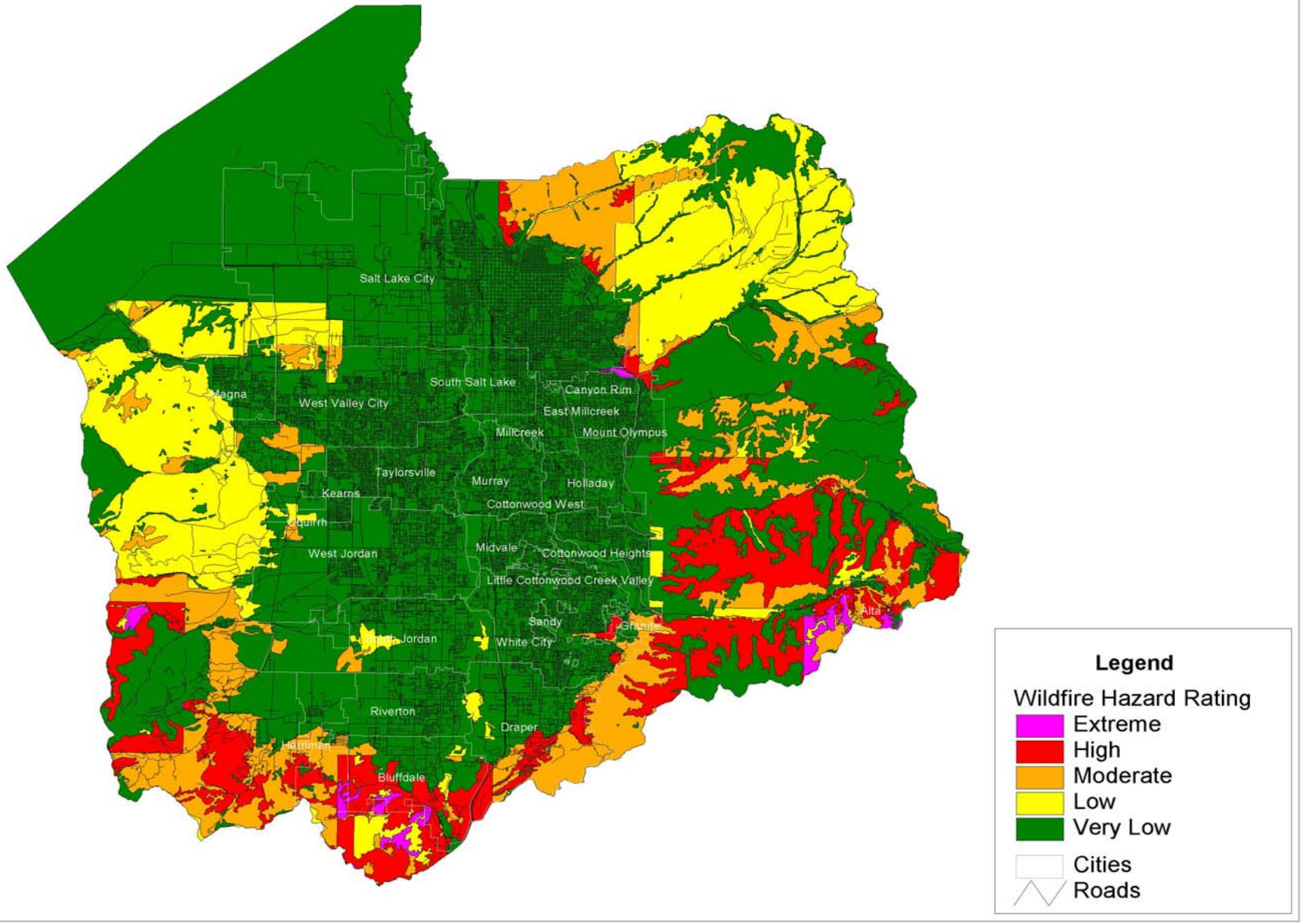
Legend

Wildfire Hazard Rating

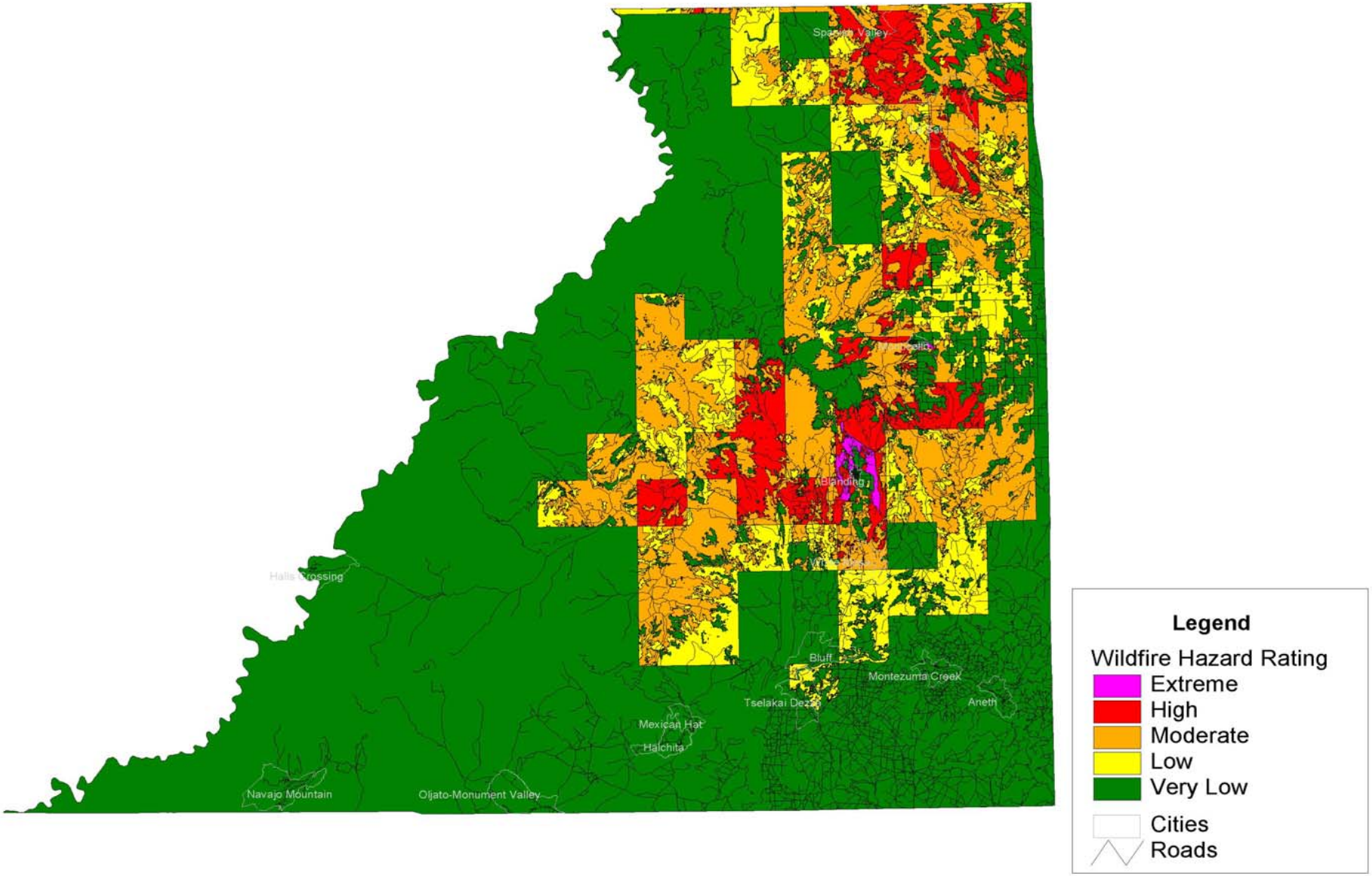
- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

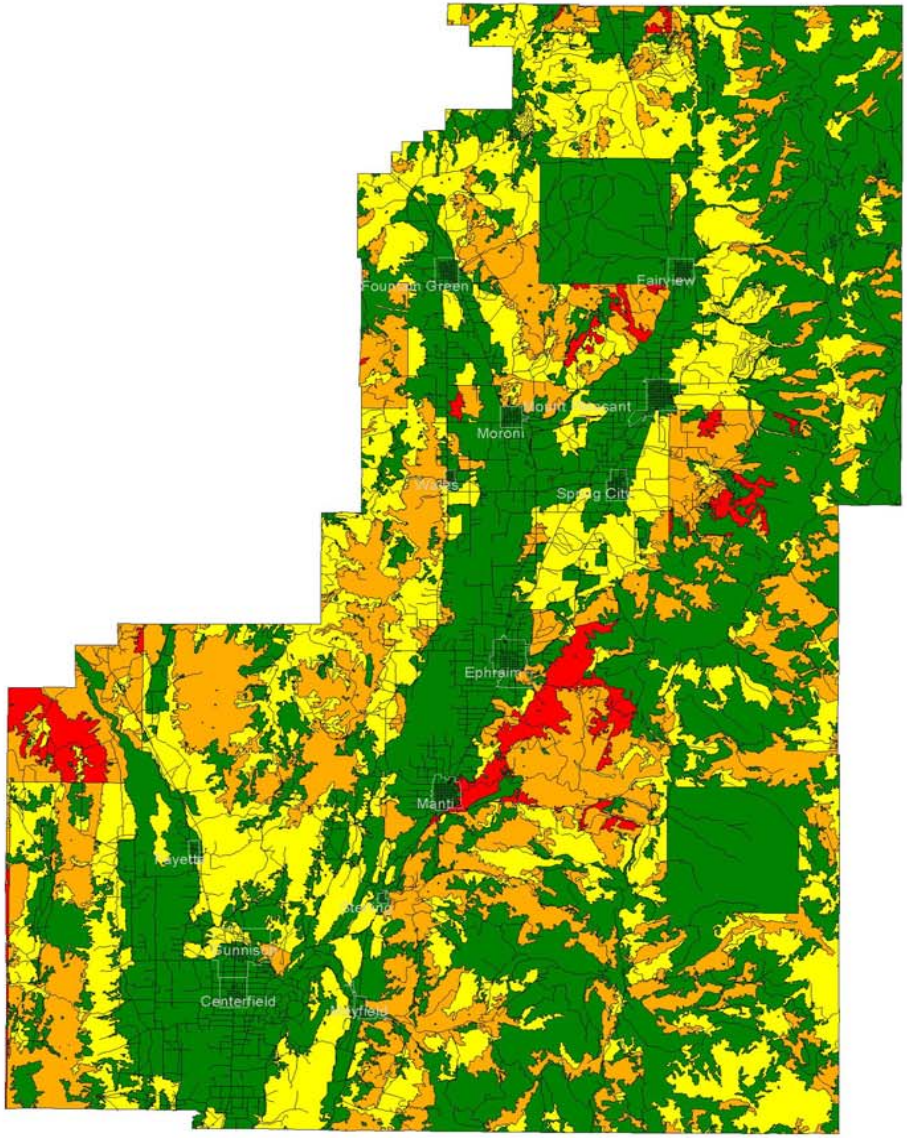
Salt Lake County Wildfire Risk



San Juan County Wildfire Risk



Sanpete County Wildfire Risk



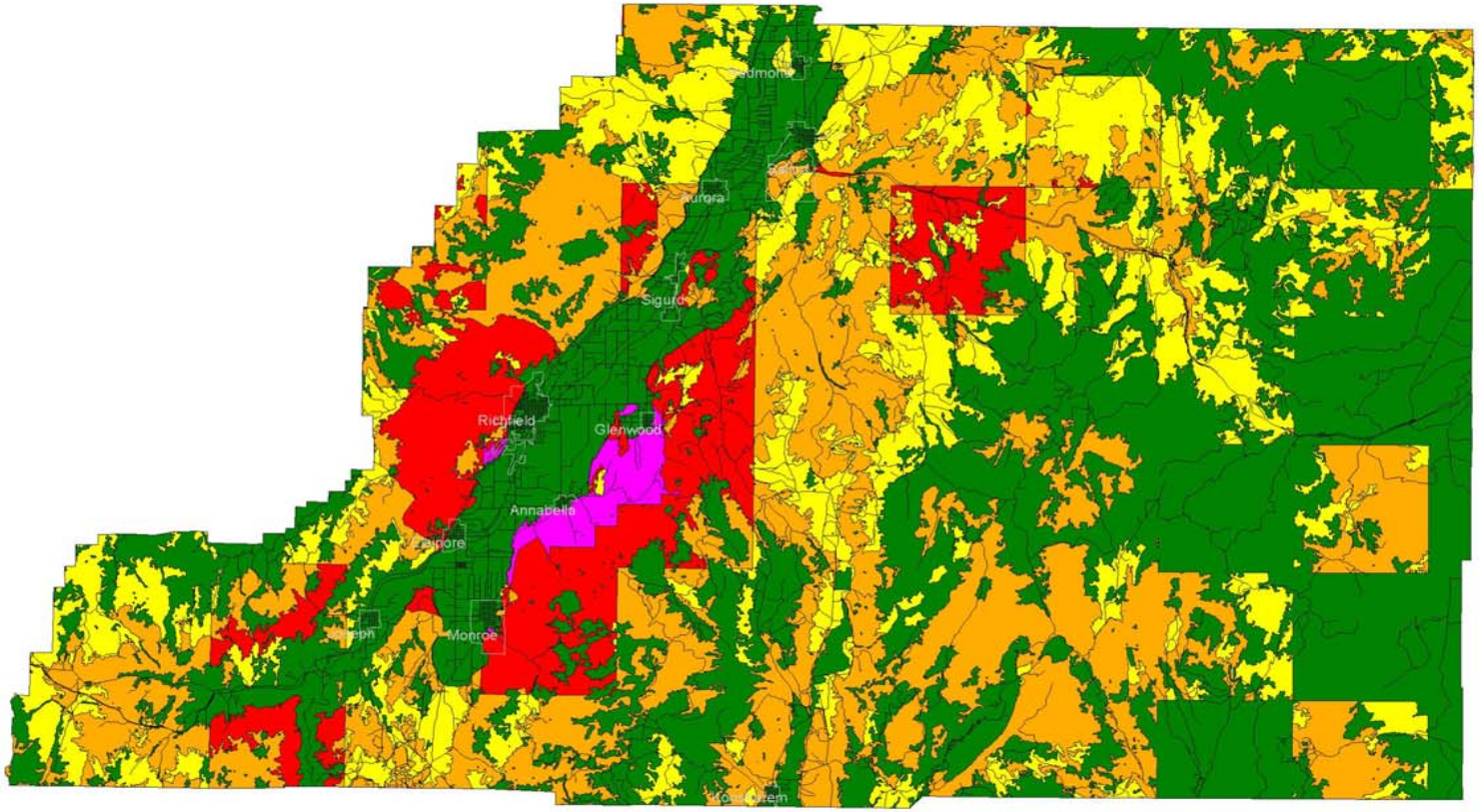
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Sevier County Wildfire Risk



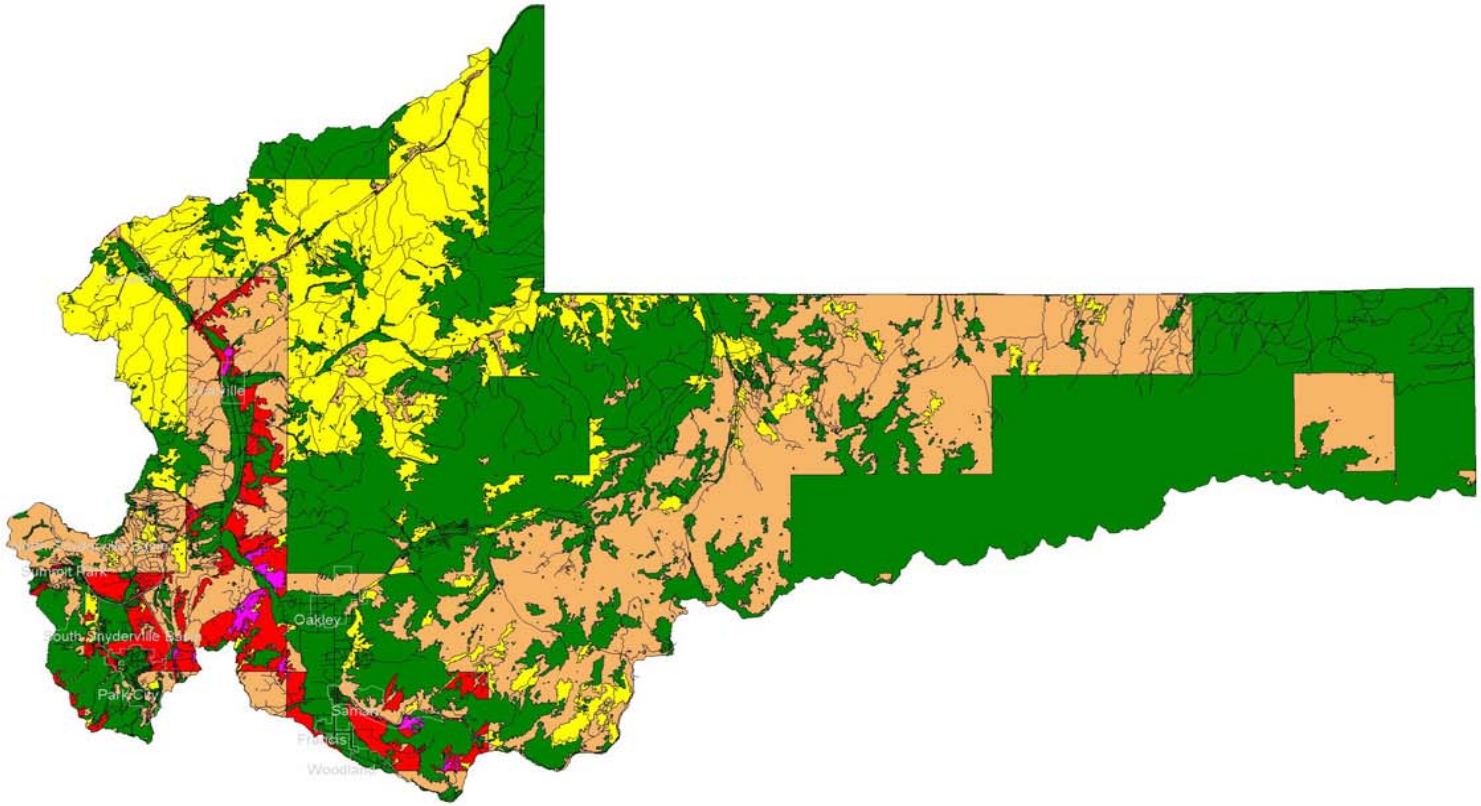
Legend

Wildfire Hazard Rating

- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Summit County Wildfire Risk



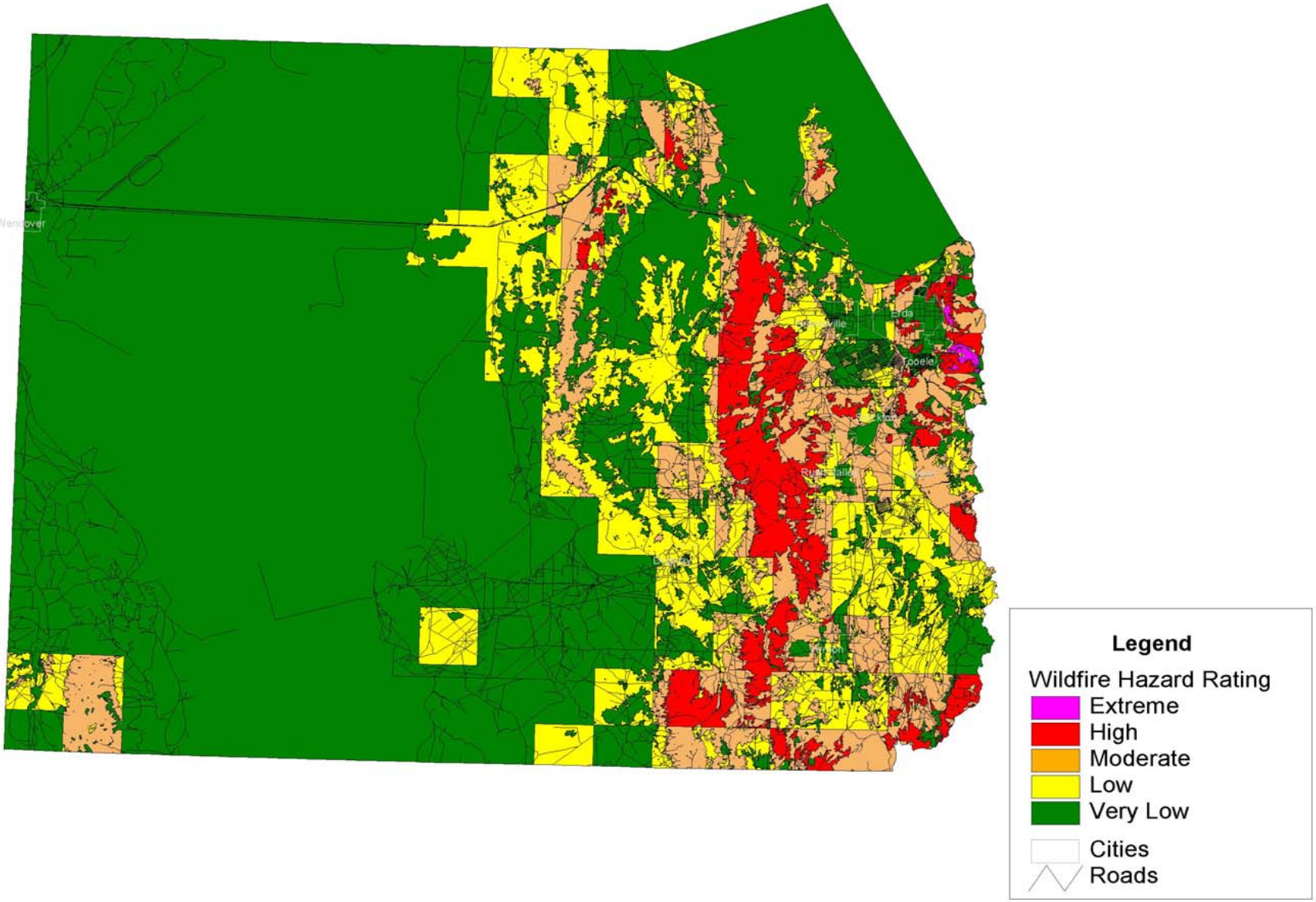
Legend

Wildfire Hazard Rating

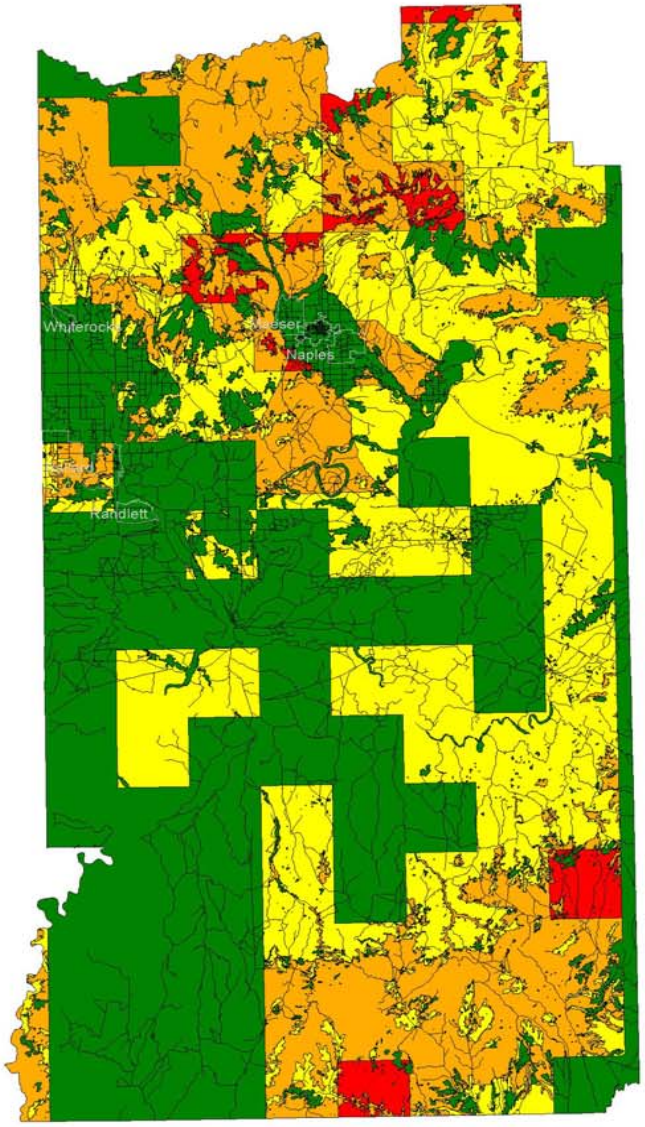
- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Tooele County Wildfire Risk



Uintah County Wildfire Risk



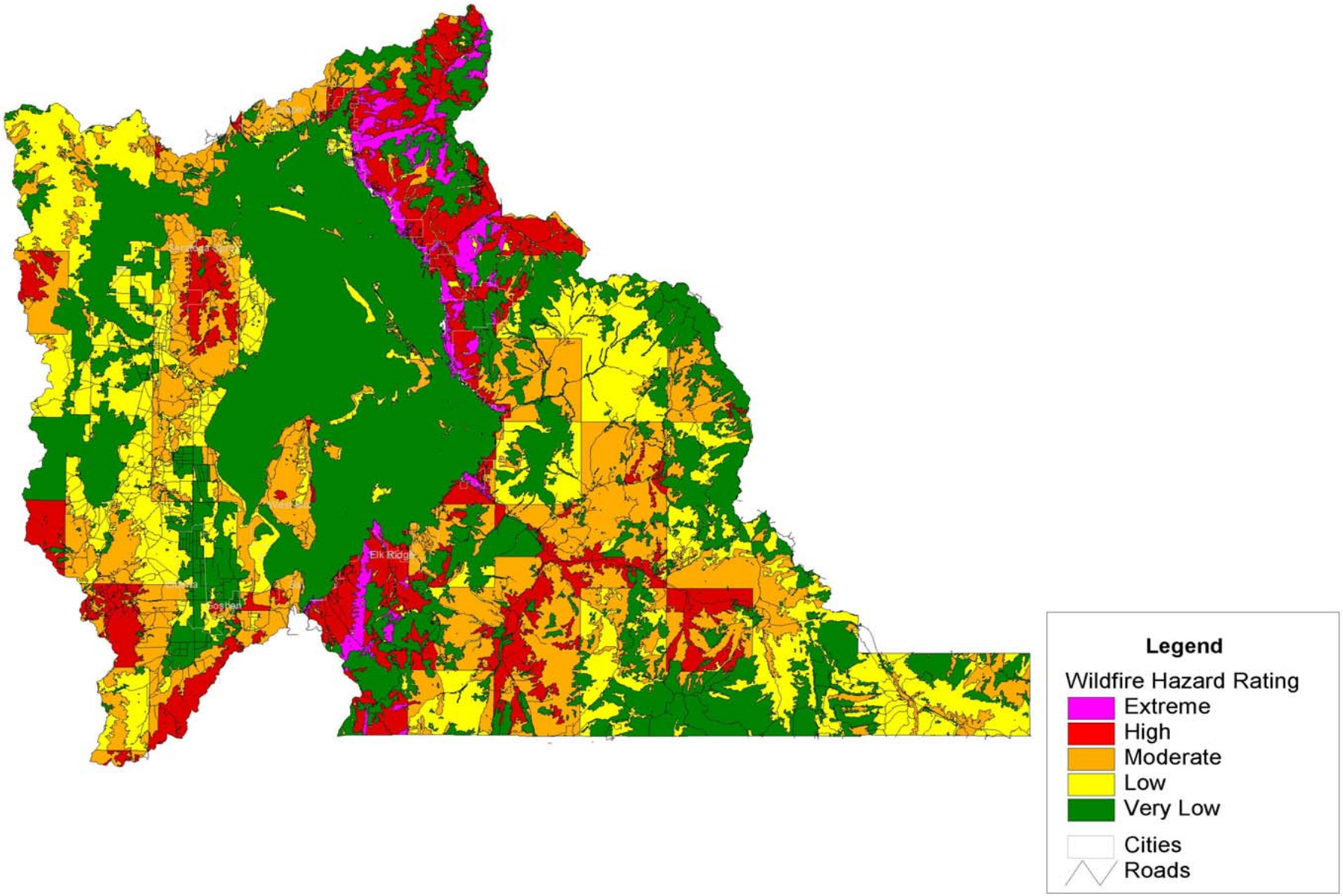
Legend

Wildfire Hazard Rating

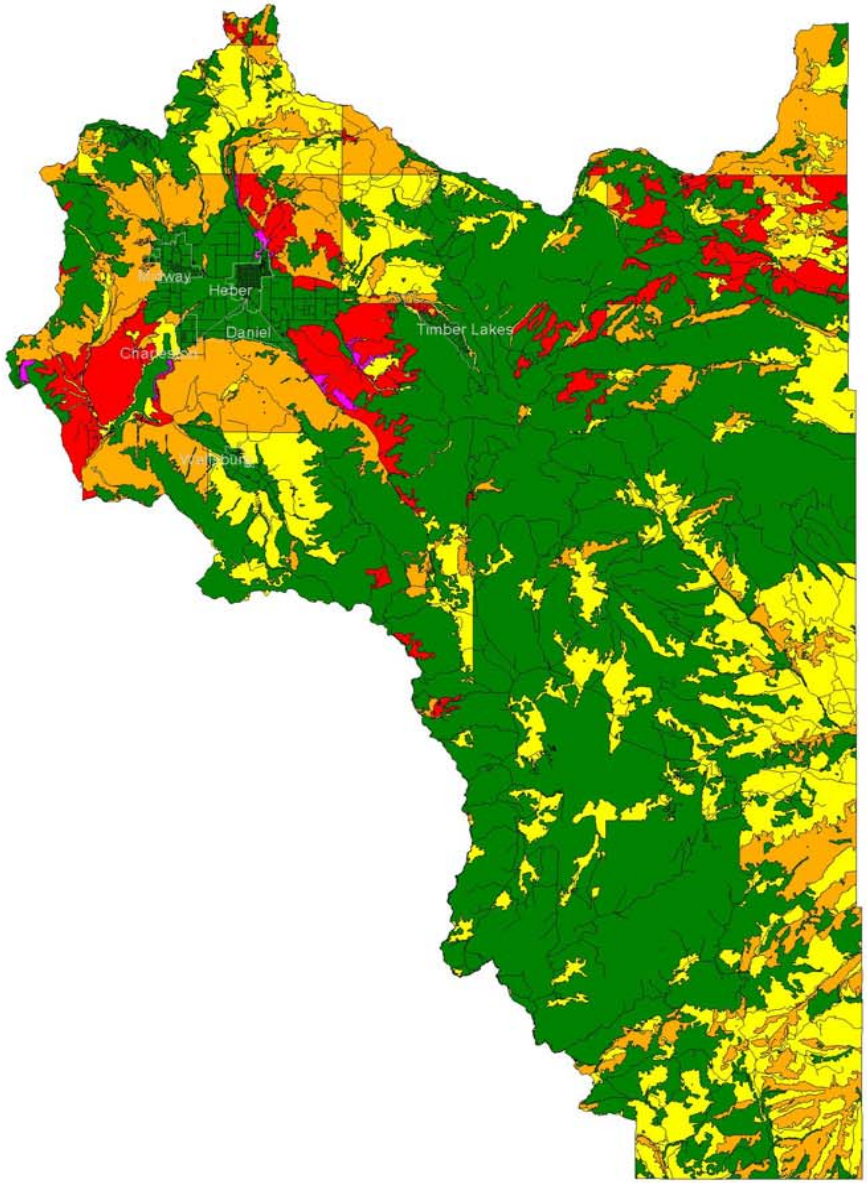
- Extreme
- High
- Moderate
- Low
- Very Low

- Cities
- Roads

Utah County Wildfire Risk



Wasatch County Wildfire Risk



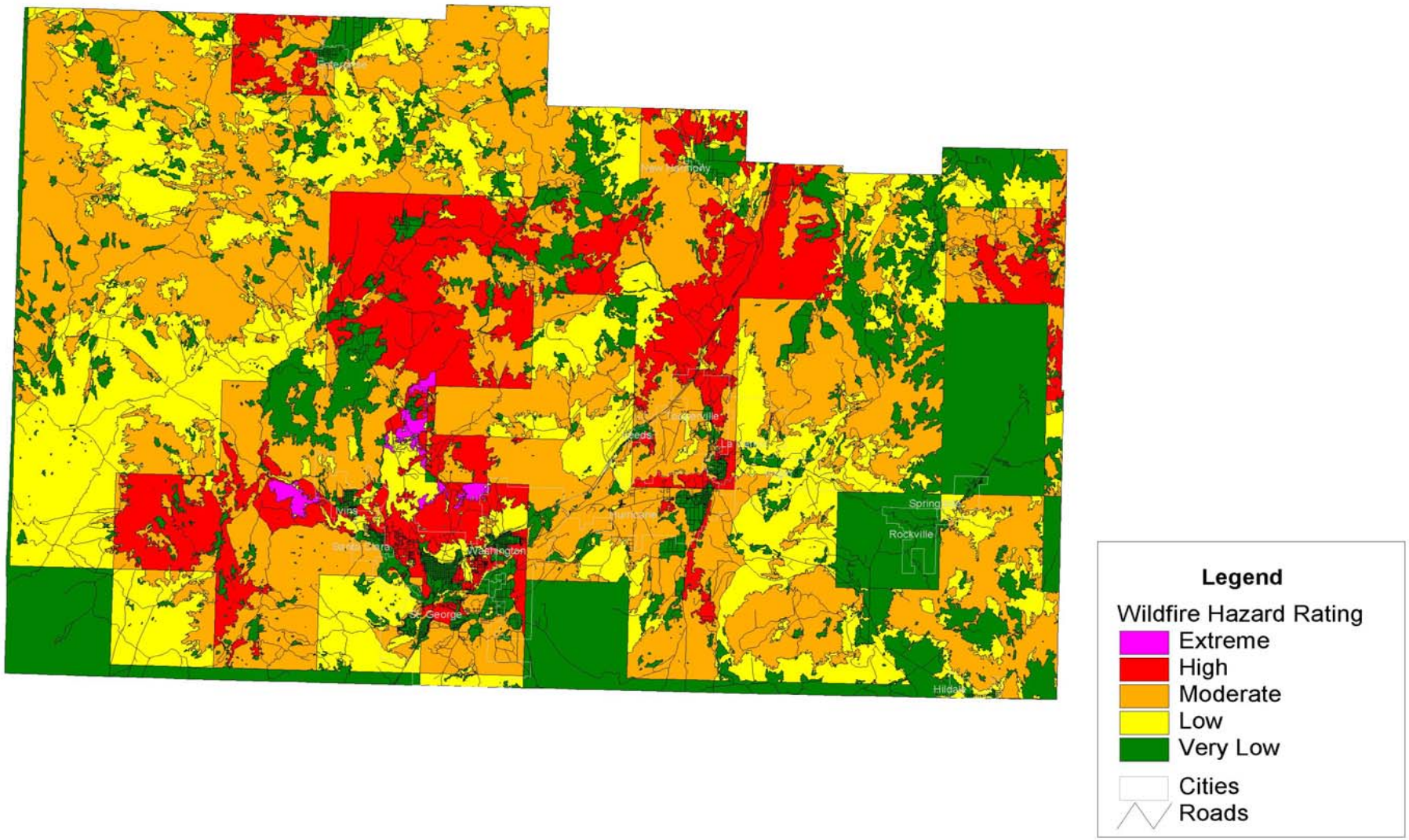
Legend

Wildfire Hazard Rating

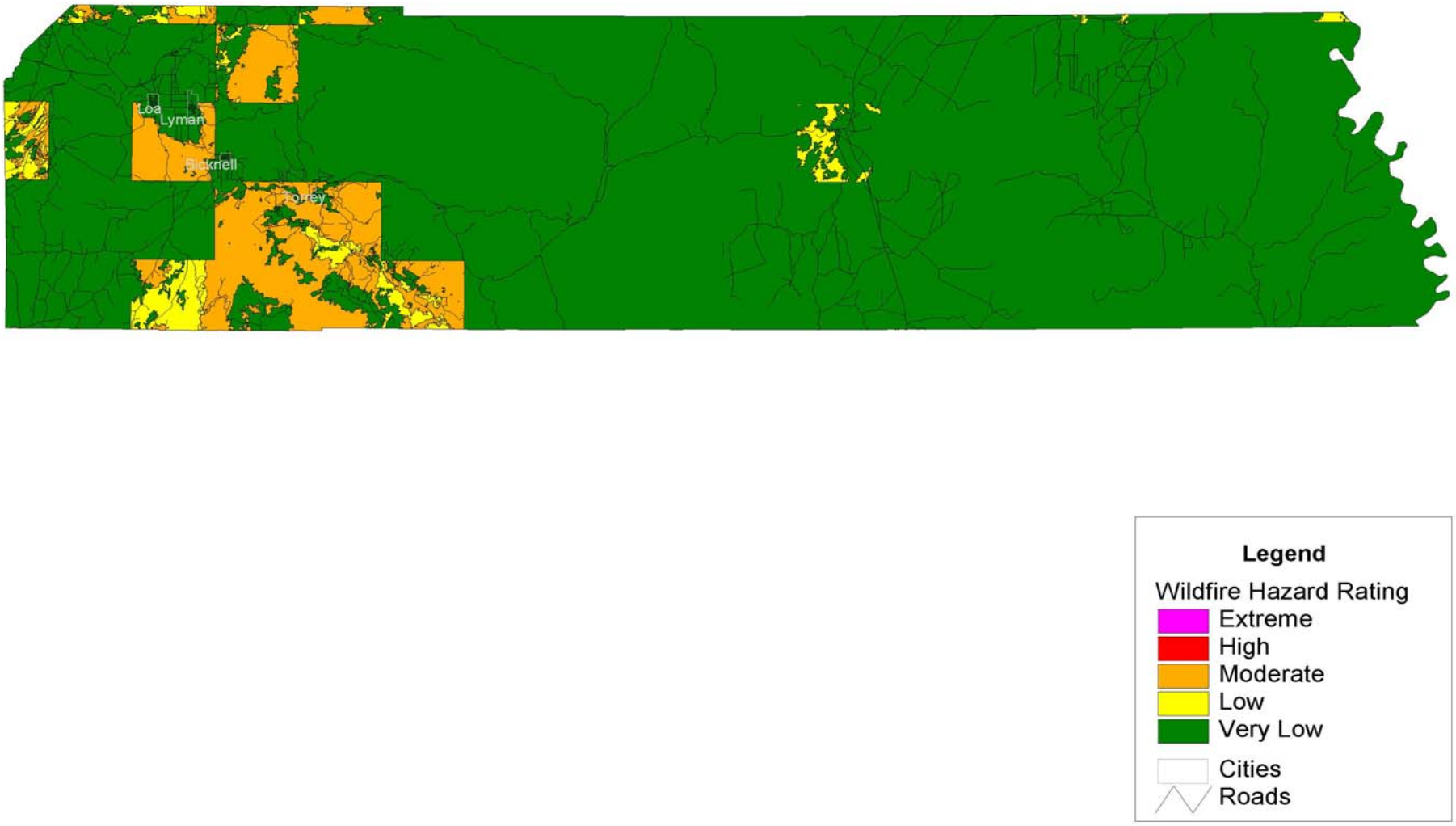
- Extreme
- High
- Moderate
- Low
- Very Low

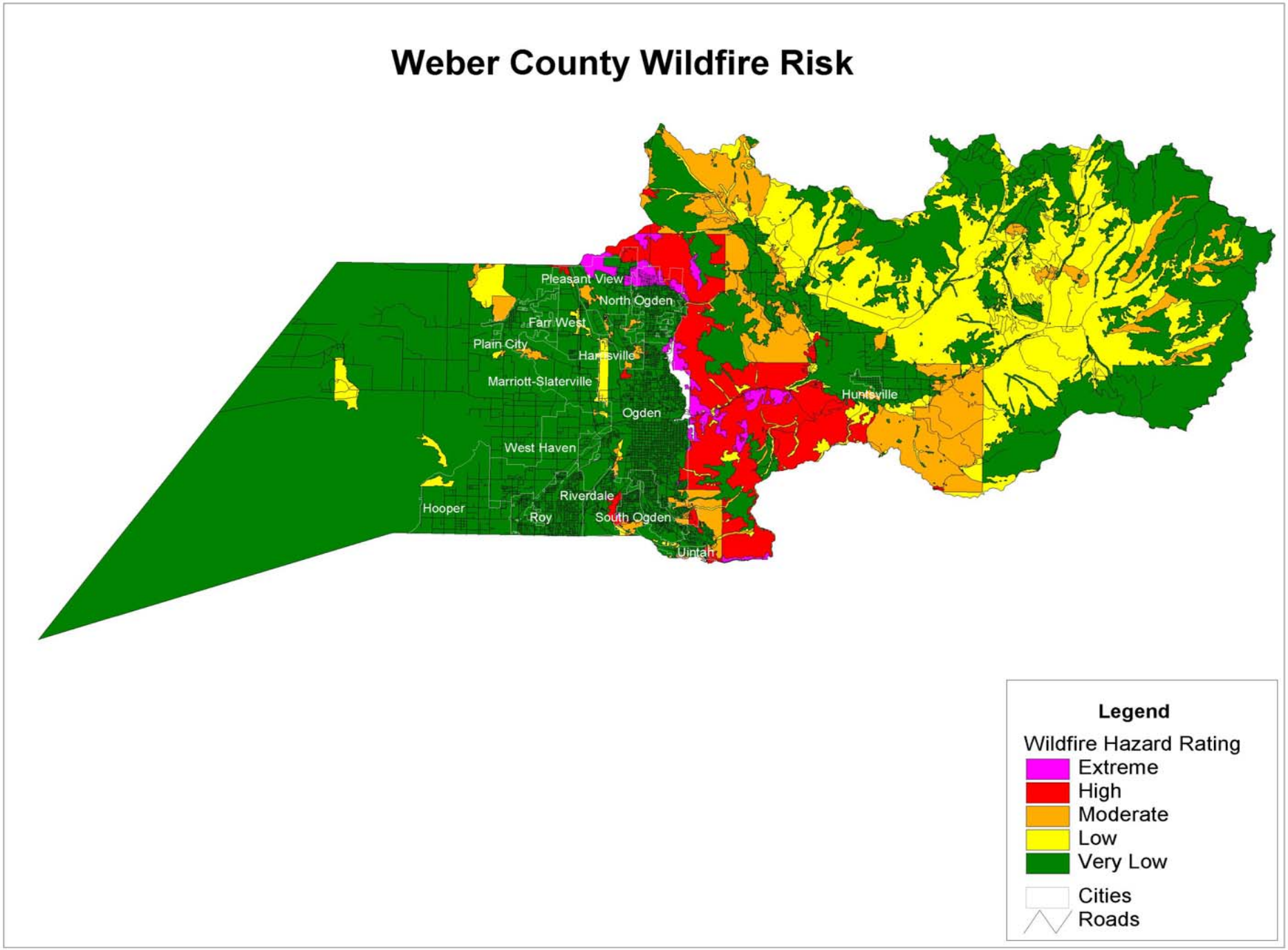
- Cities
- Roads

Washington County Wildfire Risk



Wayne County Wildfire Risk




Weber County Wildfire Risk
Pleasant View
North Ogden
Farr West
Plain City
Harrisville
Marriott-Slaterville
Huntsville
Ogden
West Haven
Riverdale
Hooper
Roy
South Ogden
Uintah
Legend
Wildfire Hazard Rating
Extreme
High
Moderate
Low
Very Low
Cities
Roads

Mitigation Strategy Concept

[The mitigation strategy shall include] a description of State goals to guide the selection of activities to mitigate and reduce potential losses.

Hazard identification presented later in this document along with the risk analysis within each chapter, together identify the likelihood of a natural hazard having severe enough consequences to warrant mitigation. The UPDMPC has developed goals, objectives, and action items specific to each hazard, when united they provide a strategy to lessen the vulnerability of each specified hazard. Strategies developed for each hazard are not all inclusive and the state reserves the right to modify strategies as it sees fit to address mitigation needs as they arise. Future occurrences, new technology, or an unforeseen event could result in a modification to strategies outlined in this plan.

Even though a potential project may not be listed in this plan as a specific mitigation action, the State will still aid in completing the project, as if it were a projected listed in this state mitigation plan. State support will be applied to any mitigation action deemed cost effective and environmentally sound, which can be classified under any of the six FEMA approved mitigation categories:

Prevention
Keeps problems form getting started of getting worse. The use of known hazards areas, like floodplains for example, can be limited through planning, land acquisition, or regulation.

Property Protection
Measures are those actions that go directly to permanently getting people , property, and businesses out of unsafe areas where, in terms of wise disaster planning they shouldn't have been in the first place.

Natural Resource Protection
Projects pertaining to natural resource protection preserve or restore natural areas or their natural functions.

Emergency Services
Measures are taken during a disaster to minimize its impacts. These measures are the responsibility of city and county emergency managers, operators of major and critical facilities, and local emergency service organizations.

Structural Projects
Structural projects are usually designed by engineers are designed to reduce or redirect the impact of natural disasters away from at-risk population areas.

Public Information
Public information advises property owners, potential property owners, and others of hazards and ways to protect people and property from them.

Additional information and suggested projects under these classifications can be found in the State of Utah Mitigation Menu in Appendix B

In this plan the following definitions apply, with regards to the layout of state mitigation strategies:

Mitigation Strategies: A method by which an aspect of a specific hazard could be mitigated. A strategy consists of at least one goal per hazard, at least one objective per goal, and at least one-action items per objective. A strategy is not complete without all three.

Goal: A statement of an ideal condition that addresses a specific aspect of a hazard to reduce the severity of its impact. Goals are not fully attainable.

Objective: A statement of a step that could reasonably be taken toward achieving a goal. Objectives may be difficult to reach, but are attainable within the planning timeframe.

Potential Projects: A specific activity that could be undertaken to provide one step toward an objective. Many of the specific action items in this plan enforce mitigation actions generated at the local level.

Per DMA 2000 requirements, State Hazard Mitigation, plans must address critical facilities, especially those owned by the State. Specific mitigation strategies exist through out his plan for state owned facilities; this is particularly true for those critical facilities found to lie within high hazard boundaries.

Strategies reflect what Utah would like to mitigate. These strategies do not take into account the biggest limiting factor in successfully completing mitigation, funding! Thus, implementation of the mitigation strategies listed in this plan or any of the locally adopted PDM plans is contingent upon the sponsor receiving financial support.

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies related to severe weather can be found in the local mitigation strategies section of this mitigation plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporation into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

Section Five of this mitigation plan contains a comprehensive table of locally generated mitigation projects. The projects in the matrix are from the seven regional mitigation plans and represent a state wide list of mitigation projects.

Goals

Short Term Goals

These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster.

- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards.
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources. If an earthquake occurs outside of the county seat it will still affect the county seat. This is similar to many natural hazards.
- Establish a framework and database for the county seat to use to apply for aid.

State Plan Mitigation Strategies

State plans shall include] an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified

Dam Safety ✔

The Division of Water Rights Dam Safety Section is in charge of maintaining dam safety within the state of Utah. Dam Safety is inherently, by nature and definition, centered on mitigation. Thus the single most important dam safety mitigation strategy would be continued funding at an

elevated level. Elevated funding would allow the state to bring more dams up to current standards in a shorter amount of time.

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies pertaining to dam safety can be found in the local mitigation strategies section of this mitigation plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporation into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

#1 Priority Goal: Eliminate unsafe dams in the State of Utah.

A. Objective: Bring existing dams up to current standards.
Possible projects:
1. Complete the Dam Safety projects prioritized in the Dam Rehabilitation Priority Listing done by Dam Safety Section. The priority listing is available in Appendix J.
2. Complete Piute, Sevier Bridge, Big Sand Wash, Red Butte, Tony Grove, Mill Meadows, Wide Hollow, DMAD, and Gunnison Bend Dam safety improvement projects.

Responsible agencies:
Utah Division of Water Rights Dam Safety Section
Private individuals, businesses, and water districts whom own dams.
Possible funding:
HMGP, PDM, State Dam Safety

#2 Priority Goal: Bring advances in the scientific and engineering fields into dam safety planning.

A. Objective: Update dam Emergency Action Plans EAP.
Possible projects:
1. Updated all dated EAP plans off of a prioritized risk table.
2. Digitized dam failure inundation maps for use in Geographic Information Systems.

Responsible agencies:
Utah Division of Water Rights Dam Safety Section
Division of Emergency Services and Homeland Security
Private individuals and companies who own dams.
Possible funding:
HMGP, PDM, State Dam Safety

B. Objective: Study dam failure vulnerability.
Possible projects:

3. Utilized digitized dam failure inundation map to calculate locational vulnerability.
4. Estimate losses for inundated areas to validate dam upgrades.

Responsible agencies:

Utah Division of Water Rights Dam Safety Section
Division of Emergency Services and Homeland Security
Automated Geographic Reference Center
Private individuals, businesses, and water districts whom own dams.

Possible funding:

HMGP, PDM, State Dam Safety

Drought Mitigation Strategies ✔

The impacts of drought can be partially mitigated through cooperative partnerships between state and federal agencies, Tribes, public land users, and the Governor's Office. The unique composition of land ownership in Utah means drought mitigation must be completed through multi-agency efforts utilizing multi-disciplinary teams. Mitigation strategies listed below support the statewide drought mitigation plan, Utah Partners for Conservation and Development Drought Assessment and Mitigation State of the State Report (Appendix H), Land Use Plans from land management agencies, the State Drought Plan Appendix G. The bottom line is, it takes teamwork, science, and above all time, patience, and communication to mitigate the economic, social, and environmental impacts of drought.

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures which yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies can be found in the local mitigation strategies section of this plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporation into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

#1 Priority Goal: To conserve existing water resources in all sectors.

A. Objective: *To educate the public about water conservation at home and in the workplace.*

Possible projects:

1. Provide related printed and broadcast material.
2. Provide teacher education on this subject for classroom use.
3. Provide speakers for civic groups and schools.

Responsible agencies:

State government for technical assistance and program development.

Local government for program development and delivery.

Possible funding:

Local government operating budget.

B. Objective: To adopt strict water conservation practices in all state buildings.

Possible projects:

1. Retrofit buildings with water saving devices.
2. Educate employees about water conservation in the workplace.
3 Develop and install water conserving landscaping.

Responsible agencies:

State government for program development and delivery.

Possible funding:

State government operating budget.

C. Objective: *To conserve water within the agricultural sector.*
Possible projects:
1. Develop and demonstrate water conservation practices for agricultural use.
2. Promote the use of treated wastewater effluent where appropriate.
Responsible agencies:
State government for technical assistance.
Local government for program development and delivery.
Possible funding:
Local government operating budget.

#2 Priority Goal: To reduce the impact of development on water resources.

A. Objective: *To enhance building codes for new construction in areas where potable water supply is a problem.*
Possible projects:
1. Modify existing building codes or adopt new ones where appropriate.
2 Require water-conserving landscaping.
3. Require the use of water-conserving appliances and fixtures in new construction.
Responsible agencies:
State government for technical assistance.
Local government for program development and delivery.
Possible funding:
Local government operating budget.

B. Objective: *To develop demonstration projects to show the public how they can retrofit their property with appropriate water conservation technology.*
Possible projects:
1. Develop demonstration projects to show how to utilize water conservation technology including, but not limited to, graywater use and rainwater capture.
Responsible agencies:
State government for technical assistance.
Public water systems for program development and delivery.
Possible funding:
Public water system operating budget.

C. Objective: *To require that all public water systems have drought contingency plans.*
Possible projects:
1. Provide technical assistance for drought contingency planning.
Responsible agencies:

State government for technical assistance.
Local government for program development and delivery.

Possible funding:

Local government operating budget.

#3 Priority Goal: To improve public water infrastructure.

A. Objective: *To reduce water loss within public water infrastructure.*

Possible projects:

1. Identify and correct leakage from water mains.

Responsible agencies:

State government for technical assistance.
Local government for program development and delivery.

Possible funding:

Local government operating budget.

B. Objective: *To reduce water use by consumers.*

Possible projects:

1. Meter all water usage within water systems.
2. Set water rates that encourage water conservation and cover the cost of operations and maintenance.

Responsible agencies:

State government for technical assistance.
Local government for program development and delivery.

Possible funding:

Local government operating budget.

C. Objective: *To increase efficiency through shared system management.*

Possible projects:

1. Develop incentives for public water systems to conserve their resources through merger or sharing.

Responsible agencies:

State government for technical assistance.
Public water systems for mutual cooperation.

Possible funding:

Public water system operating budget.

D. Objective: *To expand and improve existing potable water systems.*

Possible projects:

1. Enhance the productivity and efficiency of existing raw water extraction methods.
2. Develop new well fields or surface water sources for public drinking water.

Responsible agencies:

State government for technical assistance.
Public water systems for program development and delivery.

Possible funding:

Public water system operating budget.

E Objective: *Support the State's Drought Mitigation Plans and initiatives.*

Possible projects:

1. Support the State Department of Natural Resources Water Resources Section in developing and updating the state drought plan.

Responsible agencies:

State Water Resources
Public water systems users
National Weather Service.

Possible funding:

Operating budgets of involved Agencies.

Earthquake Mitigation Strategies ✔

In addition to the mitigation strategies detailed below, the State Natural Hazard Mitigation Plan also incorporates any seismic mitigation-indorsed by the Utah Seismic Safety Commission, and fully incorporates "A Strategic Plan for Earthquake Safety In Utah" completed in January 1995 by the Utah Seismic Safety Commission. A Strategic Plan of Earthquake Safety in Utah is located in Appendix C along with Earthquake Safety in Utah, A Progress Report on the Activities and Accomplishments of the Utah Seismic Safety Commission, December 2000.

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the state's technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies for earthquakes is found in the local mitigation strategies section of this mitigation plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporated into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Governments.

#1 Priority Goal: To reduce the effects of earthquakes on critical facilities.

A. Objective: *To prepare digital maps that locate critical facilities in earthquake zones.*
Possible Projects:
1. Support seismic mitigation of state-owned critical facilities.
2. Develop maps showing critical facilities overlaid on the earthquake hazard.

Responsible agencies:
State government for state-owned facilities.
Local government for other facilities.
Possible funding:
State and local government operating budgets.

B. Objective: *To retrofit critical facilities to withstand earthquakes.*
Possible projects:
1. Reinforce the most hazard-prone parts of critical facilities.
2. State Capitol retro-fit

Responsible agencies:
Owners of those facilities.
Possible funding:
HMGP, PDM for public facilities.

#2 Priority Goal: To reduce the effects of earthquakes on businesses, residential structures, and public buildings.

A. Objective: *To retrofit businesses, residential structures, and public buildings to withstand moderate earthquakes.*
Possible projects:

1. University of Utah J.W. Willard Marriott Library
2. State Capitol building
3. Reinforce the most hazard-prone parts of businesses, residences, and public buildings.

Responsible agencies:
Owners of those buildings.

Possible funding:
HMGP, PDM for public buildings

#3 Priority Goal: To include seismic standards in building codes where appropriate.

A. Objective: *Better enforcement of the seismic standards in the International Building Code IBC, which have been adopted statewide.*

Possible projects:
1. Training of building inspectors to the seismic provision in IBC

Responsible agencies:
State government for technical assistance.
Local government for code enhancement and enforcement.

Possible funding:
Local government operating budget.

#4 Priority Goal: To educate the public about earthquake safety, earthquake mitigation actions at home and in the workplace, etc.

A. Objective: *To develop and disseminate earthquake safety programs for the public.*

Possible projects:
1. Provide printed and broadcast material.
2. Community Emergency Response Teams CERT
2. Provide teacher education and presentations for schools and civic groups.

Responsible agencies:
State government for technical assistance.
Local government for program development and delivery.

Possible funding:
HMGP, PDM
Local government operating budget.

Flood Mitigation Strategies ✔

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies completed, as part of the seven AOG plans is located in the mitigation strategy section of this mitigation plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporation into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

#1 Priority Goal: To obtain benefits of NFIP for all property owners.

A. Objective: *To update and digitize all Flood Insurance Rate Maps (FIRMs).*
Possible projects:
1. Initiate planning process for the Map Modernization Program.
2. Commence map modernization on a prioritized basis.

Responsible agencies:
State government, Division of Emergency Services
Possible funding:
FEMA grant under Floodplain Map Modernization

B. Objective: *To have all jurisdictions participate in NFIP*.
Possible projects:
1. Enact legislation requiring all eligible jurisdictions to participate in NFIP.
2. Promote the benefits of NFIP participation to all jurisdictions.

Responsible agencies:
State government for NFIP guidance
Local government for NFIP ordinance and enforcement
Possible funding:
Local government operating budget

C. Objective: *To lower policy holders' insurance rates through participation in the Community Rating System (CRS).*
Possible projects:
1. Eligible communities participate in CRS.

Responsible agencies:
State government for guidance and periodic CRS evaluation.
Local government for CRS program compliance.
Possible funding:
Local government operating budget

D. Objective: *To identify for the purposes of vulnerability insurable and non-insurable structures in the flood hazard area.*
Possible projects:

1. Locate all such structures through use of GIS digital floodplain maps.

Responsible agencies:

Local government

Possible funding:

Local government operating budget

E. Objective: *To regulate the alteration of existing drainage patterns by new development.*

Possible projects:

1. Adopt codes and ordinances that set reasonable limits on the alteration of drainage patterns due to new development.
2. Provide technical assistance for the development or modification of codes and ordinances related to this mitigation objective.

Responsible agencies:

State government to provide technical assistance.

Local government to enact and enforce codes and ordinances.

Possible funding:

Local government operating budget

#2 Priority Goal: To mitigate flood loss by structural projects.

A. Objective: *To survey all roads, bridges, and drainage structures determine their ability to withstand and pass the highest anticipated flood.*

Possible projects:

1. Identify and map all inadequate structures.
2. Propose solutions to any problems disclosed in the survey.

Responsible agencies:

State government for state-owned property.

State government for technical assistance to local governments.

Local government for property within their jurisdiction.

Possible funding:

State agency operating budgets.

Local government operating budgets.

B. Objective: *To provide maintenance, repairs, and improvements to roads, bridges, and drainage structures.*

Possible projects:

1. Remove debris and vegetation from floodways and drainage structures through a systematic maintenance program.
2. Improve flood resistance through enhancement of wing walls, flood barriers, foundations, etc., at likely flood impact points.
3. Construct debris basins, flood retention ponds, energy dissipaters, etc., to control the flow and release of flood waters.

Responsible agencies:

State government for state-owned property.

Local government for property within their jurisdiction.

Possible funding:
State and local operating budgets for maintenance and repair.
HMGP, PDM for structural projects.

#3 Priority Goal: To assure that all people have basic information relating to flood issues.

A. Objective: *To provide flood-related information through print and broadcast media.*
Possible projects:
1. Prepare and disseminate brochures, public service spots, etc., related to flood mitigation and flood safety issues.
Responsible agencies:
State government for technical assistance.
Local government for program development and execution.
Possible funding:
HMGP, PDM, FMA

B. Objective: *To provide information and programs to schools.*
Possible projects:
1. To prepare and deliver flood related programs and materials for schools.
Responsible agencies:
State government for technical assistance.
Local government for program development and execution.
Possible funding:
HMGP, PDM, FMA

#4 Priority Goal: To mitigate flooding as a result of wildfires.

A. Objective: *To re-vegetate and rehabilitate areas burned by wildfire.*
Possible projects:
1. Identify areas where re-vegetation and rehabilitation is necessary, and prioritize.
2. Commence re-vegetation and rehabilitation on a priority basis.
Responsible agencies:
Federal and state government for areas within their jurisdiction.
Federal and state government for technical assistance.
Local government for areas within their jurisdiction.
Possible funding:
Federal programs via USFS, BLM, NRCS, or others.
HMGP and PDM unlikely due to immediate need.

B. Objective: *To construct temporary debris traps and other flood mitigating structures in wildfire-burned areas.*
Possible projects:
1. Identify areas where such construction is necessary, and prioritize.

2. Commence construction on a priority basis.

Responsible agencies:

Federal and state government for areas within their jurisdiction.
Federal and state government for technical assistance.
Local government for areas within their jurisdiction.

Possible funding:

Federal programs via USFS, BLM, NRCS, or others.
HMGP and PDM unlikely due to immediate need.

#5 Priority Goal: To provide support for all feasible flood related mitigation developed or proposed by a local jurisdiction.

A. Objective: *To support locally generated flood mitigation.*

Possible projects:

3. To numerous to list see local mitigation section of this plan for details on mitigation proposed by the local jurisdictions.

Responsible agencies:

Federal and state government for areas within their jurisdiction.
Federal and state government for technical assistance.
Local government for areas within their jurisdiction.

Possible funding:

Federal programs via USFS, BLM, NRCS, or others.
HMGP and PDM.

Landslide Mitigation Strategies ✔

State plans shall include] an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies developed as part of the county mitigation working groups were used in the multi-jurisdictional plans and can be found in the local mitigation strategies in this plan. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporated into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

#1 Priority Goal: To reduce the impacts of landslides on critical facilities

A. Objective: *Prepare digital maps that locate critical facilities in relation to potential landslide threats.*
Possible Projects:
3. Support seismic mitigation of state own critical facilities.
4. Develop maps showing critical facilities located in the landslide hazard area.

Responsible agencies:
State government for state-owned facilities.
Local government for other facilities.
Possible funding:
State and local government operating budgets.

#2 Priority Goal: Increase the level of knowledge related to landslides

B. Objective: *Educate general public on landslide risk.*
Possible projects:
5. Utah Geologic Survey website
6. Division of Emergency Services website
7. Training manuals
8. Educational publications

Responsible agencies:
Utah Geologic Survey
Division of Emergency Services
Possible funding:
HMGP, PDM for public facilities.

C. Objective: *Provide educational and training opportunities for city and county planners*

Possible projects:

9. Conduct half day landslide awareness training
10. Develop county landslide susceptibility maps for use in city and county planning

Responsible agencies:

United States Geologic Survey
Utah Geologic Survey
Division of Emergency Services

Possible funding:

HMGP, PDM for public facilities.

D. Objective: *Educate developers*

Possible projects:

11. Provide training to developers on landslide, there risks, and potential mitigation and legal liability.

Responsible agencies:

Utah Geologic Survey
Division of Emergency Services

Possible funding:

HMGP, PDM for public facilities.

#3 Priority Goal: Monitor landslide movement

E. Objective: *Continue to monitor landslide movement and respond to landslide activity.*

Possible projects:

12. Continued monitoring of landslide movement by the Utah Geologic Survey.
13. Continued field response to debris flows, landslides, and rock falls by the Utah Geologic Survey

Responsible agencies:

Utah Geologic Survey

Possible funding:

Utah Geologic Survey operating budget.

#4 Priority Goal: Encourage Cities, Towns, and Counties to develop ordinances for geologic hazards.

F. Objective: *Enable counties to develop ordinances*

Possible projects:

14. Develop updated landslide susceptibility maps starting with those areas most prone to landslides.
15. Continue to fund geotechnical report reviews. Currently upon request the Utah Geologic Survey will review geologic reports submitted by cities and counties.

16. Develop model ordinances and assist city and counties in development of geologic hazard ordinances.

Responsible agencies:

Utah Geologic Survey
Department of Natural Resources
Division of Emergency Services

Possible funding:

Utah Geologic Survey operating budget, HMGP, PDM, city and county.

Severe Weather Mitigation Strategies ✔

#1 Priority Goal: To assure that all people have basic information relating to severe weather issues.

A. Objective: *To provide weather-related information through print and broadcast media.*

Possible projects:

1. Prepare and disseminate brochures, public service spots, etc., related to severe weather, including, but not limited to, thunderstorms, tornados, lightning, hail, heavy snow fall, ice storms, extreme cold, and extreme heat.

Responsible agencies:

National Weather Service for publications.
American Red Cross for publications.
State government for technical assistance.
Local government for program development and execution.

Possible funding:

HMGP, PDM

B. Objective: *To provide severe weather information and programs to schools.*

Possible projects:

2. Prepare and deliver severe weather-related programs and materials for schools.

Responsible agencies:

National Weather Service for publications.
American Red Cross for publications.
State government for technical assistance.
Local government for program development and execution.

Possible funding:

HMGP, PDM

#2 Priority Goal: To provide or enhance severe weather warning systems.

A. Objective: *To be able to warn people in tornado-prone areas through appropriate technology.*

Possible projects:

1. Increase participation the National Weather Service StormReady program.
2. Increase weather radio availability

Responsible agencies:

National Weather Service
State government for technical assistance and grant funding.
Local government for program development and execution.

Possible funding:

HMGP, PDM

B. Objective: *To be able to warn people of hazardous weather via broadcast media.*

Possible projects:

1. Enhance the Emergency Alert System (TV and radio) statewide.
2. Enhance NOAA Weather Radio coverage statewide.

Responsible agencies:

State government.

Possible funding:

HMGP, PDM

#3 Priority Goal: Enhance avalanche knowledge and warning ability

A. Objective: *To be able to warn people in potentially avalanche prone areas through appropriate technology.*

Possible projects:

1. Continued support and funding of the Utah Avalanche Forecast Center UAFC. The UAFC has numerous warning systems in place with an avalanche warning posted on the web and through their hotline each morning.

Responsible agencies:

National Weather Service
U.S. Forest Service
State government for technical assistance and grant funding.
Local government for program development and execution.

Possible funding:

HMGP, PDM

B. Objective: *Increase the avalanche skill base among the various users groups*

Possible projects:

2. Continued support and funding of the Utah Avalanche Forecast Center
3. Low or no cost avalanche education similar to the avalanche education offered by the Utah Avalanche Forecast Center or avalanche expert.
4. Tie in with ski resorts to assist in offering avalanche training.
5. Conduct training specific to snowmobilers.
6. Increase avalanche knowledge of city and county emergency managers.

Responsible agencies:

National Weather Service
U.S. Forest Service
State government for technical assistance and grant funding.
Local government for program development and execution.

Possible funding:

HMGP, PDM

#3 Priority Goal: To design public buildings and private property to withstand the effects of severe weather.

A. Objective: *To require that all new construction of any type meet enhanced standards for wind-loading, snow-loading, and other weather-related hazards.*

Possible projects:

1. Develop codes and ordinances that require safe rooms in new construction.

Responsible agencies:

State government for technical assistance.
Local government for code development and enforcement.

Possible funding:

Local government operating budget.

C. Objective: *To retrofit existing structures to meet extreme weather standards.*

Possible projects:

1. Ensure retrofits comply with new building codes.

Responsible agencies:

State government for technical assistance.
Local government for program development and execution.

Possible funding:

HMGP, PDM, local government operating budget.

D. Objective: *To identify and equip public buildings to serve as shelters for travelers stranded because of severe winter storms.*

Possible projects:

1. Identify suitable public buildings and equip them with supplies and emergency power generation capability.

Responsible agencies:

American Red Cross for guidance on shelter requirements.
State government for technical assistance.
Local government for program development and execution.

Possible funding:

HMGP, PDM, local government operating budget.

Wildfire Mitigation Strategies ✔

The majority of mitigation projects in Utah are locally determined and prioritized based on community priorities. Part of the states technical assistance efforts have been directed to assisting communities in identifying cost effective mitigation measures that will yield benefits toward reducing their risk to hazards. A complete list of locally generated mitigation strategies relating to wildfire is available in the local mitigation strategies section of this mitigation. Interdisciplinary multi-jurisdictional working groups, coordinated at the county level, generated these mitigation strategies, which were incorporation into the regional Pre-Disaster Mitigation plans completed by the seven Associations of Government.

#1 Priority Goal: To eliminate dangerous fuel loading in wildlands.

A. Objective: *To reduce fuel loads in and around critical facilities, regardless of ownership.*

Possible projects:

1. Reduce fuels in the vicinity of power stations, power lines, and transformer sites.
2. Reduce fuels along major transportation routes, prioritized by vulnerability and usage.
3. Reduce fuels in critical watersheds.
4. Reduce fuels around other critical facilities.

Responsible agencies:

State government for state-owned facilities and acreage.
Federal government for federal facilities and acreage.
Local government for their own jurisdictions.
DPS-OEM for Mitigation grants.
EMNRD-Forestry Division for various grants.
Private individuals and companies for their own property

Possible funding:

HMGP, PDM, SFA-WUI, FLEP

B. Objective: *To reduce fuels on private property.*

Possible projects:

1. Provide assistance with disposition of vegetative material removed from private land, as through chipping or burning.
2. Develop programs for re-use of vegetative material that would contribute to the local economy.

Responsible agencies:

State and local government for providing assistance.
DPS-OEM for Mitigation grants.
EMNRD-Forestry Division for various grants.
USFS for various grants.
Private individuals and businesses for their own property

Possible funding:

HMGP, PDM, SFA-WUI, FLEP, RCA-EAP, CFRP

C. Objective: *To reduce fuels on public lands.*

Possible projects:

1. Provide assistance with disposition of vegetative material removed from public land, as through chipping or burning.
2. Develop programs for re-use of vegetative material that would contribute to the local economy.

Responsible agencies:

Federal, state and local government for their jurisdictions.
DPS-OEM for Mitigation grants.
EMNRD-Forestry Division for various grants.
USFS for various grants.

Possible funding:

HMGP, PDM, SFA-WUI, FLEP, RCA-EAP, CFRP

#2 Priority Goal: To provide public information and education regarding the wildfire hazard and what people can do about it.

A. Objective: *To provide public information through print and broadcast media on the subject of defensible space.*

Possible projects:

1. Develop and disseminate printed information on the subject of defensible space, to include (but not limited to): (a) reducing fuels; (b) building with fire-resistant materials; (c) designing roads and driveways; (d) protecting utilities; and (e) using fire-resistant landscaping.

2. Develop and disseminate radio and TV spots for the same.

Responsible agencies:

State government for technical assistance and dissemination of information to local governments. Local government for dissemination of information to people in their jurisdictions. DPS-OEM for grant funding.

Possible funding:

HMGP, PDM

B. Objective: *To provide educational community meetings and seminars on the subject of defensible space.*

Possible projects:

1. Develop and deliver community meetings and seminars on the subject of defensible space.
2. Develop demonstration project to illustrate defensible space tactics.

Responsible agencies:

State government for technical assistance and assistance with delivery of meetings.

Local government for delivery of meetings and development of demonstration project.

DPS-OEM for grant funding.

Possible funding:

HMGP, PDM
Local government operating budgets

C. Objective: *To provide information and technical assistance to local government planners and private developers on the subject of fire*-resistant communities.
Possible projects:
1. Develop and deliver printed materials to guide planners and developers in utilizing defensible space tactics when laying out subdivisions and other development projects.
Responsible agencies:
State government for technical assistance and dissemination of information to interested parties.
Local government for dissemination of information to interested parties in their jurisdictions.
DPS-OEM for grant funding.
Possible funding:
HMGP, PDM
Local government operating budgets

D. Objective: *To provide public information on the subject of what to do if a wildfire is nearby.*
Possible projects:
1. Develop and deliver public information on personal and family preparedness for evacuation and/or defense if a wildfire appears to be threatening.
Responsible agencies:
State government for technical assistance and dissemination of information to local governments.
Local government for dissemination of information to people in their jurisdictions.
DPS-OEM for grant funding.
Possible funding:
HMGP, PDM
Local government operating budgets

#3 Priority Goal: To encourage and assist local governments to require property owners and developers to utilize defensible space tactics.

A. Objective: *To develop local code enhancements that require utilization of defensible space tactics where appropriate.*
Possible projects:
1. Develop and enact appropriate code enhancements.
Responsible agencies:
State government for technical assistance.
Local government for code development and enforcement.
Possible funding:
Local government operating budget.

#4 Priority Goal: To complete the rural addressing program and digital maps that locate critical facilities, subdivisions, fire fighting resources, roads and bridges, and specific private addresses.

A. Objective: *To identify every residence or business with a street name and address.*
Possible projects:
1. Complete the rural addressing program and stay current with it.
Responsible agencies:
Local government.
Possible funding:
Local government operating budget.

B. Objective: *To develop digital maps of the wildland-urban interface.*
Possible projects:
1. Digitally map all street addresses, critical facilities, fire fighting resources, etc., in the wildland-urban interface.
2. Extend digital mapping to include all areas subject to the wildfire hazard.
Responsible agencies:
State government for technical assistance.
Local government for doing the work.
Possible funding:
Local government operating budget.

#5 Priority Goal: To provide training, equipment, and resources for fire departments to fight wildfires.

A. Objective: *To enhance existing wildfire training programs and equipment procurement for fire departments.*
Possible projects:
1. Enhance existing programs.
Responsible agencies:
State government for technical assistance.
Local government for requesting assistance.
Possible funding:
HMGP, PDM, SFA-WUI, RFA, VFA
Local government operating budgets

B. Objective: *To enhance existing or develop new fire fighting resources for wildfire suppression.*
Possible projects:
1. Enhance existing or develop new water sources in wildfire-prone areas.
2. Maintain water filling areas for helicopters.
Responsible agencies:
Local governments

Possible funding:

HMGP, PDM, SFA-WUI, local government operating budgets

C. Objective: *To preposition extra fire fighting resources prior to the beginning of the fire season.*

Possible projects:

1. Contract with air and ground fire fighting contractors to position their assets at key points within the state.

Responsible agencies:

State government

Possible funding:

State operating budget

All Hazard Mitigation Strategies ✔

All hazard mitigation strategies are those strategies, which do not directly correspond with one hazards or in there completion mitigate a number of hazards. The emphasis in the all hazard mitigation arena in the coming years will be to include man made hazards and terrorism in the state mitigation plan, refine the current plan in an attempt to have it meet the federal requirements as an enhanced mitigation plan, and finally to increase the accuracy of the vulnerability assessment. Completing these strategies will allow the mitigation plan to be a more useful plan to the end users.

#1 Priority Goal: Improve the State's Disaster Response and Recovery Capability.

A. Objective: *Facilitate the enhancement of State and local Emergency Recovery Plans and provide related training and technical assistance.*

Possible projects:

1. Facilitate the review of existing Disaster Recovery Plans for potential enhancement with respect to All Natural and Man-made Hazard Mitigation initiatives
2. Provide planning and related technical resources to facilitate the enhancement of Disaster Recovery Plans to include Hazard Mitigation initiatives

Responsible agencies:

State government, Division of Emergency Services

Possible funding:

EMPG, HMGP, FMA, DRI, State

#2 Priority Goal: Continued and forceful involvement with mitigation planning in Utah.

A. Objective: *Push for an Enhanced PDM plan.*

Possible projects:

1. Have a state mitigation plan approved by November 1, 2004
2. Submit a PDM-C grant application to
   i. Increase the accuracy of GIS data utilized in the current plan
   ii. Digitize the state owned facilities data base
3. Review DES records to support financial management of federal funding. DES has successfully managed the federal funding for the Olympics, Homeland Security, CESSP, EMPG, and DR-1285.

Responsible agencies:

State government, Division of Emergency Services

Possible funding:

EMPG, HMGP, FMA, PDM, State

B. Objective: *To provide technical assistance, especially during the planning review process, to regional planning agencies and communities in a timely manner, with a turnaround time no greater than 2 weeks, as the multi-jurisdictional and local plans are completed.*

Possible projects:

1. Continued involvement with the SHMT
2. Continued coordination with the SHMO, Earthquake Program Manager, and State Flood Plain Manager
3. Coordination with FEMA
4. Standing Natural Hazard PDM plan review committee.

Responsible agencies:

State government, Division of Emergency Services

Possible funding:

EMPG, HMGP, FMA, PDM, State

Local Capability Assessment

[The State mitigation strategy shall include]: a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.

Staff at Division of Emergency Services, have been actively working with local government to identify measures most effective for hazard mitigation planning. The State of Utah has a history of strong property owners' rights. The value residents of Utah place on property rights seems to be waning as Utah's population becomes more urban. This coupled with recent events such as the five years of drought, Farmington wildfire and Santaquin Debris flows as well as large wildfires in New Mexico, Montana, Colorado, and recently California have opened the door for hazard mitigation. The UPDMPC worked with the seven Associations of Governments to identify measures most effective in reducing the risk to natural hazards.

This process yielded results at opposite ends of the scale. Urban areas within the state have highly sophisticated planning departments enforcing land use planning through zoning ordinances and site-specific building ordinances. In the case of communities along the Wasatch Front regional planning is taking hold. This planning primarily addresses transportation, land use, flood control, and water resources. A good example of this is Envision Utah a multi-jurisdictional planning initiative to encourage smart growth along the Wasatch Front. Almost all of the urban cities and counties along the Wasatch Front have planners, zoning officials, building inspectors, and full time emergency managers. Combined, this results in an effective ability to mitigate natural hazards.

At the other end of the scale are the rural areas of Utah. These areas are with the exception of Washington and Summit Counties those areas of the state having a more rural makeup, these areas do not have a tax base large enough to sustain the staff required to provide planning, zoning, and building inspections functions within their jurisdiction. While this limits their capability to establish the policies and programs typically used to judge a jurisdictions capability to perform mitigation, it does not mean they lack the capability. Project Impact was very successful in both the Cities of Moab and Logan. A good example of planning and land use in rural Utah is the 21 Century Program:

21-Century Program:

Governor Leavitt and the Governor's Rural Partnership Office extend an invitation and a challenge to rural cities, towns, counties, and Indian tribes to engage in the planning and development processes that will lead to designation as a 21st Century Community.
The challenge of the 21st Century Communities program is to:

- Prepare rural Utah for unprecedented population and visitor growth
- Create new jobs and reduce unemployment
- Diversify rural economies
- Protect quality of life

To accomplish this task the 21st Century Program requires communities to:

- Complete a community assessment; topics addressed in the assessment are economic development, community planning, tourism and heritage development, transportation planning, governance, public safety, education, and health care.
- Participate in training
- Completing a community general plan
- Completing a community work plan

This challenge includes a call; for rural leaders to look to the future and begin now to develop a game plan for community prosperity and success. It is a call to evaluate the forces of change that are shaping the future, to assess community needs and opportunities, to improve leadership skills and knowledge, and to develop strategies to resolve problems and achieve community goals.

The purpose of the 21st Century program and Circuit Rider Planner Grants has been to provide circuit rider planners and other planning assistance to rural communities.

The following rural communities are participating in the 21st Century program:

Lindon City
Payson City
Santaquin City
Wasatch County
Coalville City
Cedar Fort Town
Eagle Mountain City
Woodland Hills City
Elk Ridge City
Francis Town
Kamas City
Oakley Town
Alpine City
Saratoga Springs City
American Fork City
Panguitch City
Beaver City
Milford City
Parowan City
Big Water Town
Escalante City
Springdale Town
Ivins City
LaVerkin City
New Harmony Town
Enterprise City
Toquerville Town
Kanab City

Antimony
Leamington
Manti
Mayfield
Monroe
Mt. Pleasant
Richfield
Salina
Scipio
Spring City
Wales
Piute County
Kanosh Band
Koosharem Band
Altamont
Ballard
Daggett County
Duchesne County
Duchesne City
Manila Town
Myton Town
Naples City
Roosevelt City
Tabiona Town
Uintah County
Vernal City
Carbon County
East Carbon City

Helper City
Price City
Scofield Town
Sunnyside City
Wellington City
Emery County
Castle Dale City
Clawson Town
Cleveland Town
Emery Town
Ferron City
Green River City
Huntington City
Orangeville City
Grand County
Moab City
San Juan County
Blanding City
Monticello City

Building Codes

The State of Utah adopted the International Building Code IBC. By law, each jurisdiction in Utah must also adopt the IBC. This process has occurred in the majority of both urban and rural jurisdictions Utah. These higher design codes especially with regards to seismic design will greatly reduce damage to new buildings.

Building Code Effectiveness Grading Reports

The Insurance Services Office, Inc performs Building Code Effectiveness Grading Reports (BCEGS). The program implemented in 1995 assesses the building codes in effect in a particular community and how well the community enforces its building codes. BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with one showing an exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. FEMA also uses these scores in their competitive grant programs giving a higher ranking to those projects in jurisdictions with lower scores. For these reasons the BCEGS scores were used in the development of this plan to assess local jurisdictions building codes. The table C-1, contains the residential and commercial BCEGS scores where reported in the State of Utah.

Table C-1 Building Code Effectiveness Grading Reports

Community	BCEGS Classification	Date	Community	BCEGS Classification	Date
ALPINE	RES 03 COM 03	2001	MURRAY	RES 02 COM 02	2000
AMERICAN FORK	RES 03 COM 03	1999	N LOGAN	RES 03 COM 03	1999
BEAVER	RES 04 COM 04	2000	N OGDEN	RES 04 COM 04	1999
BEAVER CO	RES 03 COM 03	2002	N SALT LAKE	RES 04 COM 04	1997
BIG WATER	RES 05 COM 05	1998	NEPHI	RES 06 COM 06	2001
BLANDING	RES 04 COM 04	2002	OGDEN	RES 03 COM 03	1999
BLUFFDALE	RES 03 COM 03	2002	OREM	RES 04 COM 04	1999
BOUNTIFUL	RES 03 COM 03	2001	PARK CITY	RES 03 COM 03	2001
BOX ELDER CO	RES 04 COM 04	2001	PAYSON	RES 05 COM 05	2002
BRIGHAM CITY	RES 03 COM 03	2001	PLAIN CITY	RES 05 COM 05	2003
CACHE CO	RES 03 COM 03	2001	PLEASANT GROVE	RES 03 COM 03	2000
CARBON CO	RES 04 COM 04	2001	PRICE	RES 03 COM 03	2001
CEDAR CITY	RES 04 COM 99	2000	PROVO	RES 04 COM 04	1999
CENTERVILLE	RES 03 COM 03	1999	RIVERDALE	RES 05 COM 05	1999
CLEARFIELD	RES 05 COM 05	1999	RIVERTON	RES 05 COM 05	2000
CLINTON	RES 05 COM 05	2000	ROOSEVELT	RES 99 COM 05	2001
DAVIS CO	RES 05 COM 05	2001	ROY	RES 04 COM 04	2000
DRAPER	RES 04 COM 04	2000	S JORDAN	RES 05 COM 05	1999
DUCHESNE	RES 99 COM 99	1999	S OGDEN	RES 03 COM 03	2000
DUCHESNE CO	RES 99 COM 03	2003	S SALT LAKE	RES 03 COM 03	2002
ELK RIDGE	RES 99 COM 99	1999	S WEBER	RES 04 COM 04	1998
EMERY CO	RES 04 COM 04	2002	SALEM	RES 03 COM 03	2003
ENOCH CITY	RES 05 COM 05	2002	SALT LAKE CITY	RES 03 COM 03	2002
ENTERPRISE	RES 03 COM 03	2002	SALT LAKE CO (CONT 1)	RES 04 COM 04	1998
EUREKA	RES 04 COM 04	2000	SAN JUAN CO	RES 04 COM 04	2002

FARMINGTON	RES 05 COM 05	2000	SANDY	RES 03 COM 03	1999
FARR WEST CITY	RES 04 COM 04	2002	SANPETE CO	RES 04 COM 04	2001
FERRON	RES 05 COM 05	1998	SANTAQUIN	RES 04 COM 04	2002
FILLMORE	RES 04 COM 04	2000	SEVIER CO	RES 03 COM 03	2001
FRUIT HEIGHTS	RES 05 COM 05	2001	SMITHFIELD	RES 04 COM 04	2000
GARDEN CITY	RES 99 COM 07	1998	SPANISH FORK	RES 03 COM 03	1999
GARFIELD CO	RES 06 COM 06	1997	SPRINGVILLE	RES 04 COM 04	1999
GENOLA	RES 05 COM 05	2002	ST GEORGE	RES 04 COM 04	2000
GOSHEN	RES 99 COM 99	1999	STOCKTON	RES 99 COM 99	1999
GRAND CO	RES 03 COM 03	2001	SUMMIT CO	RES 04 COM 04	2000
GRANTSVILLE	RES 99 COM 99	1999	SYRACUSE	RES 04 COM 04	1999
GREEN RIVER	RES 03 COM 03	2002	TAYLORSVILLE	RES 04 COM 04	1998
HEBER CITY	RES 04 COM 04	1999	TOOELE	RES 03 COM 03	2003
HIGHLAND	RES 05 COM 05	1999	TOOELE CO	RES 02 COM 02	2003
HILDALE	RES 99 COM 99	1999	TREMONTON	RES 05 COM 05	2000
HUNTINGTON	RES 03 COM 03	2001	UINTAH	RES 03 COM 03	2003
HUNTSVILLE	RES 03 COM 03	2003	UINTAH CO	RES 04 COM 04	2003
HURRICANE	RES 04 COM 04	2000	UTAH CO	RES 03 COM 03	2000
HYDE PARK	RES 03 COM 03	2001	VERNAL	RES 02 COM 02	2001
IRON CO	RES 04 COM 04	2001	VINEYARD	RES 03 COM 03	2003
IVINS	RES 04 COM 04	2002	W BOUNTIFUL	RES 99 COM 99	1999
KANAB	RES 03 COM 03	2002	W JORDAN	RES 03 COM 03	2000
KANARRAVILLE	RES 99 COM 99	1998	W POINT	RES 06 COM 06	1998
KANE CO	RES 99 COM 05	2001	W VALLEY CITY	RES 04 COM 04	1999
KAYSVILLE	RES 05 COM 05	1999	WASATCH CO	RES 03 COM 03	2000
LA VERKIN	RES 03 COM 03	2002	WASHINGTON	RES 05 COM 05	2002
LAYTON	RES 04 COM 04	1999	WASHINGTON CO	RES 03 COM 03	2000
LEHI	RES 04 COM 04	1999	WASHINGTON TERRACE	RES 03 COM 03	1999
LINDON	RES 04 COM 04	2002	WEBER CO	RES 05 COM 05	2000
LOGAN	RES 03 COM 03	1999	WENDOVER	RES 03 COM 03	1997
MANILA	RES 04 COM 04	2003	WILLARD	RES 05 COM 05	1998
MAPLETON	RES 04 COM 04	2000	WOODLAND HILLS	RES 99 COM 99	1998
MARRIOTT-SLATERVILLE	RES 03 COM 03	2001	WOODS CROSS	RES 99 COM 99	2002
MIDVALE	RES 04 COM 04	1999	Source: ISO. 99 is used for jurisdictions which are either unclassified or do not meet the minimum criteria of the BCEGS program. This would include departments which do not do plan review, inspections, have legally adopted codes or have declined to participate in the ISO program.		
MILLARD CO	RES 04 COM 04	1997			
MOAB	RES 04 COM 04	1997			
MORGAN	RES 03 COM 03	2002			
MORGAN CO	RES 04 COM 04	2001			

Zoning & Land Use

The State of Utah maintains a philosophy of local responsibility for zoning and land use planning. State agencies provide an integrated network of support, services, and resources related to zoning activities many of these services are explained in depth in the *State Capabilities* section below. The best generalization with regards to zoning and land use planning in Utah is as the population increases and areas become more urbanized emphisis on land use planning and zoning increases.

County Emergency Operations Plan EOP

Emergency operation planning has been taking place in Utah Counties for over twenty years. These plans identify both natural and man-made hazards, which may impact the residents of the county, then details the response and recovery procedures that local officials should follow if a disaster strikes. While each county has an EOP in place many of these EOP are dated and seldom exercised.

New Policies

Several recent changes in the Wildfire Suppression Fund will have enormous effects at the local level on wildfire mitigation and wildfire suppression in URWIN areas. During the 2004 Legislative General Session Craig W. Buttars sponsored a bill to modify the cooperative agreements between counties and the Division of Forestry, Fire, and State Lands. This modification to the Wildfire Suppression Fund requires a county, in order to be eligible to enter into a cooperative agreement with the state to among other things: adopt a wildland fire ordinance. This is a huge shift in policy, which will greatly enhance wildfire mitigation.

Federal Mitigation Funding Sources & Capabilities

[The State mitigation strategy shall include][Identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.

The following grant sources may provide assistance to local governments or other eligible applicants for mitigation projects or planning.

- **Hazard Mitigation Grant Program (HMGP)**
  - Lead Agency: DES
  - Funding: Varies by disaster
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Natural Hazard Mitigation
  - Reference: www.fema.gov
- **Pre-Disaster Mitigation Competitive (PDM-C) Grant Program**
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Natural Hazard Mitigation, Planning
  - Reference: www.fema.gov
- **Flood Mitigation Assistance (FMA) Program**
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Flood Mitigation, Planning
  - Reference: www.fema.gov
- **Disaster Resistant Universities (DRU) Program**
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Post-Secondary Educational Institutions
  - Project Type: Natural Hazard Mitigation, Planning
  - Reference: www.fema.gov
- **Small Business Administration (SBA) Pre-Disaster Mitigation Loans**
  - Lead Agency: SBA
  - Funding: 5-year renewable
  - Funding Formula: Low interest loans (4% or less)

- Funding Source: SBA
- Applicants: Small Businesses
- Project Type: General Natural Hazard Mitigation
- Reference: Federal Register, Vol. 67, No. 194, pp 62335-62339

- **State Fire Assistance – Wildland/Urban Interface (SFA-WUI)**
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 50% federal : 50% non-federal
  - Funding Source: Combined Federal Agencies
  - Applicants: Public Sector
  - Project Type: Wildland fire preparedness, prevention, and fuel reduction
  - Reference: www.ffsl.utah.gov/communityfirepln.htm
  - Contact davedalrymple@utah.gov
- **Rural Fire Assistance (RFA)**
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 90% federal : 10% non-federal
  - Funding Source: Department of the Interior
  - Applicants: Fire Departments
  - Project Type: Wildland fire education, training, equipment
  - Reference: www.ffsl.utah.gov/ufragrant.htm
  - Contact tracydunford@utah.gov
- **Volunteer Fire Assistance (VFA)**
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 90% federal : 10% non-federal
  - Funding Source: USFS
  - Applicants: Volunteer Fire Departments
  - Project Type: Organization, training, prevention, equipment
  - Reference: www.ffsl.utah.gov/ufragrant.htm
- **Rural Community Assistance Economic Action Program (RCA EAP)**
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 80% federal : 20% non-federal
  - Funding Source: USFS
  - Applicants: Public sector
  - Project Type: Utilization of forest products
  - Contact daveschen@utah.gov
- **Forestland Enhancement Program (FLEP)**
  - Lead Agency: FFSL
  - Funding: $100 Million over 5 years nationwide
  - Funding Formula: 75% federal : 25% non-federal
  - Funding Source: USFS

- Applicants: Non-industrial private forest owners
- Project Type: Forest ecosystem health (including fuel reduction)
- Contact rongropp@utah.gov

Project Impact

Under the Clinton Administration, FEMA initiated a program designed to unite local governments with businesses in their jurisdiction to create disaster resistant communities. That program was Project Impact. Utah had five communities participate in this program Centerville 1997, Moab 1998, Logan 1998, Salt Lake 1999, and Provo 2000.

Selected communities received funding directly from FEMA. The states role was to recommend communities and provide support and technical expertise. What follows is abbreviated list of accomplishments made by selected jurisdictions.

Centerville

- SNOTEL Site installation for monitoring snowpack and flood potential
- USGS Stream Gage for gathering baseline data on Deuel Creek
- Weather station at Centerville Elementary School
- Development of a flood prediction model using data from stream gage, weather station and SNOTEL site
- Debris basin on Barnard Creek (Resulted in a LOMR on the FIRM, 13 JUN 2002)
- New culvert under I-15 (Currently working on LOMR to FIRM as a result of this project)
- Flood Mitigation plan development
- Review of development codes
- Participation in the NFIP CRS program
- Bonneville shoreline trail development
- The "Garden Walk" (education program for the wildland fire interface area & for provident living)
- Development / Enhancement of the Neighborhood Network
- Creation of a Drainage Utility

Moab

- The City completed the Tusher Canyon Dam Discharge Project. In the past, canyon floodwaters were released below the dam and distributed throughout the community. The City installed culverts to pipe the drainage from the Tusher Dam to Mill Creek. The new culverts and drop drains also catch floodwaters from Oak Street, Walker Street and Sand Flats road and direct the floodwaters into Mill Creek.
- The City installed the 500 West Culvert/Underpass. A 25' X 9' culvert was placed next to the 500 West/Mill Creek Bridge to allow more Mill Creek and Pack Creek floodwater through the area and to reduce the floodplain.
- The City with the help of the County and Weather Service installed a NOAA weather radio transmitter. For over a year the area (Grand County, San Juan County and Emery

County) is served by the transmitter. The City gave away 50 weather radios to public organizations that need them.
- The City thinned trees along Mill Creek to reduce hazards. The City also removed trees and made a trail from 100 West to 500 West.

Logan
- Snotel site
- River gage on the blacksmith fork river
- River Channel rework
- Rail road tressel change
- Emergency generator for service center
- Print Emergency Safety Tips booklet

Salt Lake City
- Installed SNOTEL Site to monitor low level snowpack in City Creek Canyon
- Completed non-structural earthquake mitigation manual for seismic design in Utah Schools
- Earthquake water heater strap tie down purchase and install.
- Living With Fire Program Wildfire Education
- Seismic upgrade to culinary water system
- City Creek Stream Gauge
- Landslide Vulnerability analysis
- Salt Lake City CERT Program

Provo
- Snotel site in drainage to the east of the city.
- Updated GIS hazard maps for seismic, wildfire, and flooding.
- Design work on an outfall project to control seasonal frontal canyon flooding.
- Non-structural mitigation for critical areas at Provo City and BYU.
- Re-enforced windows at Provo High, a primary Red Cross shelter location.
- CERT program materials and supplies.
- Educational community classroom.

Table C-2 Federal Mitigation Programs, Activities and Initiatives

Program / Activity	Type of Assistance	Agency & Contact
Basic & Applied Research/ Development		
Center for Integration of Natural Disaster Information	**Technical Assistance**: Develops and evaluates technology for information integration and dissemination	Department of Interior (**DOI**) –US Geological Survey (**USGS**) The Center for Integration of Natural Hazards Research: (703) 648-6059 hazinfo@usga.gov
Hazard Reduction Program	**Funding** for research and related educational activities on hazards.	National Science Foundation (**NSF**), Directorate for Engineering, Division of Civil and Mechanical Systems, Hazard Reduction Program:

		(703) 306-1360
Decision, Risk, and Management Science Program	**Funding** for research and related educational activities on risk, perception, communication, and management (primarily technological hazards)	**NSF** – Directorate for Social, Behavioral and Economic Science, Division of Social Behavioral and Economic Research, Decision, Risk, and Management Science Program (DRMS): (703) 306-1757 www.nsf.gov/sbe/drms/start.htm
Societal Dimensions of Engineering, Science, and Technology Program	**Funding** for research and related educational activities on topics such as ethics, values, and the assessment, communication, management and perception of risk	**NSF** – Directorate for Social, Behavioral and Economic Science, Division of Social, Behavioral and Economic Research, Societal Dimensions of Engineering, Science and Technology Program: (703) 306-1743
National Earthquake Hazard Reduction Program (NEHRP) in Earth Sciences	**Research** into basic and applied earth and building sciences.	**NSF** – Directorate for Geosciences, Division of Earth Sciences: (703) 306-1550
Technical and Planning Assistance		
Planning Assistance to States	**Technical and planning assistance** for the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.	Department of Defense (**DOD**) US Army Corps of Engineers (**USACE**) Contact the Floodplain Management Staff in the Appropriate USACE Regional Office North Atlantic: (212) 264-7813 South Atlantic: (404) 331-4441 Great Lakes and Ohio River: (513) 684-6050 Mississippi Valley: (601) 634-5827 Northwestern: (503) 808-3853 Southwestern: (214-767-2613 South Pacific: (415) 977-8164 Pacific Ocean: (808) 438-8863
Disaster Mitigation Planning and Technical Assistance	**Technical and planning assistance** grants for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces.	Department of Commerce (**DOC**), Economic Development Administration (**EDA**): (800) 345-1222 **EDA**'s Disaster Recovery Coordinator: (202) 482-6225 www.doc.gov/eda
Watershed Surveys and Planning	**Surveys and planning studies** for appraising water and related resources, and formulating alternative plans for conservation use and development. Grants and advisory/counseling services to assist w/ planning and implementation improvement.	US Department of Agriculture (**USDA**) – National Resources Conservation Service (**NRCS**) Watersheds and Wetlands Division: (202) 720-4527 Deputy Chief for Programs: (202) 690-0848 www.nrcs.usda.gov
National Flood Insurance Program	**Formula grants to States** to assist communities to comply with NFIP floodplain management requirements (Community Assistance Program).	**FEMA**
Emergency Management / Mitigation Training	**Training** in disaster mitigation, preparedness, planning.	**FEMA**

National Dam Safety Program	**Technical assistance,** training, and grants to help improve State dam safety programs.	**FEMA**
National Earthquake Hazards Reduction Program	**Training, planning and technical assistance** under grants to States or local jurisdictions.	**FEMA; DOI-USGS** **USGS** Earthquake Program Coordinator: (703) 648-6785
Volcano Hazards Program	**Technical assistance**: Volcano hazard warnings and operation of four volcano observatories to monitor and assess volcano hazard risk.	**DOI-USGS** Volcanic Hazards Program Coordinator: (703) 648-6708 (650) 329-5228
Floodplain Management Services	**Technical and planning assistance** at the local, regional, or national level needed to support effective floodplain management.	**DOD-USACE** North Atlantic: (212) 264-7813 South Atlantic: (404) 331-4441 Great Lakes and Ohio River: (513) 684-6050 Mississippi Valley: (601) 634-5827 Northwestern: (503) 808-3853 Southwestern: (214-767-2613 South Pacific: (415) 977-8164 Pacific Ocean: (808) 438-8863
Watershed Protection and Flood Prevention Program	**Technical and financial assistance** for installing works of improvement to protect, develop, and utilize land or water resources in small watersheds under 250,000 acres.	**USDA-NRCS** Director, Watersheds and Wetlands Division: (202) 720-3042 (202) 690-4614 www.nrcs.usda.gov
Environmental Quality Incentives Program (EQIP)	**Technical**, educational, and limited **financial assistance** to encourage environmental enhancement.	**USDA-NRCS** NRCS County Offices Or NRCS EQUIP Program Manager: (202) 720-1834 www.nrcs.usda.gov
National Earthquake Hazard Reduction Program	**Technical and planning assistance** for activities associated with earthquake hazards mitigation.	FEMA, DOI-USGS Earthquake Program Coordinator: (703) 648-6785
Hazard ID & Mapping		
National Flood Insurance Program: Flood Mapping;	**Flood insurance rate maps** and flood plain management maps for all NFIP communities;	FEMA
National Flood Insurance Program: Technical Mapping Advisory Council	**Technical guidance and advice** to coordinate FEMA's map modernization efforts for the National Flood Insurance Program.	**DOI-USGS** **USGS** – National Mapping Division: (573) 308-3802

National Digital Ortho-photo Program	Develops **topographic quadrangles** for use in mapping of flood and other hazards.	**DOI-USGS** **USGS** – National Mapping Division: (573) 308-3802
Stream gauging and Flood Monitoring Network	Operation of a **network of over 7,000 stream gauging stations** that provide data on the flood characteristics of rivers.	**DOE-USGS** Chief, Office of Surface Water, **USGS:** (703) 648-5303
Mapping Standards Support	**Expertise in mapping and digital data** standards to support the National Flood Insurance Program.	**DOI-USGS** USGS – National Mapping Division: (573) 308-3802
Soil Survey	**Maintains soil surveys** of counties or other areas to assist with farming, conservation, mitigation or related purposes.	**USDA-NRCS** NRCS – Deputy Chief for Soil Science and Resource Assessment: (202) 720-4630
National Earthquake Hazards Reduction Program	**Seismic mapping for U.S.**	**DOI-USGS** USGS Earthquake Program Coordinator: (703) 648-6785
Project Support		
Aquatic Ecosystem Restoration	**Direct support** for carrying out aquatic ecosystem restoration projects that will improve the quality of the environment.	**DOD-USACE** Chief of Planning @ appropriate USACE Regional Office North Atlantic: (212) 264-7111 South Atlantic: (404) 331-4580 Great Lakes and Ohio River Chicago: (312) 886-5468 Cincinnati: (513) 684-3008 Mississippi Valley Division: (601) 634-7880 Northwestern Division Portland: (503) 808-3850 Omaha: (402) 697-2470 Southwestern Division: (214) 767-2314 South Pacific Division: (415) 977-8171 Pacific Ocean Division: (808) 438-3850

Beneficial Uses of Dredged Materials	**Direct assistance** for projects that protect, restores, and create aquatic and ecologically related habitats, including wetlands, in connection with dredging an authorized Federal navigation project.	**DOD-USACE** Same as above
Wetlands Protection – Development Grants	**Grants** to support the development and enhancement of State and tribal wetlands protection programs.	US Environmental Protection Agency (**EPA**) EPA Wetlands Hotline: (800) 832-7828 Or EPA Headquarters, Office of Water Chief, Wetlands Strategies and State Programs: (202) 260-6045
Clean Water Act Section 319 Grants	**Grants to States** to implement non-point source programs, including support for non-structural watershed resource restoration activities.	**EPA** Office of Water Chief, Non-Point Source Control Branch: (202) 260-7088, 7100
Coastal Zone Management Program	**Grants** for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration.	Department of Commerce **DOC** National Oceanic and Atmospheric Administration (**NOAA**) National Ocean Service Office of Ocean and Coastal Resource Management Chief, Coastal Programs Division: (301) 713-3102
Community Development Block Grant (CDBG) State Administered Program	**Grants to States** to develop viable communities (e.g., housing, a suitable living environment, expanded economic opportunities) in non-entitled areas, for low- and moderate-income persons.	US Department of Housing and Urban Development **(HUD)** State CDBG Program Manager Or State and Small Cities Division, Office of Block Grant Assistance, HUD Headquarters: (202) 708-3587
Community Development Block Grant Entitlement Communities Program	**Grants** to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate-income persons.	**HUD** City and county applicants should call the Community Planning and Development staff of their appropriate HUD field office. As an alternative, they may call the Entitlement Communities Division, Office of Block Grant Assistance, HUD Headquarters: (202) 708-1577, 3587
Emergency Watershed Protection Program	Provides **technical and financial assistance** for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.	**USDA – NRCS** National Office – (202) 690-0848 Watersheds and Wetlands Division: (202) 720-3042
Rural Development Assistance -- Utilities	Direct and guaranteed rural economic **loans and business enterprise grants** to address utility issues and development needs.	**USDA**-Rural Utilities Service (RUS) Program Support: (202) 720-1382 Northern Regional Division: (202) 720-1402 Electric Staff Division: (202) 720-1900

		Power Supply Division: (202) 720-6436
Rural Development Assistance – Housing	**Grants, loans, and technical assistance** in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.	**USDA**-Rural Housing Service (RHS) Community Programs: (202) 720-1502 Single Family Housing: (202) 720-3773 Multi Family Housing: (202) 720-5177
Project Impact: Building Disaster Resistant Communities	**Funding and technical assistance** to communities and States to implement a sustained pre-disaster mitigation program.	**FEMA**
Flood Mitigation Assistance	**Grants to States** and communities for pre-disaster mitigation to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program.	**FEMA**
Hazard Mitigation Grant Program	**Grants to States and communities** for implementing long-term hazard mitigation measures following a major disaster declaration.	**FEMA**
Public Assistance Program (Infrastructure)	**Grants to States and communities** to repair damaged infrastructure and public facilities, and help restore government or government-related services. Mitigation funding is available for work related to damaged components of the eligible building or structure.	**FEMA**
National Flood Insurance Program	Makes available **flood insurance** to residents of communities that adopt and enforce minimum floodplain management requirements.	**FEMA**
HOME Investments Partnerships Program	**Grants to States, local government** and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.	**HUD** Community Planning and Development, Grant Programs, Office of Affordable Housing, HOME Investment Partnership Programs: (202) 708-2685 (202) 708 0614 extension 4594 1-800-998-9999
Disaster Recovery Initiative	**Grants** to fund gaps in available recovery assistance after disasters (including mitigation).	**HUD** Community Planning and Development Divisions in their respective HUD field offices or HUD Community Planning and Development: (202) 708-2605
Non-Structural Alternatives to Structural Rehabilitation of Damaged Flood Control Works	**Direct planning and construction grants** for non-structural alternatives to the structural rehabilitation of flood control works damaged in floods or coastal storms. $9 million FY99	**DOD-USACE** Emergency Management contact in respective **USACE** field office:

		North Atlantic: (718) 491-8735 South Atlantic: (404) 331-6795 Great Lakes and Ohio River: (513) 684-3086 Mississippi Valley: (601) 634-7304 Northwestern: (503) 808-3903 Southwestern: (214) 767-2425 South Pacific: (415) 977-8054 Pacific Ocean: (808) 438-1673
Partners for Fish and Wildlife	**Financial and technical assistance** to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.	Department of Interior (**DOI**) – Fish and Wildlife Service (**FWS**) National Coordinator, Ecological Services: (703) 358-2201 A list of State and Regional contacts is available from the National Coordinator upon request.
Project Modifications for Improvement of the Environment	Provides for **ecosystem restoration** by modifying structures and/or operations or water resources projects constructed by the USACE, or restoring areas where a USACE project contributed to the degradation of an area.	**DOD-USACE** Chief of Planning @ appropriate USACE Regional Office North Atlantic: (212) 264-7111 South Atlantic: (404) 331-6270 Great Lakes and Ohio River Chicago: (312) 886-5468 Cincinnati: (513) 684-3008 Mississippi Valley Division: (601) 634-5762 Northwestern Division Portland: (503) 808-3850 Omaha: (402) 697-2470 Southwestern Division: (214) 767-2310 South Pacific Division: (415) 977-8171 Pacific Ocean Division: (808) 438-8880
Post-Disaster Economic Recovery Grants and Assistance	**Grant funding** to assist with the long-term economic recovery of communities, industries, and firms adversely impacted by disasters.	Department of Commerce (**DOC**) – Economic Development Administration (**EDA**) EDA Headquarters Disaster Recovery Coordinator: (202) 482-6225
Public Housing Modernization Reserve for Disasters and Emergencies	**Funding** to public housing agencies for modernization needs resulting from natural disasters (including elevation, flood proofing, and retrofit).	**HUD** Director, Office of Capital Improvements: (202) 708-1640
Indian Housing Assistance (Housing Improvement Program)	**Project grants and technical assistance** to substantially eliminate sub-standard Indian housing.	Department of Interior (**DOI**)-Bureau of Indian Affairs (**BIA**) Division of Housing Assistance, Office of Tribal Services: (202) 208-5427
Land Protection	**Technical assistance** for run-off retardation and soil erosion prevention to reduce hazards to life and property.	**USDA-NRCS**

		Applicants should contact the National NRCS office: (202) 720-4527
North American Wetland Conservation Fund	**Cost-share grants** to stimulate public/private partnerships for the protection, restoration and management of wetland habitats.	**DOI-FWS** North American Waterfowl and Wetlands Office: (703) 358-1784
Land Acquisition	**Acquires or purchases easements** on high-quality lands and waters for inclusion into the National Wildlife Refuge System.	**DOI-FWS** Division of Realty, National Coordinator: (703) 358-1713
Federal Land Transfer / Federal Land to Parks Program	**Identifies, assesses, and transfers available Federal real** property for acquisition for State and local parks and recreation, such as open space.	**DOI-NPS** General Services Administration Offices Fort Worth, TX: (817) 334-2331 Boston, MA: (617) 835-5700 Or Federal Lands to Parks Leader **NPS** National Office: (202) 565-1184
Wetlands Reserve Program	**Financial and technical assistance** to protect and restore wetlands through easements and restoration agreements.	**USDA-NRCS** National Policy Coordinator NRCS Watersheds and Wetlands Division: (202) 720-3042
Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Transfers title of certain inventory farm properties owned by FSA to Federal and State agencies for **conservation** purposes (including the restoration of wetlands and floodplain areas to reduce future flood potential)	US Department of Agriculture (**USDA**) – Farm Service Agency (**FSA**) Farm Loan Programs National Office: (202) 720-3467, 1632
Financing and Loan Guarantees		
Physical Disaster Loans and Economic Injury Disaster Loans	**Disaster loans** to non-farm, private sector owners of disaster damaged property for uninsured losses. Loans can be increased by up to 20 percent for mitigation purposes.	Small Business Administration (**SBA**) National Headquarters Associate Administrator for Disaster Assistance: (202) 205-6734
Conservation Contracts	**Debt reduction** for delinquent and non-delinquent borrowers in exchange for conservation contracts placed on environmentally sensitive real property that secures FSA loans.	**USDA-FSA** Farm Loan Programs FSA National Office: (202) 720-3467, 1632 or local FSA office

Clean Water State Revolving Funds	**Loans** at actual or below-market interest rates to help build, repair, relocate, or replace wastewater treatment plants.	**EPA** EPA Office of Water State Revolving Fund Branch Branch Chief: (202) 260-7359 A list of Regional Offices is available upon request
Section 108 Loan Guarantee Program	**Loan guarantees** to public entities for community and economic development (including mitigation measures).	**HUD** Community Planning and Development staff at appropriate HUD field office, or the Section 108 Office in HUD Headquarters: (202) 708-1871
Section 504 Loans for Housing	**Repair loans, grants and technical assistance** to very low-income senior homeowners living in rural areas to repair their homes and remove health and safety hazards.	US Department of Agriculture (**USDA**) – Rural Housing Service (**RHS**) Contact local RHS Field Office, or RHS Headquarters, Director, Single Family Housing Direct Loan Division: (202) 720-1474
Section 502 Loan and Guaranteed Loan Program	Provides **loans, loan guarantees, and technical assistance** to very low and low-income applicants to purchase, build, or rehabilitate a home in a rural area.	**USDA-RHS** Contact the Local RHS Field Office, or the Director, Single Family Housing Guaranteed Loan Division, RHS: (202) 720-1452
Rural Development Assistance -- Utilities	Direct and guaranteed **rural economic loans and business enterprise grants** to address utility issues and development needs.	**USDA**-Rural Utility Service (**RUS**) Contact Rural Development Field Offices, or RHS, Deputy Administrator, Community Programs Division: (202) 720-1490
Farm Ownership Loans	**Direct loans, guaranteed / insured loans, and technical assistance** to farmers so that they may develop, construct, improve, or repair farm homes, farms, and service buildings, and to make other necessary improvements.	**USDA-FSA** Director, Farm Programs Loan Making Division, FSA: (202) 720-1632

State Mitigation Capabilities

[The State mitigation strategy shall include] a discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including:

- ***An evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; [and]***
- ***A discussion of State funding capabilities for hazard mitigation projects.***

Financial Capabilities

At present, similar to most states, Utah does not maintain a hazard mitigation grant fund or disaster contingency fund dedicated to funding recovery or mitigation. This does not in any way mean the state does not support mitigation. The state funds mitigation through the salaries and benefits of DES staff. Those staff members include one State Hazard Mitigation Officer (Full Time Employment (FTE) 50 % state 50% federal) one State Earthquake Program Manager (FTE 50 % state, 50% federal) one State Floodplain Manager (FTE 50% state, 50% federal) and one State Mitigation Planner (50% state, 50% federal)

The State's many mitigation programs are supported through individual operating budgets of state Departments and Divisions. A detailed look at these is found under State Programs.

Legal Capabilities

The legal structure that enables specific mitigation actions is defined within the legal authorities and legislative mandates for the Division of Emergency Services and Homeland Security. They are as follows:

- The Governor's Emergency Operation Directive
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended.
- Title 44, CFR, Federal Emergency Management Agency Regulations, as amended.
- Emergency Management Act of 1981, Utah Code 53-2, 63-5.
- Disaster Response Recovery Act, 63-5A.
- Emergency Interim Succession Act, 63-5B.

State Program Capabilities

The State of Utah, maintains a philosophy of local responsibility for hazard mitigation. Although, there are no formal State-funded hazard mitigation grants, State agencies provide an integrated network of support, services, and resources for hazard mitigation activities. As demonstrated during past disasters, these agencies are well organized in their delivery and coordination of services. Additionally the State puts money into DES in the form of salaries, benefits, and related support for one Mitigation Planner, one Floodplain Coordinator, an Earthquake Program Manager, and the State Hazard Mitigation Officer.

An evaluation of the laws, regulations, authorities, policies, and programs used in Utah to mitigate hazards demonstrate mitigation works exceptionally well. This is evident by the massive amount of mitigation accomplished in Utah. Given the few numbers of disasters, and

limited nature of those emergencies. The following programs and policies have been effective in achieving mitigation objectives in the past:

- State Floodplain Management Program
- Geologic Hazards Program of the Utah Geologic Survey
- Dam Safety Section of the Division of Water Rights
- Division of Forestry, Fire, and State Lands
- Utah Seismic Safety Commission
- State Hazard Mitigation Team

Emerging Mitigation Policies and Programs

A cornerstone of the UPDMPC, SHMT, and the Staff of DES with respect to mitigation is and will continue to be the completion of local mitigation goals. The age and inaccuracy of floodplain maps in the State continually rose to the top during the prioritization of mitigation recommendations at the local level. For this reason, the Floodplain Map Modernization Program and its success is crucial. The State Floodplain Manager has completed a Floodplain Map Modernization Plan as well as a prioritization of need for floodplain map revisions based on FEMA designed methodology both of which can be found in Appendix D and E.

Several recent changes in the Wildfire Suppression Fund will have huge effects at the local level on wildfire mitigation and wildfire suppression in URWIN areas. During the 2004 Legislative General Session Craig W. Buttars sponsored a bill to modify the cooperative agreements between counties and the Division of Forestry, Fire, and State Lands. This modification to the Wildfire Suppression Fund requires a county, in order to be eligible to enter into a cooperative agreement with the state to among other things: adopt a wildland fire ordinance. This is a huge shift in policy, which will greatly enhance wildfire mitigation.

The following is a review of State departments with disaster responsibilities, describing their existing and planned mitigation programs.

Utah Division of Emergency Services and Homeland Security (DESHS) ✓

The capabilities of DESHS Hazard Mitigation Program include:

- Prepare, implement, and maintain programs and plans to provide for preventions and minimization of injury and damage caused by disasters.
- Identify areas particularly vulnerable to disasters.
- Coordinate hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters.
- Assist local officials in designing local emergency actions plans.
- Coordinate federal, state, and local emergency activities.
- Coordinate emergency operations plans with emergency pans of the federal governments.

Through the State Hazard Mitigation Section, the following occurs:

- Provides a state coordinator for hazard mitigation, the State Hazard Mitigation Officer.
- Provides a central location of the coordination of state hazard mitigation activities.

- Provides coordination for the Federal Pre-Disaster Mitigation Program.
- Flood Plain Management Program
- State Earthquake Program
- Provide coordination for Comprehensive Multi-hazard Mitigation Plan development, implementation, and monitoring.
- Provide for interagency coordination
- Provide development of procedures for grant administration and project evaluation.
- Provide State Hazard Mitigation Team assistance to local governments.
- Provide for development of specific hazard mitigation plans, such as drought and wildfire.
- Provide for local hazard and risk analysis.
- Provide for development of SHMT mitigation recommendations following disasters.

Utah Department of Agriculture ✓

The Utah Department of Agriculture administers programs serving the state's large agricultural sector. The department's response role during and after a disaster period has been to coordinate damage reports for funding needs and provides loan and recovery program information and assistance to disaster victims. This service is provided for flood, drought, insect infestation, fire, livestock disease, and frost.

Assistance During Drought Disasters

A damage reporting network coordinated through the existing County Emergency Board was established during the drought disaster of 1996. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

Loans Handbook

The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and applications procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage:

1) Rural Rehabilitation Loan Program (federally funded and operated by the state)
2) Agriculture Resource Development Loan Program (state funded)
3) Emergency Loan Program (state funded)

Soil Conservation Program

The Department of Agriculture also administers the ongoing Soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service, which provides most of the technical assistance. The ongoing program is not regulatory, but is directed towards improved water use and soil conservation.

Disaster Easements
Because of the similarity between past events, the department is now working on a permanent hazard mitigation concept known as "Disaster Easements", which may have widespread agreements with irrigation companies, water districts, or water users' associations for the purpose of routing flood water through local communities.

Monitoring Ground Water Quality
The Department also monitors the quality of groundwater, including individual wells and springs throughout the State.

Non-Point Source Pollution
The Department's Non-Point Source Pollution Program focuses on flood prevention through reduction of erosion, vegetating streams, and restoring "natural stream structure". The Department also monitors drought conditions, which are a precursor to wildfire.

Department of Community and Economic Development ✓

Community Impact Board
The Utah Permanent Community Impact Fund Board provides loans and/or grants to state agencies and sub-divisions of the state, which may be socially or economically impacted by mineral resource development of federal lands.

Permanent Community Impact Fund
The Permanent Community Impact Fund provides loans and/or grants to state agencies and subdivisions of the state, which are or may be socially or economically impacted, directly or indirectly, by mineral resource development on federal lands.

Under the Federal Mineral Lease Act of 1920, leaseholders on public land make royalty payments to the federal government for the development and production of non-metalliferous minerals. In Utah, the primary source of these royalties is the commercial production of fossil fuels on federal land held by the U.S. Forest Service and the Bureau of Land Management. Since the enactment of the Minerals Lease Act of 1920, a portion of these royalty payments, called mineral lease payments, have been returned to the state in an effort to help mitigate the local impact of energy and mineral developments on federal lands.

Funding Options
The Board has the option of funding projects with loans and/or grants. The Board's preferred financing mechanism is an interest-bearing loan.

Loan Requirements
In providing financial assistance in the form of a loan, the Board may purchase an applicant's bonds only if the bonds are accompanied by legal opinion of recognized municipal bond counsel to the effect that the bonds are legal and binding under applicable Utah Law.

The Board may purchase either a taxable or tax-exempt bond. The board may purchase taxable bonds if it determines, after evaluating all relevant circumstances, including the

applicant's ability to pay, that the purchase of the taxable bonds is in the best interest of the state and the applicant.

Grants

Grants may be provided only when the other financing mechanisms cannot be utilized, where no reasonable method of repayment can be identified, or in emergency situations regarding public health and/or safety.

Community Development Block Grant

The Community Development Block Grant, or CDBG program, provides funding from the federal government's Department of Housing and Urban Development or HUD, to small cities and counties in the State of Utah.

Utah Division of State History

The Mormon Pioneers founded the Utah State Historical Society, Utah's Division of State History, in 1897 on the 50th anniversary of the first settlement in the Salt Lake Valley. The Society became a state agency in 1917, now housed in the historic Rio Grande Depot since 1980. The Division stimulates archaeological research, study; oversees the protection and orderly development of sites; collects and preserves specimens; administers site surveys; keeps excavation records; encourage and supports the preservation of historic and pre-historic sites and publishes antiquities records. The Division also issues archaeological permits and consults with agencies and individuals doing archaeological work.

Preserving and Sharing Utah's Past

The mission of the State Division of History is "preserving and sharing Utah's past for the present and the future".

State Historical Preservation Officer (SHPO)

The SHPO administers the Section 106 process (national Historic Preservation Act) in Utah. The SHPO also serves on the Utah State Hazard Mitigation Team, providing guidance on historical and cultural preservation regulations.

Historic properties include districts, buildings, structures, objects, landscapes, archeological sites, and traditional cultural properties that are included in, or eligible for inclusion in, the National Register of Historic Places. These properties are not just "old buildings" or "well-known historic sites, but places important in local, state, or national history. Facilities as diverse as bridges and water treatment plants my, be considered historic.

Utah Geological Survey (UGS) ✓

The Utah Geologic and Mineral Survey is the principal state agency concerned with geologic hazards. Through years of study, the UGS has developed considerable information on Utah's geologic hazards. When geologic events occur or threaten to occur, the UGS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat from Geologic hazards. The UGS works in partnership with other agencies, such as DESHS, in relating the threats from natural hazard to the communities at risk.

Functions
The functions of the UGS include the following:

- Evaluation of individual geological hazards;
- Participation on local government and state agency technical teams;
- Prediction of the performance on individual slides once they began to move;
- Coordination and awareness of research efforts undertaken by other agencies;
- Provide information on status of individual geologic hazards;
- Reconnaissance reports on status of hazards statewide;
- Advise Division of Water Rights on geologic hazards associated with dam sites; and
- Provide geologic information for use during planning of remedial actions.

Laws/authorities/policies of the Utah Geological Survey for Conducting Mitigation

Utah Code Annotated
Chapter 73 Geological and Mineral Survey
Section 68-73-6 Objectives of Survey
(1) Determine and investigate areas of geologic and topographic hazards that could affect the safety of, or cause economic loss to, the citizens of this state; (f) assist local and state government agencies in their planning, zoning, and building regulations functions by publishing maps, delineating appropriately wide special earthquake risk areas, and, at the request of state agencies, review the citing of critical facilities:

Utah State Office of Education (USOE) Rule R277-455 Standards and Procedures for building plan review

R277-455-4 Criteria for Approval; to receive approval of a proposed building site, the local school district must certify that:

Staff of the Utah Geologic Survey have reviewed and recommended approval of the geologic hazards report provided by the school districts geo-technical consultant.

Division of Water Resources ✓

The Division's role of planning, funding and constructing water projects serves as both active and passive hazard mitigation against drought and flood situations throughout the state. The various State Regional Water Plans contain brief summaries of flood threat and risk for each drainage.

The Division is one of seven agencies in the State Department of Natural Resources. The eight member Water Resources Board, appointed by the governor, administers three state water conservation and development funds. These include:

- ***Revolving Construction Fund*** – This fund started in 1947 with 1 million legislative appropriation to help construct irrigation projects, wells and rural culinary water systems. Further appropriations have added to this fund.

- ***Conservation and Development Fund*** – This fund was created in 1978 wit the sale of 25 million in general obligations bonds. Money was added to this fund with bond sales in 1980 and 1983. The C & D Fund generally helps sponsors finance larger multi-purpose dams and water systems.
- ***Cities Water Loan Fund*** – Established with an initial legislative appropriation of 2 million dollars in 1974, and with continued appropriations, this fund provides financing to help construct new culinary water projects for cities, towns, improvement districts, and special service districts.

Construction Funds

In addition to overseeing these three construction funds, the Division also manages the State funds appropriated each year for renovation and reconstruction of unsafe dams. As the funding arm of the state for water resource projects the Division works closely with Water Rights, the Regulatory arm of the state charged with jurisdiction over all private and state owned dams.

Water Resource Planning

The Division is also charged with the general water resource planning for the state. The State Water Plan is a process that is coordinated to evaluate existing water resources in the state, determine water-related issues that should be confronted and recommend how and by whom issues can be resolved. The plan identifies programs and practices of state and federal agencies, water user groups and environmental interests and describes the state's current, future, and long-term water related needs. The plan is continually updated using current hydrologic databases, river basin simulations, water supply and demand models and water related land use inventories. Revisions reflect the latest water conservation and development options concerning water rights, water transfers, population, zoning, and many other complex issues for the next 50 years in the state's major river basins.

Utah Division of Forestry, Fire, and State Lands ✓

The Division of Forestry, Fire & State Lands utilizes the principles of stewardship and ecosystem management to assist non-federal landowners in management of their natural resources. The agency provides wildland fire protection for non-federal landowners commensurate with risk; and optimizes the benefits from ecosystem based, multiple-use management of resources held in the public trust. Wildfires are managed from six area offices 1) Bear River Office, 2) Northeast Area, 3)Wasatch Front Area, 4) Central Area, 5) Southwest Area, and 5) Southeast Area. The Division operates under the authority of the Utah Code Annotated 65-A-3-1 though 10.

The Flame-n-Go's (pronounced Flamingoes)

In 1978 the Division of Forestry, Fire, and State Lands and the Utah State Prison signed a cooperative agreement establishing Utah's first volunteer, inmate wildland fire hand-crew. The inmates named themselves the "Flame-N-Go's" and designed a logo that has become well known in the wildland fire fighting community.

All Flame-N-Go's are carefully screened for the program. They must complete rigorous training and sign a yearly contract committing themselves to preserving Utah's natural resources and building responsible lives.

The Flame-N-Go's are divided into three crews, each of which can respond to fires anywhere in the United States. A twenty-man type II hand line crew is the backbone of the group, responding to each assignment with all tools and equipment needed to do battle on the fire line. An Engine Strike Team, (five fire engines, outfitted with men and equipment) is ready to respond when needed as an Engine Strike Team or a Type II Hand line Crew. The Hotshot crew is trained to tackle the most dangerous fires in the most rugged terrain. All crews during peak fire season are on 24-hour call to respond within an hour's notice. These crews respond to an average of 50 fires per year and typically spend 45,000 hours fighting fires each season. At least one Division of Forestry, Fire, and State Lands supervisor and two Department of Corrections staff accompany each crew.

Each year, Flame-N-Go's are put through at least 80 hours of extensive training including classroom work and practical field exercises. Safety, individual, and team skills, and professionalism are stressed.

National Fire Plan

The Division administers the State responsibilities of the National fire Plan, a current emphasis of the U.S. Congress, which also addresses hazard and risk analysis and hazard mitigation.

Living With Fire Committee

The Division works in partnership with the U.S. Forest Service, Bureau of Land Management, and various other entities tasked with suppressing wildland fires on the "Living With Fire" program promoting wildland fire mitigation.

Utah Division of State Parks and Recreation ✓

The goal of the Division of Parks and Recreation is to enhance the quality of life for residents and visitors of our state through parks, people, and programs. They are responsible for protecting, preserving, and managing many of Utah's natural and heritage resources.

Hazard and Risk Analyses

The Division develops hazard and risk analyses for the State Parks as part of the park resource management plans. The Utah Division of Emergency Services and Homeland Security produced one analysis for Snow Canyon State Park in Washington County.

Non-Motorized Trail Program

The Recreational Trails Act of 1991 charged Utah State Parks and Recreation with coordinating the development of a statewide network of non-motorized trails. The Non-Motorized Trail program makes state and federal funds available on a 50/50 matching basis to any federal, state, or local government agency, or special improvement district for the planning, acquisition, and development of recreational trails.

Grants from State Parks Boards

The council advises the Division of Parks and Recreation on non-motorized trail matters, reviews requests for matching grant fiscal assistance, rates and ranks proposed trail projects and along with State Park's staff provides recommendations for funding to the State Parks Board.

Riverway Enhancement Program

In 1986, the Utah Legislature passed a bill, which established the Riverway Enhancement Program. The program makes state funds available on a 50/50 matching basis to state agencies, counties, cities, towns, and/or special improvement districts for property acquisition and/or development for recreation, flood control, conservation, and wildlife management, along rivers and streams that are impacted by high density populations or are prone to flooding. Public outdoor recreation should be the primary focus of the project.

Utah Division of Water Rights ✓

The Division of Water Rights is the state agency that regulated appropriation and distribution of water in the State of Utah. It is an office of public record. The Utah State Engineer's Office was created in 1897. The State Engineer's Office is the chief water rights administrative officer. A complete "water code" was enacted in 1903 and was revised and reenacted in 1919. This law, with succeeding complete reenactments of State statutes, and as amended, is presently in force mostly as *Utah Code, Title 73*. In 1963, the name was changed from State Engineers office to the Division of Water Rights.

All waters in Utah are public property. A water right is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use.

Regulate Dams

The State engineer has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.

Stream Alterations Program

The Utah State Engineer's Office administers a Stream alterations program with the purpose of regulation activities affecting the bed or banks or natural streams. The State Engineer's working definition of a natural stream is any natural waterway in the state, which has flows of sufficient duration to develop a characteristic ecosystem distinguishing it from the surrounding environments. Any individual planning an activity that will affect a natural stream must first obtain a Stream Alterations Permit from this office.

Most proposals reviewed by the State, are covered by General Permit 40, which authorizes the state to have its Stream Alteration Permit fulfill the requirements of Section 404 of the Clean Water Act for most activities. General permit 40 does not apply in some instances and a U.S. Army Corps of Engineers Individual Permit is required. Projects requiring this additional permit include those involving wetlands, threatened or endangered species,

properties listed on the National Historic Register, stream relocation, or the pushing of streambed material against a stream bank.

Dam Safety Program

The Dam Safety Section of the Division of Water Rights was established under Chapters 73-5a 101 thru 73-5a 702 including chapters 73-2-22 for Flood Control and the Chapter 63-30-10 Waiver of Immunity of the Utah Code and Rules R655-10 thru R655-12-6A. The program basically has jurisdiction over all private and state owned dams in the state during design, construction, operation, and decommissioning. This involved periodic inspections according to hazard classifications, inventory maintenance, design, and construction approval and systematic upgrade of all the high hazard structures to current dam safety Minimum Standards and creation of Emergency Action Plans for High Hazard dams. Since 1991, detailed dam reviews have been undertaken by the staff and by private consulting firms. Since 1995, the State Legislature has provided 3-4 million dollars per year to finance 50 % of the instrumentation, investigations, and design and 80 to 90 % of the construction costs of retrofitting and upgrading deficient dams, starting with the worst dams in the most hazardous locations.

The impetus for this dam safety program has been in reaction to dam failures, both in Utah and in other states, including the Teton Dam in Idaho and the Trial Lake Dam in Summit County and the Quail Creek Dam near St. George Utah. Since the establishment of our Minimum Standards program we have fostered the repair of dozens of dams and have not had a catastrophic failure since.

Future recommendations include continuation of the funding for dam upgrades for all the high hazard dams, and then the moderate hazard dams, continued annual inspections for maintenance items and dangerous deficiencies, upgrading EAP, and hazard assessment to reflect downstream development. Inclusion of the scanned design drawings and inundation maps from the EAP studies is being considered for our web page for public information and emergency access. Possible expansion of the program to cover canals and dikes has been considered.

Utah Division of Wildlife Resources ✓

It is the mission of the Utah Division of Wildlife Resources to serve people of Utah as trustee and guardian of the State's wildlife. Regulates hunting, fishing and trapping, and promotes recreational, educational, scientific and aesthetic enjoyment of wildlife.

Wildlife Habitats and Hazards

Wildlife species and/or their habitats are frequently exposed to hazards. These may be either natural or human influenced (i.e. drought, flood, fire, wind, snow, wetland drainage, water diversions, hazardous material spills, improper/illegal chemical use, earthquake, and other land or water construction/development). Impact resulting either directly or indirectly, from individuals or an accumulation of several hazards, may cause but not be limited to: decreased water supply, stream/lake channel/basin morphology change, riparian/upland vegetation loss or degradation, and impairment of water quality. These in turn have a varying influence, in the extreme causing death or at a minimum temporary stress, on wildlife populations and

their habitats. Hazards mentioned may affect a fairly large geographic area or be very localized in nature.

While the Division of Wildlife Resources (DNR) is charged with the management of wildlife, they do not have regulatory authority over water appropriations, water quality, development, or land management; except as allowed or occurring on properties they own. Therefore, when hazards occur, outside DWR property, DWR is limited to be a participating influence only through comments to the other regulatory agencies or individuals.

DWR management of wildlife is carried out largely through regulation of taking controlling, disturbance and/or possession of wildlife, and introduction of movement of species. However, there are numerous non-regulatory means (i.e. conservation agreements, memorandum of understanding, contract, lease agreements, cooperative agreements, and technical assistance) by which DWR interacts with other agencies, groups and individuals, to have an influence on wildlife and/or their habitat.

Hazard Areas of Commentary Interaction

While not being able to control/regulate many of the elements necessary for the benefit of wildlife; DWR provides technical comments for the maintenance, protection, and enhancement of wildlife and/or habitats for various value reasons. It is too extensive list all the areas of comment; however, the following are examples of fairly frequent concern:

- Steam Channel Alteration Permit Applications
- Water Rights Filings
- Energy and Mineral Exploration and Extraction Applications
- Federal Agency land management plans
- Waste Water Discharge Permit Applications
- Hydroelectric plant licensing or regimenting
- Urban and rural development project planning
- Utility transmission line style and locations
- Wetland alteration
- Federal land management planning
- Highway constructions

The Utah Division of Drinking Water ✓

Division of Drinking Water's Mission Statement is to " protect the public against waterborne heath risks through assistance, educations, and oversight". The Division acts as the administrative arm of the Utah Drinking Water Board. It implements the rules, which they adopt. As such, it is engaged in a variety of activities related to the design and operation of Utah's public drinking water system. The Utah Drinking Water Board is an 11-person board appointed by the Governor. It is empowered by Title 19, Chapter 4 of the Utah Code to adopt rules governing the design, operations, and maintenance of Utah's "public drinking water system".

Safe Drinking Water Act

There is a Federal Safe Drinking Water Act, which applies to all public drinking water systems in the country. The U.S. Environmental Protection Agency (EPA) has given Utah "primacy" for enforcing the federal act within its boundaries. To qualify for this Utah's laws and rules governing public drinking water systems must be at least as strict as the federal law.

Sanitary Surveys

The Division performs sanitary surveys on the water systems, which is a compliance action that identifies system deficiencies.

Emergency Response Plans

The Division of Drinking Water requires water utilities to prepare emergency response plans under the State Safe Drinking Water Act, Utah Code Section 19-4. The Division operates according to DDW Rules: R309 gives them authority to administer actions: R309-301 through R309-104 and R309-113, R309-150, R309-301, and R309-211.

Utah Division of Solid and Hazardous Waste ✓

The Tier II Chemical Inventory report, required by the Federal Emergency Planning and community Right-to-Know Act, requires facilities to submit lists of hazardous chemicals present on site. These reports are computerized and the information is provided to local emergency planning committees, the general public, and others for contingency planning purposes. To implement the Federal law, the State operates under Utah State Code, Section 63-5-5. The Division of Solid and Hazardous Waste requires that hazardous waste treatment storage and disposal facilities prepare and emergency response plan as required by regulations authorized by the State Solid and Hazardous Waste Act, Utah Code Section 19-6.

Other Agency programs are regulatory in nature requiring proper use or disposal of hazardous substances or pollutants. For example the Division of Solid and Hazardous Waste regulates the disposal of hazardous waste, the Division of Radiation Control regulates the proper usage and disposal of radioactive materials. As such there is a threat mitigation nature to these programs.

Utah Division of Water Quality ✓

The Utah Division of Water Quality protects, maintains, and enhances the quality of Utah's surface and underground water for appropriate beneficial uses; the Division of Water Quality regulates discharge of pollutants into surface water, and protects the public health through eliminating and preventing water related health hazards which can occur as a result of improper disposal of human, animal, or industrial wastes while giving reasonable consideration to the economic impact.

Water Quality Fund and Wastewater Treatment Project Fund: The Division Manages the Water Quality Revolving Fund that can be used by local governments for water quality projects and a Wastewater Treatment Project Fund.

Abating Watershed Pollution: Federal and State regulations charge the Division with "preventing, controlling, and abating" watershed pollution. Other state and local agencies have similar responsibilities. The Watershed Approach forms partnerships with these groups to pool resources and increase the effectiveness of existing programs. For each watershed management unit, a watershed plan will be prepared. The watershed plan addresses management actions at several spatial scales ranging from those that encompass a watershed management unit to specific sites that are tailored to specific environmental conditions. Ground water hydrologic basins and eco-region areas encompassed within the units will also be delineated.

State Revolving Fund Program

In 1987, Congress replaced the Construction Grants Program, with the State Revolving Fund Program. Rather than provide direct grants to communities, the federal government provides each state with a series of grants, then each state contributes a 20 percent state match. Grants from the federal government are combined with state funds in the Water Quality Project Assistance Program (WQPAP) and are used to capitalize a perpetual source of funds to finance water quality construction control activities at below market interests rates. Projects eligible for WQPAP financing include such traditional activities as construction of wastewater treatment plants and sewers. The program also will finance non-traditional water quality-related activities such as agricultural runoff control, landfill closures, contaminated industrial property (Brownfield) remediation, stream bank restoration, and wellhead protection.

Table C-3 A Summary of Current State Program and Initiatives

Emergency Management				
Type of Existing Protection	**Type of Disaster Assistance**	**Description**	**Effectiveness and/or Enforcement**	**Improvement and/or Changes Needed**
Civil Defense Act of 1950	Pre and Post Disaster	Authorizes the creation of the Utah Civil Defense Agency (the predecessor to DES) and the development of a statewide civil defense program.	Give DES statewide authority to coordinate emergency management activities statewide.	
Emergency Management Act of 1981, Utah Code 53-2, 63-5.	Pre and Post Disaster	Establishes an emergency/disaster management system.	Establishes DES	
Disaster Response Recovery Act, Utah Code 63-5A	Post Disater	Assist state and local government to effectively provide emergency disaster response and recovery assistance.	DES	
Emergency Interim Succession Act, Utah Code 63-5B	Post Disaster	Establish and define interim successors for state, local, and judicial branch.	Required for continuity of government	
The Emergency Planning and Community Right-to-Know Act (EPCRA) ot 1986 (Title 40 CFR, Part 350-372	Pre and Post Disaster	EPCRA establishes requirements for federal, state and local governments, Indian Tribes, and industry regarding emergency planning and "Community Right-to-Know reporting on hazardous and toxic chemicals. The "Community Right-to-Know" provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases to the environment. State and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment.	State Emergency Response Commission (SERC) is a part of DES. SERC designates Local Emergency Planning Committees (LEPC), which establish procedures for receiving and processing public requests for information collected under EPCRA and reviews local emergency response plans. LEPC may also act as a conduit for all emergency planning in a County.	

County Cooperative Agreements with State for Fire Protection, Amends Utah Code 65A-8-6	Pre and Post Disaster	Requires Counties, in order to be eligible to enter into a cooperative agreement with Division of Forestry, Fire and State Lands relating to fire protection to: adopt a wildland fire ordinance; require the county fire department or private provider to meet cert minimum standards; and file an annual budget; and prevents counties that do not enter into a cooperative agreement with the division from being eligible for financial assistance from the division.	Utah Forestry, Fire, and State Lands.	Changes have been made to require wildfire mitigation planning to be eligible for the fund
Emergency powers of State Engineer (State Water Resources) for Flood Mitigation Activities, Utah Code 73-2-23	Post Disaster	In addition to the emergency powers under Section 73-2-22, the state engineer shall assist counties in emergency flood mitigation on inter-county waterways when all the following conditions exist: (a) two or more counties are involved; (b) the flood mitigation activity has or may have adverse effect on the county; (c) the county executive of that adversely impacted county requests the state engineer's involvement; (d) the requesting county is providing an ongoing flood control program with jurisdiction-wide funding equivalent to .0004 per dollar of taxable value of taxable property; and (e) the requesting county has established a flood control program through zoning. (2) Multi-county flood mitigation activities by the state	State Engineers Office	

		engineer shall include: (a) assisting the counties in emergency flood mitigation planning; (b) furnishing engineering or other technical services; (c) making recommendations in emergency situations, and, if requested, participating in making emergency flood control decisions; and (d) in the event a decision is not reached, the final decision-making authority. (3) The assistance or involvement will cease when in the state engineer's judgment the flood conditions or potential for flooding subsides or when the county governing bodies of all affected counties request that the jurisdiction cease.		
Hazard Mitigation Grants for Plans & Projects				
Hazard Mitigation Grant Program (HMGP) – Robert T. Disaster Relief and Emergency Assistance Act, Public Law 3-288	Post Disaster	Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP) provides grants to States and local governments to implement long - term hazard mitigation measures **after a major disaster declaration**. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster declaration	FEMA and DES	Increase percentage back to 15%. Also address tax issues on individual projects (relocation and elevation)
Pre-Disaster Mitigation Program (PDM) Grants for Mitigation Planning and Projects.	Pre-Disaster	The Pre-Disaster Mitigation Program (PDM) allows local governments to receive technical and financial assistance to perform cost - effective pre - disaster natural hazard mitigation activities. The primary focus of the PDM program for the next two years will be natural hazard mitigation planning.	The State of Utah received federal funding from FEMA to aid in the mitigation planning process through a Pre-Disaster Mitigation Grant. Funding from this one time grant was used to contract with the Associations of Government, to assist in meeting the standards set in DMA 2000. This planning process, unlike previous planning, requires a significant amount of public involvement and buy in from local officials. All entities wishing to remain in	Establish a set-aside planning funds for States.

			contention for pre and post disaster federal assistance must participate in the planning process and promulgate the completed plan.	
Flood Mitigation Assistance (FMA) Planning Grants	Pre-Disaster	FMA was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). Funding for the program is provided through the National Flood Insurance Fund, and FMA is funded at $20 million nationally. FMA provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP).	This program is not effective in Utah due the requirement on focus on repetitive loss structures. Utah has a limited number of repetitive loss structures. This change in focus to repetitive loss on the federal level has limited critical funding for local flood mitigation planning, technical assistance and small project grants.	Federal government should reconsider the focus on repetitive loss structures, especially in States that do not have a significant repetitive loss issues.
Flood Mitigation Assistance (FMA) Project Grants	Pre-Disaster	There are three types of grants available under FMA: Planning, Project, and Technical Assistance Grants. FMA Planning Grants are available to States and communities to prepare Flood Mitigation Plans. NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project Grants. FMA Project Grants are available to States and NFIP participating communities to implement measures to reduce flood losses. Ten percent of the Project Grant is made available to States as a Technical Assistance Grant. These funds may be used by the State to help administer the program. Communities receiving FMA Planning and Project Grants must be participating in the NFIP. A few examples of eligible FMA projects include: the elevation, acquisition, and relocation of NFIP-insured structures.	FEMA	Emphasis on repetitive loss should be removed.
Hazard Identification & Mapping				
Multi-Hazard Flood Map Modernization Program (Federal and State)	Pre-Disaster	The goal of FEMA's Map Modernization Program, is to upgrade the nation's 100,000 panel flood map inventory by: • Developing up - to - date flood hazard data for all flood prone areas nationwide to support sound floodplain management and prudent flood insurance decisions.	Age of Flood Maps in Utah • 15% are less than 5 years old • 2% are 5 - 10 years old	Continue ongoing funding of flood mapping in States and ensure new maps reflect new H and H. It is also critical to continue funding for State Mapping

		• Providing the maps and data in digital format to improve the efficiency and precision with which mapping program customers can use this information. • Fully integrating FEMA's community and state partners into the mapping process to build on local knowledge and efforts. • Improving processes to make it faster to create and update the maps. Improving customer services to speed processing of flood map orders and raises public awareness of flood hazards.	• 13% are 11 - 15 years old 70% are more than 15 years old State has developed and is implementing two plans: State Business Plan and Five Year Strategic Plan. Both plans focus on flood mapping and the overall NFIP in the State.	Coordinator positions.
Public Safety				
Utah State Building Code - Utah Uniform Building Standards Act, 58-56	Pre-disaster	Building codes and amendments adopted by the State of Utah	Adopted IBC.	
National Dam Safety Act - (Public Law 104 - 303) was signed into law. Section 215 of Public Law 104 - 303	Pre-Disaster	Established a National Dam Safety Program and named the Director of the Federal Emergency Management Agency (FEMA) as its coordinator. The purpose of the National Dam Safety Program, as expressed in Section 215(a) of Public Law 104 - 303, is to "reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national dam safety program to bring together the expertise and resources of the federal and non - federal communities in achieving national dam safety hazard reduction."	The Utah State Engineer's Office, Division of Water Rights, Department of Water Resources, has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.	
"Utah Fire Prevention and Safety Act." 1993	Pre-Disaster	The fire officers of any city or county shall enforce the rules of the state fire marshal in their respective areas. The state fire marshal may enforce the rules in: areas outside of corporate cities, fire protection districts, and special districts organized for fire protection purposes; and state owned property, school district owned property, and		

		privately owned property used for schools located within corporate cities and county fire protection districts, asylums, mental hospitals, hospitals, sanitariums, homes for the aged, residential health care facilities, children's homes or institutions, or similar institutional type occupancy of any capacity. The state fire marshal may enforce the rules in corporate cities, counties, and fire protection districts, and special service districts organized for fire protection purposes upon receiving a request from the chief fire official or the local governing body.		
Management of Forest Lands and Fire Control, Utah Code 65A-8-1	Pre and Post Disaster	Division of Forestry Fire and State Lands responsibilities for fire control and the preservation of forest, watershed, and other lands to include reciprocal agreements for fire protection to include federal agencies, to provide fire protection for land and improvements for which the organization normally provides fire protection.	UFF&SL	
State of Utah Federal Surplus Property Program	Pre and Post Disaster	The Federal Surplus Property Program is a Utah State governmental program that is tasked with the responsibility of locating, acquiring and distributing federal surplus personal property to what are commonly referred to as "donees" consisting of state and local governments and eligible non-profit organizations. Property is acquired from various federal agencies and military installations throughout the country. Property is "screened" directly for donees based upon their wants and needs, or it is brought into our warehouses on a speculative basis and is displayed for customer viewing. Items normally available includes office furniture, generators, vehicles, boats, power tools, food service equipment, construction materials, clothing, beds, medical equipment, paints and solvents, fire fighting equipment, heavy equipment, etc. Eligibility is limited to all state and local governments and eligible nonprofit organizations. Nonprofit organizations must serve the public in one of the following areas: Public Health, Educational Activity, Provider of Assistance to the Homeless, Programs for Older Individuals, Museums, Sheltered Workshops, Day Care		

Planning and Technical Assistance				
Envision Utah – Planning references; Utah Code 10-8-301/302 and 17-27-310/302	Pre-Disaster	In 1997, the state partnered with *Envision Utah*, a public/private community partnership dedicated to studying the effects of long-term growth, creating a publicly supported vision for the future, and advocating the necessary strategies necessary to achieve this vision. Land Use, population and growth analysis, transportation and circulation, Environmental Analysis (which includes topography, climate, natural features and hazards, man made environmental impacts and an analysis of lands suitable for development), Public Utilities and facilities, social conditions (housing and redevelopment), economic analysis, community visual quality and urban design.	Envision Utah	Greater emphasis on natural hazards in the planning areas.
The Utah Energy Office – Department of Natural Resources	Pre-Disaster	Utah Energy Office promotes efficient use and appropriate development of energy resources in Utah. This mission is accomplished by providing the public, private industry, nonprofit organizations, and government agencies with information, objective research, technical assistance, and energy-related policy analysis, as well as access to federal and state energy programs. As an example, the "Cool Communities" program works to reduce energy consumption and increase air quality in Utah by promoting "cool" strategies of appropriate placement of trees and shrubs and use of reflective roofing and pavements. Partnering with many groups, the program is involved in education and demonstration projects, and incorporating "Cool Communities" strategies into municipal policy and city ordinances. Utah offers a state income tax credit for renewable energy systems. The credit for residential systems is 25 percent of the equipment and installation cost up to a maximum of $2,000. Commercial systems receive a 10 percent tax credit up to a maximum of $50,000. The technologies included are: solar electric, solar thermal, passive solar, wind, and hydropower. Businesses can also receive the tax credit for biomass systems.		

LeRay McAllister Critical Land Conservation Fund – State of Utah, Governor's Office of Planning and Budget	Pre and Post Disaster	The *LeRay McAllister Critical Land Conservation Fund (LMF)* is an incentive program providing grants to encourage communities and landowners to work together to conserve their critical lands. The fund targets lands that are deemed important to the community such as agricultural lands, wildlife habitat, watershed protection, and other culturally or historically unique landscapes. LMF Conservation Funds can be used to protect lands possessing resources deemed critical to your community. These resources may include, but are not limited to agricultural lands, historical and cultural sites, wildlife habitat, natural recreation, wetlands and watershed protection areas. Funds may not be used to purchase land for "active recreation" sites such as city parks containing constructed playgrounds, baseball or soccer fields, etc. The funded project must be something that will be preserved predominantly in, or restored to its natural state or used for agricultural production**.**		
Utah Tomorrow – Strategic Plan, Utah Code 36-18-1	Pre-Disaster	*Utah Tomorrow* is a broad-based, ongoing strategic planning effort designed to enable all segments of Utah society to focus on and measure progress toward specific goals for Utah's future. Protecting, enhancing and restoring watersheds is a key strategic element of the plan as well has drought mitigation practices.		
Other Programs				
Resource Development and Coordinating Committee, Governor's Office of Planning and Budget	Pre and Post Disaster	The RDCC assists the State Planning Coordinator in fulfilling the responsibilities of reviewing and coordinating technical and policy actions which may affect the physical resources of the state and facilitate the exchange of information on such actions among State agencies and other levels of governments.		

Local Mitigation Planning Coordination

[The section should include a] description of the State process to support, through funding and technical assistance, the development of local mitigation plans.

Local Funding and Technical Assistance

The Department of Public Safety Division of Emergency Services provides technical and financial assistance to locals for mitigation planning through the Natural Hazards Section. The Natural Hazards Section within DES is comprised of the Earthquake Program Manager, State Hazard Mitigation Officer, State Floodplain Administrator, and State Mitigation Planner. This group along with their ties to state and federal technical experts will assist any local jurisdiction with mitigation planning. The Natural Hazards Section can offer assistance with funding, planning process, risk assessment, capability assessment, hazard analysis, GIS, project development, etc.

As mentioned previously in this plan, locals participated in completing PDM plans through assistance and participation the multi-jurisdictional mitigation plans. Several city and county governments have since decided to complete there own hazard mitigation plan, which will be more specific to there particular jurisdiction and hazards. It is expected locally specific mitigation planning will continue into the future. The State can easily meet the request for technical assistance, yet funds for plan development could be limited. Funds for planning assistance currently come from three federal sources the Pre-Disaster Mitigation Grant Program, the Emergency Management Performance Grant (EMPG) or the HMGP 7% planning assistance funds. HMGP funds are only available after and event, thus this funding source is currently unavailable in Utah. The state has no mechanism to fund the development of local mitigation plan. The locals are typically picking up the cost of local plan development through operating budgets for emergency management programs.

If funding becomes available to update local mitigation plans every five years as specified in DMA 2000 the UPDMPC will prioritize plan updates based on the following criteria:

- Vulnerability to hazards
- Age of plan
- Development pressure
- Any changes in population, building stock, or hazards

Following plan update prioritization, a committee will be formed for each region. Region boundaries will follow those used in the current multi-jurisdictional mitigation plan, which align with the Association of Government planning districts. Stakeholders will be contacted and assembled to devise a tactic for completing plan updates. Updates and the method by which these updates occur will be determined democratically by the local jurisdiction participating in the planning process. Stakeholders will include at a minimum:

- County emergency managers
- City emergency managers
- City and County Elected Officials
- DES Natural Hazard Mitigation Planner

- DES State Hazard Mitigation Officer

At the conclusion of this committee meeting the following will be determined:

- Whether to complete county plans or update multi-jurisdictional plans
- Determine who will complete those mitigation plans
- Set up a timeline
- Address funding

Integrating Local Mitigation Planning

[The section should include a] description of the State process and timeframe by which the local plans will be reviewed, coordinated, and linked to the State Mitigation Plan.

It is the responsibility of the State Hazard Mitigation Officer and the State Mitigation Planner to implement the coordination of local and state mitigation planning. Coordinating local planning efforts is primarily the responsibility of the State Mitigation Planner with oversight provided by the State Hazard Mitigation Officer. Coordinating mitigation planning done at the local level includes but is not limited to providing technical expertise, aiding in planning development, and training. Completing local plans should take no longer than 18 months, updating of a local mitigation plan should take no longer than one year. If funding is available DES will work consistently to maintain mitigation plans, which meet DMA 2000 requirements for each jurisdiction.

The state believes timelines and meeting those timelines are essential in completing a planning process. Therefore, DES believes it is important to maintain defined deadlines and meet those deadlines. At the beginning of any mitigation planning process the UPDMPC will again come together to accomplish reverse planning. This is the art of determining what needs to be done and by when; then creating timelines to insure plans are completed prior to a deadline. During this time the committee will determine the amount of time the state will need to review and approve each submitted mitigation plan. Based on past experience we believe it is possible to do a comprehensive review, on up to seven mitigation plans, in two week (10 working days).

These reviews are completed by the UPDMPC with assistance from the SHMT, if needed. The State Hazard Mitigation Planner coordinates the review process with UPDMPC members assigned responsibilities as follows:

- State Floodplain Manager: reviews portions of the plans pertaining to flooding and reviews overall layout and grammar
- Earthquake Program Manager: reviews those pieces of the plan pertaining to seismic and geologic hazards.
- State Hazard Mitigation Officer: concentrates on accuracy of information in the plan and layout.
- State Hazard Mitigation Planner: reviews plans entire plan ensuring the plan meets the requirements of DMA 2000.

The Natural Hazards Section will implement findings of the local mitigation planning at the first update of the State Mitigation Plan. Updates will occur every three years, after an event, or at the discretion of FEMA or the State Director of the Division of Emergency Services.

Prioritizing Local Assistance

[The section should include] criteria for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs, which should include:

- ***Consideration for communities with the highest risks,***
- ***Repetitive loss properties, and***
- ***Most intense development pressures.***

…[For] non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs.

When prioritizing mitigation grant applications, at the state level, for planning and project grant assistance application will be separated into two categories one applying for planning grants the other for project grants. Grant applications in each category will then be prioritized. This will eliminate planning applications from competing against project applications. The state will assemble a grant applications/project review committee with members from DES and the SHMT. The level of funding assistance available and number of grant applications will determine committee size and level of expertise. The committee will utilize the following list of criteria to serve as a measure upon which individual hazard mitigation projects and planning grants will be evaluated, and subsequently prioritized.

- The greatest good for the greatest number within reason.
- Overall risk the community exhibits.
- Intensity of development pressure.
- Identification of persons, agency or organization responsible for implementation.
- Projecting a time frame for implementation.
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available.
- Identifying alternative measures, should financing not be available.
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties.
- Be based on the county seat Vulnerability Analysis.
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters.
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options.
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal.
- Property, damage to critical facilities, economic loss, and hardship or human suffering.
- Meet applicable permit requirements.
- Not encourage development in hazardous areas.
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem.

- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation.
- Have manageable maintenance and modification costs.
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement.
- Whenever possible, use existing resources, agencies and programs to implement the project.

Benefit Cost Analysis
Mitigation projects will employ, as one of the primary criteria in prioritizing a project, the extent to which benefits are maximized with respect to cost. Grant applications will utilize one of the FEMA approved Benefit/Cost models to derive a benefit to cost ratio. The use of similar models will allow for consistence in the project review. FEMA has developed models for earthquake, flood, and wildfire. Models will be checked for accuracy before grant applications are prioritized. FEMA approved benefit/cost models are available from the Utah Division of Emergency Services Natural Hazards Section.

The benefit cost models for each hazard display there own intricacies resulting in inaccuracies when ratios are compared between models. One would think a normalized benefit to cost ration would allow quantitative comparison between for example flood and wildfire projects, this is not the case. For this reason if levels of mitigation assistance become high enough or the number of applications large enough, b/c ratios will only be prioritized against similar projects. Thus, flood projects b/c ratios will only be compared with b/c ratios from flood projects.

Plan Maintenance Procedure

[The Standard State plan should detail the State's] established method and schedule for monitoring, evaluating, and updating the plan.

Monitoring, Evaluating and Updating the Plan
Periodic monitoring and reporting of this plan is required to ensure that the goals and objectives for the state are kept current and state and local mitigation efforts are being carried out. This plan has therefore been designed to be a "living" and user-friendly document in terms of monitoring and implementing.

Annual Reporting Procedures
This plan shall be reviewed annually, or as situations dictate such as following a disaster declaration. Each year the Division of Emergency Services in conjunction with the State Hazard Mitigation Team will review the plan and ensure the following:

1. The Division Director of Emergency Services and FEMA Region VIII will receive an annual report and/or presentation on the implementation status of the plan.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan.

3. The report will recommend, as appropriate, any required changes or amendments to the plan.

If the Division Director, State Hazard Mitigation Team, or FEMA determines that a modification of the plan is warranted, an amendment to the plan may be initiated.

Revisions and Updates
Periodic revisions and updates to the plan, based on funding, are required to ensure that the goals and objectives for the state are kept current. More importantly, revisions may be necessary to ensure the plan is in full compliance with Federal regulations and State statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

Three (3) Year Plan Review
The entire plan including any background studies and analysis should be reviewed every three (3) years to determine if there have been any significant changes in the region that would affect the plan. These revisions will include updates made in regional and single jurisdiction mitigation plans. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that will be addressed in plan revisions.

The Natural Hazard Pre-Disaster Mitigation Planning Committee along with supporting mitigation committees will be notified or assembled every three (3) years for the review and update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the plan will need to be revised to reflect lessons learned or to address specific circumstances arising of the disaster.

The results of this three (3) year review will be summarized in the annual report prepared for this plan under the direction of the Division Director of Emergency Services. The annual report will include an evaluation of the effectiveness and appropriateness of the plan, and will recommend, as appropriate, any required changes or amendments to the plan.

If the Division Director, FEMA, State Hazard Mitigation Team, or state jurisdictions, determines the plan requires modification, an amendment may be initiated as described below.

Plan Amendments
An amendment to the plan may be initiated by Utah DES Division Director, either at his/her own initiative or upon the recommendation of the State Hazard Mitigation Officer, State Hazard Mitigation Team, or elected official of an affected community.

Upon initiation of an amendment to the plan, DES will forward information on the proposed amendment to all interested parties including, but not limited to, all affected state agencies, city or county jurisdictions, residents and businesses. Depending on the magnitude of the amendment, the full planning committee may be reconstituted. At a minimum, the information

will be made available through public notice in a newspaper of general circulation and available on the DES website.

All plan amendments will be sent out in order to seek input on the amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Natural Hazard Pre-Disaster Mitigation Committee for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the plan; and/or

3. There has been a change in information, data or assumptions from those on which the plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

The Division Director of DES will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Division Director will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Defer the amendment request for further consideration and/or hearing.

4. Reject the amendment request.

Monitoring Progress

[The Standard State plan maintenance process should include:]

- ***A system for monitoring implementation of mitigation measures and project closeouts, [and]***
- ***A system for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.***

Completion of not only the state mitigation strategies, but also those strategies featured in local plans will be the ultimate marker by with this mitigation plan and the state natural hazard program will be judged. The UPDMPC will review the mitigation strategies in this plan each year to make certain progress is being made towards their completion or continued support. If for some reason progress has been stalled it will be the responsibility of the UPDMPC to determine why. If those variables inhabiting progress are within the control of the State, a tactic will be designed and implemented to assist in completing the strategy.

Funded Projects

Mitigation and financial staff of DES will be responsible for the monitoring and tracking of all funded mitigation projects. Tracking of these projects will involve quarterly reporting by state sub-grantees due one month following the end of the federal quarter. These quarterly reports will either follow the format required by the funding agency or will be designed by the state mitigation staff. Quarterly reports will at a minimum include a narrative providing details on progress made, problems, percentage of completion and financial information.

Upon project completion the state will assist sub-grantees in filling out any required closeout documentation. At close out the mitigation staff will complete a project close out site visit, to insure the project was completed as stated in the grant scope and within the bounds of all state and federal laws.

Past Progress

The UPDMPC views this mitigation plan and the new DMA 2000 legislation as a new beginning for mitigation in the State of Utah. Tremendous progress as been made in the past for example:

- Salt Lake County Flood Control Project
- Utah Living With Fire Committee
- Flood Management Assistance
- I-15 Reconstruction
- State Capitol Renovation
- Olympics

Yet, because this plan represents the first mitigation plan produced by the reorganized mitigation section within DES to meet the Pre-Disaster Mitigation planning requirements this document does not catalog successes or failures of the past mitigation program.

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List of Acronyms and Recognized Abbreviations

AGRC	Automated Geographic Reference Center
AOG	Association of Governments
Assoc.	Association
ATV	All Terrain Vehicle
Bldg.	Building
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
Bur.	Bureau
Corp.	Corporation
CRS	Community Rating System
Dept.	Department
DESHS/DES	Division of Emergency Services and Homeland Security
Div	Division
DMA 2000	Disaster Mitigation Act of 2000
DOT	Department of Transportation
DNR	Division of Natural Resources
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FFSL	Forestry Fire and State Lands
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FS	Forest Service
GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HAZUS MH	Hazards United States
ICS	Incident Command System
LEPC	Local Emergency Planning Committee
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
SCS	Soil Conservation Service
SLC	Salt Lake City
SPI	Standardized Precipitation Index
SWSI	Surface Water Supply Index
UFFSL	Utah Forestry, Fire, and State Lands
UGS	Utah Geological Survey
URWIN	Urban-Rural Wildland Interface Zone
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UT	Utah

Glossary of Terms

Abutment (dam) - the valley side against which a dam is constructed.

Acre-foot of water - approximately 326,000 gallons of water, or approximately a football field covered by one foot of water.

Active Fault - a fault displaying evidence of displacement
along one or more of its traces during Holocene time (about the last 11,000 years).

Aftershocks - earthquakes during the seconds, hours, days to months following a larger earthquake (main shock) in the same general region.

Alluvial fan - a cone-shaped deposit of stream sediments, generally deposited at the base of a mountain where a stream encounters flatter terrain.

Amplitude (seismic waves) - the maximum height of a wave crest or depth of a trough. Amount the ground moves as a seismic wave passes, as measured from a seismogram.

Avalanche path - the area in which a snow avalanche runs; generally divided into starting zone, track, and runout zone.

Basin and Range physiographic province - consists of north-south-trending mountain ranges separated by valleys, bounded by the Rocky Mountains and the Colorado Plateau to the east and the Sierra-Cascade Mountains to the west (includes western Utah).

Bearing capacity - the load per unit area, which the ground can safely support without excessive yield.

Bedrock - solid in-place rock, sometimes exposed and sometimes concealed beneath the soil.

Collapsible soil (hydrocompaction) - loose, dry, low-density soil that decreases in volume or collapses when saturated for the first time following deposition.

Critical Areas - Environmentally sensitive areas which include wetlands fish and wildlife habitat conservation areas; geologically hazardous areas; areas with a critical recharging effect on aquifers used for potable water; and frequently flooded areas. Critical areas have measurable characteristics which, when combined, create a value for or potential risk to public health, safety and welfare.

Critical/Essential Facilities - Structures meeting one or more of the following criteria:

- Fire stations, police stations, storage facilities for vehicles/equipment needed after a hazard event, and emergency operation centers.
- Hospitals, nursing homes, and housing which is likely to contain occupants who may not be sufficiently mobile to avoid injury or death as a result of a hazardous event.
- Public and private utility facilities, which are vital to maintaining or restoring normal services to, damaged areas after a hazardous event.
- Structures or facilities that produce, store, or use highly flammable, explosive, volatile, toxic and/or water reactive materials.

Debris flow - involves the relatively rapid, viscous flow of surficial material that is predominantly coarse grained.

Debris slide - involves predominantly coarse-grained material moving mainly along a planar surface.

Delta - a deposit of sediment formed at the mouth of a river where it enters an ocean or lake.

Earth flow - involves fine-grained material that slumps away from the top or upper part of a slope, leaving a scarp, and flows down to form a bulging toe.

Earthquake - a sudden motion or trembling in the earth as fracture and movement of rocks along a fault release stored elastic energy.

Earthquake Fault Zone - earthquake fault zones are regulatory zones around active faults. The zones are used to prohibit the location of critical facilities and structures designed for human occupancy from being built astride an active fault. Earthquake Fault Zones are plotted on topographic maps at a scale of 1-inch equals 2,000 feet. The zones vary in width, but average about one-quarter mile wide.

Earthquake induced Seiches - earthquake generated water waves causing inundation around shores or lakes and reservoirs.

Epicenter - the point on the earth's surface directly above the focus of an earthquake.

Erosion - the removal of earth or rock material by many types of processes, for example, water, wind, or ice action.

Expansive soil and rock - soil and rock which contain clay minerals that expand and contract with changes in moisture content.

Fault - break in the earth along which movement occurs.

Fault segment - section of a fault that behaves independently from adjacent sections.

Fault zone - an area containing numerous faults.

FEMA - The Federal Emergency Management Agency was authorized under Section 404 of the Stanford Act. Provides funding for hazard mitigation projects that are cost-effective and complies with existing post-disaster mitigation programs and activities. These projects cannot be funded through other programs may be eligible.

Fill - material used to raise the surface of the land generally in a low area.

Fire-resistant vegetation - plants that do not readily ignite and burn when subjected to fire because of inherent physiological characteristics of the species such as moisture content, fuel loading, and fuel arrangement.

Flood plain - an area adjoining a body of water or natural stream that has been or may be covered by flood water.

Flood way - an area of land immediately adjacent to a stream or river channel that, in times of flooding, becomes an enlarged stream or river channel and carries the floodwater with the highest velocity.

Floodplain - an area adjoining a body of water or natural stream that has been or may be covered by floodwater.

Floodplain (100 year) - floodplains that have the potential to flood once every 100 years or that has a one percent chance of flooding equal to or in excess of that in any given year.

Fluvial - concerning or pertaining to rivers or streams.

Focus - the point of origin of an earthquake within the earth, and the origin of the earthquake's seismic waves.

Formation (geologic) - a mappable rock unit consisting of distinctive features/rock types separate from units above and below.

Frequency (seismic waves) - the number of complete cycles of a seismic wave passing a point during one second.

Fuel (fire) - vegetation, building material, debris, and other substances that will support combustion.

Fuel break - a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located strip of land to reduce or hinder the rate of fire spread.

Fuel type - a category of vegetation used to indicate the predominate cover of an area.

Glacial moraine - debris (sand to boulders) transported and deposited by glacial ice along a glacier's sides or terminus.

Graben - a block of earth down dropped between two faults.

Gradient (slope) - a measure of the slope of the land surface.

Ground failure - a general term referring to any type of ground cracking or subsidence, including landslides and liquefaction-induced cracks.

Ground shaking - the shaking or vibration of the ground during an earthquake.

Ground water - that portion of subsurface water which is in the zone of saturation.

Gypsiferous deposits - soil or rock containing gypsum, which can be subject to dissolution.

Gypsum - a mineral composed of hydrated calcium sulfate. A common mineral of evaporites.

Hazard Mitigation Plan - the plan resulting from a systematic evaluation of the nature and extent of vulnerabilities posed by a hazard present in society that includes the strategies needed to minimize future vulnerability to hazards.

Hazard Mitigation - any action taken to reduce or permanently eliminate the long-term risk to human life and property and the environment posed by a hazard.

HAZUS - Hazard United States. Earthquake Loss estimation software using GIS databases developed by FEMA.

Head (landslide) - the upper parts of the slide, material along the contact between the disturbed material and the main scarp.

Holocene - geologic epoch covering the last 10,000 years (after the last Ice Age).

Igneous rocks - rocks formed by cooling and hardening of hot liquid material (magma), including rocks cooled within the earth (for example, granite) and those that cooled at the ground surface as lavas (such as basalt).

Impermeable - materials having a texture that does not permit water to move through.

Intermountain seismic belt - zone of pronounced seismicity, up to 120 miles wide and 800 miles long, extending from Arizona through central Utah to northwestern Montana.

Lacustrine - concerning or pertaining to lakes.

Lake Bonneville - a large, ancient lake that existed 30,000 to 12,000 years ago and covered nearly 20,000 square miles in Utah, Idaho, and Nevada. The lake covered many of Utah's valleys, and was almost 1,000 feet deep in the area of the present Great Salt Lake.

Lake Bonneville sediments - sediments deposited by Lake Bonneville, found in the valleys, which range from gravels and sands to clays.

Landslide - a general term for a mass of earth or rock, which moves down slope by flowing, spreading, sliding, toppling, or falling (see slope failure).

Lateral spread - lateral down slope displacement of soil layers, generally several feet or more, above a liquefied layer.

Levee (flood) - a berm or dike used to contain or direct water, usually without an outlet or spillway.

Liquefaction - sudden large decrease in shear strength of a cohesionless soil (generally sand or silt) caused by collapse of soil structure and temporary increase in pore-water pressure during earthquake ground shaking.

Magnitude (earthquake) - a quantity characteristic of the amplitude of the ground motion of an earthquake. The most commonly used measurement is the Richter magnitude scale; a logarithmic scale based on the motion that would be measured by a standard type of seismograph 60 miles from the earthquake's epicenter.

Metamorphic rocks - rocks formed by high temperatures and/or pressures (for example, quartzite formed from sandstone).

Middle Rocky Mountains physiographic province - consists of mountainous terrain of high relief, extending from northern Utah to Wyoming, Idaho, and Montana (includes the Wasatch Range and Uinta Mountains in Utah).

Modified Mercalli intensity (MMI) - the most commonly used intensity scale in the U.S.; it is a measure of the severity of earthquake shaking at a particular site as determined from its effect on the earth's surface, man, and man's structures.

Montmorillonite - a clay mineral characterized by expansion upon wetting and shrinking upon drying.

Natural vegetation - native plant life existing on a piece of land before any form of development.

Normal fault - fault caused by crustal extension in which relative movement on opposite sides is primarily vertical; for example, the Wasatch fault.

Oolite - spherical grains of carbonate sand with a brine shrimp fecal pellet nucleus.
Outlet (dam) - a conduit through which controlled releases can be made from the reservoir.

Peat - unconsolidated surficial deposit of partially decomposed plant remains.

Period (geologic) - a standard (world-wide) geologic time unit.

Permeability - the capacity of a porous rock or soil for transmitting a fluid.

Physiographic province - a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piping (problem soil and rock) - a weak incoherent layer in unconsolidated deposits that acts as a channel directing the movement of water. As the layer becomes saturated it conducts water to a free face (cliff or stream bank for example) that intersects the layer, and material exits out a "pipe" formed in the free face. Piping can occur in a dam as the result of progressive development of internal erosion by seepage.

Pore space - the open spaces in a rock or soil between solid grains. The spaces may be filled with gas (usually air) or liquid (usually water).

Porosity - the ratio of the volume of pore space in rock or soil to the volume of its mass, expressed as percentage.

Probable Maximum Flood (PMF) - a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in a region.

Probable Maximum Precipitation (PMP) - the maximum amount and duration of precipitation that can be expected to occur on a drainage basin.
Problem soil and rock - geologic materials that are susceptible to volumetric changes, collapse, subsidence, or other engineering geologic problems.

Project Impact - An initiative of the Federal Emergency Management Agency intended to modify the way in which the United States handles natural disasters. The Goal of Project Impact from a Federal Government perspective is to reduce the personal and economic costs of hazard events by bringing together the private and public sector to better enable the citizens of a community to protect themselves from natural hazards.

Quaternary - a geologic time period covering the last 1.6 million years.

Recurrence interval - the length of time between occurrences of a particular event (an earthquake, for example).

Rock fall- abrupt free fall or down slope movement, such as rolling or sliding, of loosened blocks or boulders from an area of bedrock. The rock-fall runout zone is the area below a rock-fall source which is at risk from falling rocks.

Rock topple - forward rotation movement of a rock unit(s) about some pivot point.

Runout zone (avalanche) - where a snow avalanche slows down and comes to rest (deposition zone). For large avalanches, the runout zone can include a powder- or wind-blast zone that extends far beyond the area of snow deposition.

Sand boil (earthquake) - deposit of sandy sediment ejected as water and sand to the surface, formed when ground shaking has caused liquefaction at depth.

Scarp - a relatively steeper slope separating two more gentle slopes. Scarps can form as result of earthquake faulting.

Sediment - material that is in suspension, is being transported, or has been moved from its site of origin by water, ice, or wind, and has come to rest on the earth's surface either above or below the sea level.

Sedimentary rocks - rocks formed from loose sediment such as sand, mud, or gravel deposited by water, ice, or wind, and then hardened into rock (for example, sandstone); or formed by dissolved minerals precipitating out of solution to form rock (for example, tufa).

Seiche - a standing wave generated in a closed body of water such as a lake or reservoir. Ground shaking, tectonic tilting, sub aqueous fault rupture, or landsliding into water can all generate a seiche.

Seismic waves - vibrations in the earth produced during earthquakes.

Seismicity - seismic or earthquake activity.

Sensitive clay - clay soil that experiences a particularly large loss of strength when disturbed. Deposits of sensitive clay are subject to failure during earthquake ground shaking.

Shear strength - the internal resistance that tends to prevent adjacent parts of a solid from "shearing" or sliding past one another parallel to the plane of contact. It is measured by the maximum shear stress that can be sustained without failure.

Shear stress - a stress causing adjacent parts of a solid to slide past one another parallel to the plane of contact.

Slope failure - a general term referring to any type of natural ground movement on a sloping surface (see landslide).

Slump - a slope failure that slides along a concave rupture surface. Generally slumps do not move very far from the source area.

Snow avalanche - a rapid down slope movement of a mass of snow, ice, and debris.

Stafford Act - Robert T. Stafford Disaster Relief and emergency Assistance Act, PL 100-707, signed into law November 23 1988: amended the Disaster Relief Act of 1974, PL 93-288

Starting zone (avalanche) - where the unstable snow or ice breaks loose and starts to slide.

Subsidence - a settling or sinking of the earth's crust.

Surface fault rupture (surface faulting) - propagation of an earthquake-generated fault rupture to the ground surface, displacing the surface and forming a scarp.

Tectonic subsidence - subsidence (down dropping) and tilting of a basin on the down dropped side of a fault during an earthquake.

Toe (landslide) - the margin of disturbed material most distant from the main scarp.

Track (avalanche) - the slope or channel down which a snow avalanche moves at a fairly uniform speed.

Unconsolidated basin fill – un-cemented and non-indurated sediment, chiefly clay, silt, sand, and gravel, deposited in basins.

Urban area - a geographical area, usually of incorporated land, covered predominately by engineered structures including homes, schools, commercial buildings, service facilities, and recreational facilities.

Urban/Wildland Interface (URWIN) - a geographical area where two different environments, wildland and urban residential meet and interact.

Velocity (ground motion) - the rate of displacement of an earth particle caused by passage of a seismic wave.

Wasatch fault - a normal fault that extends over 200 miles from Malad City, Idaho to Fayette, Utah, and trends along the western front of the Wasatch Range.

Watershed - the area of land above a reference point on a stream or river, which contributes runoff to that stream.

Weathering - a group of processes (such as the chemical action of air, rain water, plants, and bacteria and the mechanical action of temperature changes) whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.

Wildfire - uncontrolled fire burning in vegetation.

Wildland area - a geographical area of unincorporated land covered predominately by natural vegetation.

Wildland Urban Interface - Wildland vegetation and forested areas adjacent to or intermingled with residential developments.

Zone of deformation (earthquake) - the width of the area of surface faulting over which earth materials have been disturbed by fault rupture, tilting, or subsidence.

Local Mitigation Strategies

The local mitigation strategies, which comprise this table, were taken from the Multi-Jurisdictional Pre-Disaster Mitigation Plan completed by the Seven Associations of Government. The strategies were developed at the local level through a grass roots effort designed and funded by the State of Utah. Local government committees headed by the county Emergency Manager were formed to develop the mitigation strategies. The strategies are based on the vulnerability assessment developed as part of the planning process by the Seven Associations of Government. Once the full list of potential projects was developed the committee prioritized the projects as high, medium, or low. For the most part the ranking was done using the STAPLEE method developed by FEMA. For more information on the method and process see the individual mitigation plans, available in the digital Appendix I.

BEAVER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building and fire codes.						
	Action: Develop and enforce current local, state and national codes.	**HIGH**	Ongoing	Local state and federal grants	Countywide	Unknown	Local state and federal agencies	Implement and enforce rules, regulations and codes.
	Objective: Reduce the threat of Wildfire in Elk Meadows, Whispering Pines and HiLo subdivision areas.	**Problem Identification:** Specific areas of the county are susceptible to wildland fire danger.						
	Action: Complete community fire plans for each of these areas	**MED**	Next fiscal year	Local	Countywide	Minimal	Local state and federal agencies	Contact Keith Parke (Five County Fire Planner)
	Objective: Reduce the threat of Wildfire in The Grove area	**Problem Identification:** Specific areas of the Grove in the county/city area are susceptible to wildland fire danger.						
	Action: Complete community fire plans for the Grove	**MED**	Next fiscal year	Local	Beaver City	Minimal	Local state and federal agencies	Contact Keith Parke (Five County Fire Planner)
Landslide	**Objective:** Reduce landslide impact on Hwy 153, east of Beaver.	**Problem Identification:** Potential landslides around upper elevations mostly by Kents Lake and Elk Meadow. Possibility of east Hwy 153 being washed out, stream damned up, etc.						
	Action: Determine hazard according to UDOT.	**MED**	According to UDOT.	According to UDOT funding.	Countywide	Undetermined	Undetermined	Hazard will be referred to UDOT.
	Objective: Reduce potential landslide risk on commercial and residential structures on upper elevations.	**Problem Identification:** Potential risk of structures in mountainous areas to be damaged by landslides.						
	Action: Assessing possibility of landslides.	**MED**	Undetermined	Property owner	Countywide	Unknown	Unknown	Soil surveys and other engineer surveys.
Flood	**Objective:** Identify flood prone areas in County.	**Problem Identification:** There is not enough flood information on flood areas in Beaver County to identify the problem at this time.						
	Action: Mapping of potential flood areas.	**HIGH**	Unknown	Undetermined	Countywide	Undetermined	State and FEMA personnel.	Contact DESHS flood map specialist.
	Objective: Reduce flooding along the Beaver River between the Grove and Highway 160	**Problem Identification:** The Beaver River floods between the Grove area and Highway 160						

BEAVER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Alleviate obstructions to Beaver River	**MED**	1-2 years	City	Beaver City	$5,000.00	City	Clean the riverbed of trees and undergrowth
	Objective: To impound	**Problem Identification:** The area on the eastern boundary of Milford in the Industrial Park has flooded periodically which can impact some farms, Circle 4 Farms and Basin Perlite						
	Action: To impound flood waters if and when it leaves the river prior to reaching Milford to help recharge the	**MED**	5 years	Local	Milford		Local, UACD	
	Objective: To reduce flooding impact of a Minersville Dam failure due to a seismic event.	**Problem Identification:** Possible Impact from flooding due to a seismic event that could cause failure of Rocky Ford Irrigation Dam (Minersville Reservoir)-**Multi hazard event**						
	Action: Identify areas of inundation from possible failure of the Rocky Ford Irrigation Dam (Minersville Reservoir)	**HIGH**	Next funding year	FEMA, state and local.	Minersville	Minimal	AOG/state	Contact state GIS center (AGRC) to request a mapping study with assistance from the Five County Association of Governments
	Objective: To reduce reoccurring flooding problems along a 2½-block section of Center Street.	**Problem Identification:** There has been an ongoing flooding problem along Center Street within town boundaries that threatens 4 homes and 1 business						
	Action: Retain flood waters in the street	**HIGH**	1-5 years	FEMA, state and local.	Minersville	$10,000.00	Town staff	Install a drainage line along Center Street
Earthquake	**Objective:** Have a study done to determine seismic resistance of specific structures within the county i.e. Elementary and high schools, hospitals, public buildings, high traffic areas, etc.	**Problem Identification:** Unknown number of seismically unsafe structures around the county.						
	Action: Structural and non-structural earthquake hazard assessment.	**HIGH**	Ongoing	Unknown	Countywide	Unknown	Unknown	Contact DESHS earthquake program specialist.
	Objective: Public Awareness							
	Action: Conduct pubic awareness campaign.	**HIGH**	Ongoing	Federal and state grants, local sources.	Countywide	Unknown	Agency personnel and volunteers.	Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.
	Objective: Better community response to emergency situations							

BEAVER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Organize Community Emergency Response Teams.	**HIGH**	Ongoing	Federal and State grants.	Countywide	$2000 for course	State and local personnel.	Contact the Regional Citizens Corp. Council.
	Objective: Reduce the likelihood of pipe failure due to small tremors	**Problem Identification:** Cast iron water pipes in 200 North on the West side of town break after a small seismic event.						
	Action: Upgrade the quality of water pipes in specific areas	**HIGH**	1-5 years	City	Beaver City	$75,000.00	City	Replace existing cast iron pipes, install new bedding materials, install PVC pipe
	Objective: To maintain continuous water service to all areas of Milford	**Problem Identification:** Old city water lines at 200 West 600 South to 600 North break due to seismic events						
	Action: Upgrade water pipes along 200 West	**HIGH**	1-3 years	CIB or other grants	Milford	Unknown	City staff	Replace existing cast iron pipes, install new bedding materials, install PVC pipe
	Objective: To maintain continuous water service to all areas of Milford	**Problem Identification:** During small seismic events caste iron water pipes along 200 west break causing an interruption in service of culinary water to residents						
	Action: Upgrade water pipes along 200 West	**HIGH**	1-3 years	CIB or other grants	Minersville	Unknown	City staff	Replace existing cast iron pipes, install new bedding materials, install PVC pipe
Drought	**Objective:** Developing more water storage capacity in several areas in Beaver County.	**Problem Identification:** Inadequate Water Storage in Beaver County						
	Action: Conduct feasibility study.	**MED**	5 years	Unknown	Countywide	Unknown	Unknown	Contact land agencies and irrigation companies to see if studies have been done.
	Objective: Upgrading irrigation systems.	**Problem Identification:** Outdated irrigation systems throughout Beaver County.						
	Action: Put new hardware on the ground to improve efficiency of water	**MED**	Ongoing	State and Federal grants and loans.	Countywied	Unknown	NRCS, UACD, USU Extension, etc.	This is an ongoing project at this time throughout the county.
	Objective: Enforcing water law.	**Problem Identification:** There has not been enforcement of water law.						
	Action: Find out who is responsible to enforce the water law, then enforce it.	**LOW**	5 years	Unknown	Countywide	Unknown	Unknown	May start by litigation.

BEAVER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Education	**Problem Identification:** Lack of public awareness of efficient water usage.						
	Action: Use several ways in educating the public on efficient water usage.	**HIGH**	Ongoing	State and Federal grants and loans, federal program money, city and county funds, irrigation companies.	Countywide	Unknown	NRCS, UACD, USU Extension, Municipalities .	Research problem areas. Create programs to make the public aware. Use newsletters and the newspapers. Hold field trips.
Severe Weather	**Objective:** Reduce power outages.	**Problem Identification:** Wind damage to property and resulting loss of power to facilities in the Milford and Beaver valleys.						
	Action: Improve infrastructures to minimize power outages.	**HIGH**	Ongoing	Multiple groups.	Countywide	Unknown	Private people and local utilities.	Contact utilities on current situation. Gather data on power outage, and frequency of outages.
	Objective: Reduce damage to power lines from trees and limbs that blow down in severe wind storms							
	Action: Decrease the number of trees which have limbs growing around power lines	**HIGH**	Ongoing	Local	Countywide	Unknown	Local Utilities	Identify trees which pose a problem, remove or trim trees that are a threat to power lines
	Objective: Reduce damage to crops and structures.	**Problem Identification:** Wind damage to crops and structures in the Milford valley.						
	Action: Improve conditions to reduce soil erosion.	**HIGH**	Ongoing	USDA government programs.	Milford	Unknown	NRCS, UACD	Encourage people to sign up for help
Insect Infestation	**Objective:** Have government agencies develop better control methods on federal grounds.	**Problem Identification:** Heavy infestations of Mormon crickets and grasshoppers south of Minersville, Bald Ridges, North of Beaver and in the Mineral Ranges.						
	Action: Improve control methods on private and federal grounds.	**MED**	5 years	Federal government.	Countywide	Unknown	APHIS, BLM and other federal and state agencies.	Educate private and federal landowners on control methods and more into their lifecycles.
	Action: Eradicate crickets and grasshoppers.	**MED**	Ongoing.	Federal government.	Countywide	Unknown	APHIS, BLM and other federal and state agencies.	

BOX ELDER COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
Multi-Hazard		All Jurisdiction	Prepare for Severe Weather Events	Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)	Medium	2006		Minimal	NOAA
Multi-hazard		Brigham, Mantua	Protect critical infrastructure	Bury the 36" Penstock water line that carries culinary water, produces power and provide irrigation water to Brigham City.	High	2007	Local, FEMA		
Multi-hazard		Perry City	Improve emergency preparedness	CERTS training and equipment	High	2006	Local, FEMA	$3,000-$5,000	UDESHS, FEMA
Multi-hazard		Perry City	Protect critical infrastructure	Install electrical generators at culinary water wells.	High	2005	Local, FEMA	$20,000	UDESHS, FEMA
Flooding		Snowville, Plymouth and Tremonton	Mitigate impacts related to flooding.	Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.	High	2005		Minimal	UDESHS, ACOE
Flooding		Jurisdictions with identified flood hazards	Make better informed decisions.	Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.	Medium	2009	FEMA, UDESHS, Local	$2,500 to $65,000 each	Consultants, FEMA, UDESHS, Public Works
Flooding		Brigham City, Perry, Willard	Minimize flood risk from canal failure or overtopping	For those not already been studied, analyze and model the canals to determine deficiencies related to present and future demands (taking into account projected storm water increases based on projected development).	Medium	2007	Local, FEMA	$40,000	Consultants
Flooding		Perry, Willard	Minimize flooding along the base of the Willard Mountains (Perry south to Weber County Boundary).	Pearson Canyon drainage-extend storm water drain west of SR-89 to the east of the railroad tracks and eventually under the tracks to wetlands.	Medium	2005	Willard City, Willard Flood Improvement District, FEMA	$106,100	
Flooding		Willard	Minimize flooding along the base of the Willard Mountains (Perry south to Weber County Boundary).	Pearson Canyon drainage-dike the north channel east of the Ogden-Brigham Canal to divert water to the south branch. Deepen existing detention basin and low level outlet constructed.	Medium	2007	Willard City, Willard Flood Improvement District, FEMA	$126,000	
Flooding		Tremonton	Protect critical community facilities.	Berm around the west and north sides of the regional waste water treatment plan (similar to south and east sides). 840 feet, 3 feet high and 15	Medium	2006	Tremonton, FEMA	$12,000	

BOX ELDER COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
				feet wide along Malad River.					
Flooding		Honeyville	Educate citizens	Provide education and issue warnings when building permits are issued along the Bear River.	High	2004	Honeyville Town	Minimal	
Flooding		Honeyville	Educate citizens	Educate citizens and property owners along foot of Wellsville Mountains of areas of past flooding.	High	2004	Honeyville Town	Minimal	
Wildfire		Honeyville, Deweyville, Brigham City, Perry, Willard	Become "Firewise" communities.	Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).	High	2007		Minimal	BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.
Wildfire		Honeyville	Build citizen capacity	Educate and train property owners along the foot of the Wellsville Mountains about living with wildfire threats.	High	2006	Honeyville Town	Minimal	BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.
Earthquake and Landslide		All Jurisdictions	Make better informed decisions.	Improve the geologic hazard information and mapping for populated portions of the county.	Medium	2008	Utah Geologic Survey, Local	$65,000	Utah Geologic Survey, BRAG
Earthquake and Landslide		All Jurisdictions	Avoid placing new development at risk from geologic hazards.	Develop land use ordinances that require site specific geo-hazard studies be performed prior to development permitting in areas determined to be high risk related to earthquakes (especially for critical or high-occupancy buildings).	High	2006		Minimal	Utah Geologic Survey, BRAG, Utah League of Cities and Towns.

CACHE COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	Goal	Jurisdiction(s)	Objective	Project Description	Priority	Timeframe	Potential Funding	Estimated Cost	Resources
Multi-Hazard		All Jurisdiction	Prepare for Severe Weather Events	Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)	Medium	2006		Minimal	NOAA
Multi-Hazard		All Jurisdictions	Make critical infrastructure disaster resistant.	Provide for a redundant source of electrical power in Cache Valley.	High	2007	Pacificorp, Local, Logan City, Hyrum City	YTD	Cache Chamber of Commerce, UDESHS
Flooding		Unincorporated County, Nibley City	Reduce the threat of flooding from the Blacksmith Fork River	Dredge and widen the river channel, and build up river bank at 5200 South on the parallel to Hollow Road.	High	2006	Local, FEMA	$4,500	
Flooding		Amalga, Nibley, Paradise, Trenton	Mitigate impacts related to flooding.	Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.	High	2005		Minimal	UDESHS, ACOE
Flooding		Jurisdictions with identified flood hazards	Make better informed decisions.	Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.	Medium	2009	FEMA, UDESHS, Local	$2,500 to $65,000 each	Consultants, FEMA, UDESHS, Public Works
Flooding		All Jurisdictions with Canals	Minimize flood risk from canal failure or overtopping	For those that have not already been studied, analyze and model the canals to determine deficiencies related to present and future demands (taking into account projected storm water increases based on projected development).	Medium	2007	Local, FEMA	$95,000	Consultants
Flooding		All Jurisdictions	Minimize flood risk from storm water runoff.	Work toward requiring all new development to accommodate its own storm water discharge on-site. Develop ordinances and standards that require new development be designed to do on-site storm water retention.	Medium	2005	Local Funds, EPA, FEMA	$7,000 per jurisdiction	BRAG, EPA, Utah Association of Conservation Districts, FEMA, UDESHS
Flooding		Logan City	Improve Logan City's flood management capability.	Dredge 1st, 2nd & 3rd Dams. Mud and silt has built up over the years causing the settlement area to shrink.	Medium	2005	Local Funds, FEMA	Approx $120,000 per dam	
Wildfire		Paradise, Hyrum, Wellsville, Millville, Providence, Logan, North Logan, Hyde Park, Smithfield, Mendon and Richmond	Become "Firewise" communities.	Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).	High	2007		Minimal	BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.
Earthquake		All Jurisdictions	Make better informed	Obtain better earthquake information for local level	Medium	2008	Utah Geologic	$45,000	Utah Geologic

CACHE COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	Goal	Jurisdiction(s)	Objective	Project Description	Priority	Timeframe	Potential Funding	Estimated Cost	Resources
and Landslide			decisions.	decision makers. This work has been done for the Newton, Wellsville, Logan and Smithfield 7.5 USGS quads. Complete similar work for the Clarkston, Richmond, Trenton and Paradise 7.5 minute quads. .			Survey, Local		Survey, BRAG
Earthquake and Landslide		All Jurisdictions	Avoid placing new development at risk from geologic hazards.	Develop land use ordinances that require site specific geo-hazard studies be performed prior to development permitting in areas determined to be high risk related to earthquakes (especially for critical or high-occupancy buildings).	High	2006		Minimal	Utah Geologic Survey, BRAG, Utah League of Cities and Towns.

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
WILDLAND FIRES	**OBJECTIVE:** Decrease fuel potential in areas of western Carbon County	**Countywide Problem Identification** Wildfire can significantly impact identified areas and communities in Carbon County.						
	ACTION: Remove dead and diseased trees	**HIGH**	Ongoing	Private	Western Carbon County	Sale of trees will generate income		.
	OBJECTIVE: - Maintain adequate fire breaks between wildfire zones and residences in East Carbon County							
	ACTION: Secure up-to-date property mapping	**HIGH**	Ongoing	None	East Carbon County	Unknown	City Staff: GIS, County Assessor, Recorder	
	ACTION: Build roads between fire interface zone and residential areas	**HIGH**	6 Months	City Funding	East Carbon County	Unknown	City and Public Works	
	OBJECTIVE: Prevent fire hazards within city limits	**Countywide Problem Identification** Urban contiguous fire impacts lives and property in the County						
	ACTION: Review building codes	**MEDIUM**	Immediately	None	Countywide	Minimal	Local	
	ACTION: Install parapets on building tops	**MEDIUM**	Extended	Private	Countywide	Unknown-Variable	Local	.
DAM FAILURE	**OBJECTIVE:** Protect lives and property from dam failure inundation risk. Prevent or mitigate damage and loss of life from Scofield Dam failure	**Countywide Problem Identification** National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all dam failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.						
	ACTION: Install Remote Warning Systems	**HIGH**	Immediately	None	Western Carbon County	Minimal	Local	

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Maintain periodic testing of dam	**HIGH**	Immediate	State, Federal, Local	Western Carbon County	Unknown	Federal	
	ACTION: Build new bridge to bypass Scofield Dam Road	**HIGH**	Undetermined	State, Federal, Local	Western Carbon County	$10,000,000	State and Local	
	ACTION: Construct series of dams on Lower Fish Creek	**HIGH**	Ongoing/ Extended	Unknown	County	$5,000,000/ea.	Contractor	
	ACTION: Construct water holding reservoir in Price Canyon	**HIGH**	Begin now with proposals, could take several years	Unknown	County	$Millions	Contractor	
	OBJECTIVE: Protect lives and property from Grassy Trail Dam failure.							
	ACTION: Obtain funding for engineering, equipment and long-term system maintenance	**HIGH**	Unknown	Unknown	County/East Carbon/ Sunnyside	Unknown	City Admin. Staff	
	ACTION: Install sensors at dam site and monitor devices at City Offices	**HIGH**	6 months	Federal grant	County/East Carbon/ Sunnyside	Unknown	Private engineering firm will work with East Carbon and Sunnyside administration	
	ACTION: Monitor dam	**HIGH**	Ongoing	Unknown	County/East Carbon/ Sunnyside	Unknown	City Staff	
	OBJECTIVE: Minimize safety risk and property damage to East Carbon City and Sunnyside City from dam failure							
	ACTION: Construct riprap dike on the east side of Highway 13 from northern Sunnyside City boundary to Sunnyside Park	**HIGH**	1 year	Federal grant	County/East Carbon/ Sunnyside	Unknown	Private Construction Firm	

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Excavate wash	**HIGH**	1 year	Federal grant	County/East Carbon/ Sunnyside	Unknown	Private Construction Firm	
FLOODING	**OBJECTIVE:** Minimize safety risk and property damage to Carbon County residents due to flooding by establishing, upgrading and maintain structural control measures	**Countywide Problem Identification** Flooding continues to be of concern in the County and Cities and Towns within the County. The County experiences flooding during spring snowmelt and summer thunderstorm season.						
	ACTION: Build catch pond on Meads Wash	**HIGH**	Underway	City and Federal	County/City/ Town	$100,000	City Staff	
	ACTION: Build catch pond on Cardinal Wash	**HIGH**	2 years	State, County, City	County/City/ Town	$75,000	County	
	ACTION: Build catch pond on Grassy Trails	**HIGH**	2 years	State, Federal, County, City	County/City/ Town	$30,00	County	
	ACTION: Excavate wash	**HIGH**	1 year	Federal grant	County/City/ Town	Unknown	Private Contractor/ City	
	ACTION: Increase culvert size on Cardinal Wash at Highway 50-6	**HIGH**	1 year	Federal grant	County/City/ Town	$500,000	UDOT/	
	ACTION: Excavate wash	**HIGH**	1 year	Federal grant	County/City/ Town	Unknown	Private Contractor/ City	
	ACTION: Enlarge culvert at Pine Street and Edgehill Drive in Sunnyside	**HIGH**	1 year	Federal grant	County/City/ Town	Unknown	Private Contractor/ City	
	OBJECTIVE: Promote flood insurance throughout the County	**Countywide Problem Identification** Reduce economic loss due to flooding						
	ACTION: Create outreach document promoting flood insurance and include in local newspaper(s)	**HIGH**	1 year	Federal grant	County/City/ Town	Unknown	Private Contractor/ City	

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
DROUGHT	**OBJECTIVE:** Minimize loss of life, damage to property and disruption in commerce and governmental services caused by drought through proactive water conservation measures	**Countywide Problem Identification** Cyclical periods of drought place a strain on community culinary water resources						
	ACTION: Promote secondary water sources	**MEDIUM**	Underway	State, Federal, Local	County/City/ Town	Unknown	County/City/ Town	
	OBJECTIVE: Increase overall water storage capacity by building new water storage facilities							
	(**Same as below)**	**MEDIUM**	5 years	State, Federal, Local	County/City/ Town	$100,000,000	Contractor	
	ACTION: Construct dam in Willow Creek Canyon	**MEDIUM**	5 years	State, Federal, Local	County/City/ Town	$100,000,000	Contractor	
	OBJECTIVE: Find new water sources							
	ACTION: **Update** research on the possibility of "cloud seeding"	**MEDIUM**	Immediately	County	County/City/ Town	$100,000	Contractor	
	OBJECTIVE: Secure adequate water for culinary and agricultural needs of East Carbon and Sunnyside through structural measures							
	ACTION: Design and build silt control coffers at water inlets at Grassy Trail Reservoir to prevent buildup.	**MEDIUM**	1 year	Federal grant	County/City/ Town	Unknown	Contractor, private engineering firms to work with cities	
	(**Same as below)**	**MEDIUM**	Unknown	Unknown	County/City/ Town	Unknown	Unknown	

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Tunnel from Range Creek dam site to drop off point	**MEDIUM**	2 years	Federal grant	County/City/ Town	$100,000	Contractor, private engineering firms to work with cities	
	ACTION: Obtain funding to build Range Creek Dam	**MEDIUM**	Unknown	Unknown	County/City/ Town	Unknown	City Staff	
	ACTION: Construct Range Creek Dam	**MEDIUM**	5 years	Federal grant	County/City/ Town	$10,000,000	Contractor, private engineering firms to work with cities	
LANDSLIDE	**OBJECTIVE:** Minimize loss of life, damage to property and disruption in residents, commerce and governmental services caused by landslides through structural measures	**Countywide Problem Identification** There is a potential risk to structures located in areas identified Federal and state agencies and depicted in GIS as landslide risk areas						
	ACTION: Build retaining fences and momentum absorbers along highways	**LOW**	5 years	Federal, State, Local	County/City/ Town	$1,000,000	UDOT	
	ACTION: Dislodge large rocks along highways	**LOW**	Immediate	Federal, State, Local	County/City/ Town	$100,000	UDOT	
	ACTION: Build retaining walls on residencies identified as at risk	**LOW**	5 years	Individual	County/City/ Town	Variable	Unknown	
	ACTION: Develop pathways to capture falling rocks adjacent to residences	**LOW**	5 years	Federal, State, Local	County/City/ Town	$100,000	City and County	
PROBLEM SOILS	**OBJECTIVE:** Protect roadways	**Countywide Problem Identification** Problem soils are a risk to property and life due to its volatility						
	ACTION: Increase width of slope adjacent to roadways	**LOW**	Extended	Federal, State, Local	County/City/ Town	Unknown	State, County, City	
	ACTION: Educate homeowners about problem soil risk	**LOW**	2 years	Local	County/City/ Town	$3000	City and County	

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Monitor and control water on alkali soils	**LOW**	Ongoing	Local	County/City/ Town	$3000	City and County	
INFESTATION	**OBJECTIVE:** Control insects and birds	**Countywide Problem Identification** Infestation of noxious insects and bird species can impact the health, safety, and welfare of the County and its residents						
	ACTION: Insecticide spray	**LOW**	Ongoing	Local	County/City/ Town	$100,000	City and County	
	ACTION: Remove dead and diseased trees	**LOW**	Extended	Private	County/City/ Town	Trees will be harvested by commercial enterprise	Private	
	ACTION: Control pigeon population	**LOW**	Undetermined	Federal, State, Local	County/City/ Town	$15,000	City and County	
SEVERE WEATHER	**OBJECTIVE:** Protect County from adverse affects of severe weather	**Countywide Problem Identification** Snowstorms, summer thunderstorms, hail, and high wind over eastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologist.						
	ACTION: Participate in Storm Ready Program at the County level	**MEDIUM**	2 years	State and Federal	County/City/ Town	Unknown	City and County LEPC Emergency Management	Set up within the County Emergency Management and encourage all cities to participate, all requirements of the NWS Storm Ready Program.

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Encourage avalanche preparedness in County backcountry areas	**MEDIUM**	1 year	Federal, State, Local	County/City/ Town	$15,000	City and County Emergency Management	Avalanches and avalanche preparedness are not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While avalanche terrain is mainly on USFS land the search and rescue for the lost individual is more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Carbon County and the cities within the County. Most avalanche victims die in avalanches started by themselves or someone in their party. Education can limit the number of avalanche related searches each year.
	ACTION: Assess Emergency Operations Centers (EOC's) to ensure they are grounded for lightning, to include buildings with towers, etc.	**MEDIUM**	2 - 3years	Federal grant	County/City/ Town	Unknown	City and County Emergency Management	Proposed alternate Command Centers (Public Works, Public Utilities), Sheriff's Dispatch, Command Vehicles and associated equipment need to be protected from severe weather events including lightning.
HAZARDOUS MATERIALS	**OBJECTIVE:** Protect lives and property from hazardous materials spills.	**Countywide Problem Identification** Highway 6 is one of the main arteries going east and west in the State. In most places this is a two-lane highway that experiences numerous accidents and hazardous material incidents.						

CARBON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Work with County LEPC to help identify hazardous materials traffic on Highway 6	**MEDIUM**	Ongoing	Federal grants	Countywide	Unknown	City and County Emergency Management/ LEPC/State HMI	

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Dam Failure	**Objective:** Use technology to aid in prevention of flood loss due to dam failure							
	Action: Digitize high hazard dam failure inundation maps	**MED**	Ongoing	State	Countywide	$500 dollars per dam	UUtah Dam Safety Section, and AGRC	Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to town stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Daggett County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.
	Action: Update Emergency Operations Plan to include GIS dam failure estimates	MED	Next EOP update	County	Countywide	Undetermined	County GIS and Emergency Manager	
	Action: Educate the local elected officials, developers, and citizens.	MED	2 years	County	Countywide	Undetermined	County Employees	
	Action: Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**	MED	Ongoing	FEMA, State and Local	Countywide	Unknown	State and Local	
	Action: Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.	MED	Ongoing	Town and County funds	Countywide	Minimal	Water surveyor and newsletter editor	
Drought	**Objective:** Conserve culinary water by educating the public.							
	Action: The Local LEPC will hold meetings semi-annually to educate the public on the need to be water wise.	HIGH	Ongoing	County	Countywide	Minimal	Water surveyor and newsletter editor	Use a newsletter to educate the public
	Objective: Develop more water storage tanks within the County.							
	Action: Conduct a feasibility study.	HIGH	Ongoing	Town and County funds	Countywide	Unknown	Water surveyor and newsletter editor	

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Install new wheel lines to improve efficiency of water.	HIGH	Ongoing	Federal, and State funding	Countywide	Unknown	NRCS, UACD, USU, Extension, ect.	
	Action: Implement and enforce water laws that prohibit the use of extensive amounts of water.	HIGH	Ongoing	Town and County funds	Countywide	Unknown	Water surveyor and newsletter editor	
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	Town funds, State and Federal Government loans and/or grants	Manila	TBD	Manila Town Staff, Professional Services, and Contractors	
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	Town and County funds	Manila	Minimal	Water surveyor and newsletter editor	The Town should continue to maintain and implement a tiered water rate structure.
Earthquake	**Objective:** Provide for emergency response and relief	**Problem Identification:** Transportation and utilities services could be severely impacted.						
	Action: Identify and maintain critical transportation and utility services	MED	Ongoing	Local governments and possible grants	Countywide	Unknown-Determined by the extent of damage anticipated.	Town staff.	Critical transportation systems
	Action: Conduct a public awareness campaign.	MED	Ongoing	Local governments and possible grants	Countywide	Unknown	Agency personnel and volunteers	Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.
	Objective: Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.	**Problem Identification:** Unknown number of seismically unsafe structures around the county.						

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Structural and non-structural earthquake hazard assessment.	HIGH	Ongoing	Unknown	Countywide	Unknown	Unknown	Critical transportation systems
Flood	**Objective:** Design master storm drainage plans for residential areas	**Problem Identification:** Control flooding in residential areas of Daggett County, Including but not limited to the Town of Manila and the unincorporated Dutch John. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	HIGH	Ongoing	Local, State and Federal grants	Countywide	Unknown	State, Local, and possibly Federal	Aerial Topography is needed for master storm drainage design.
	. **Action:** Design master storm drainage plans to handle storm water runoff through residential areas.	HIGH	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.
	Objective: Implement storm drainage plans throughout the residential areas of Daggett County.							
	Action: Provide information to the public on how the storm drainage plans will assist in preventing flood damage to the residents of Daggett County.	HIGH	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide`	Unknown, will depend on the finals plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Use technology to aid in prevention of flood loss due to canal failure.	**Problem Identification:** This unlined earthen canal has failed before causing damage to the KOA camp ground on the Western edge of Manila.						
	Action: Daggett County and the Town of Manila will form a partnership with the current owners of the Sheep Creek Canal. In doing so, this will enable them to work together in the lining or piping of portions of the canal as funding becomes available.	HIGH	Ongoing	FEMA, state and local.	Manila	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the populated areas in Daggett County.	HIGH	Within the next two years	FEMA, state and local.	Countywide	Unknown	County and Town Employees, Local Volunteers	

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Place a restrictive clause in the County and Town Ordinances that will prohibit any new development in the County floodplain.	HIGH	Within the next year	FEMA, state and local.	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Place a restrictive clause in the County and Town Ordinances that will prohibit any undercutting of the canal.	HIGH	Within the next year	FEMA, state and local	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: educate the public on Canal maintenance and repair.	HIGH	Ongoing	FEMA, state and local.	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	Past and future flooding
	Action: County and Town building inspectors and the planning committee will implement a maintenance and inspection schedule in coordination with the owners of the canal.	HIGH	Ongoing	FEMA, state and local.	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	Past and future flooding
	Action: County and Town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Countywide	Unknown at this time	County staff	
	Action: Implement a flood ordinance that will cover the County and Town with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Countywide	Unknown at this time	County and Town Employees, Local Volunteers	
Insect Infestation	**Objective:** Reduce the impact of insects	**Problem Identification:** South and west sides of Daggett County are vulnerable to Mormon cricket and Cutworm infestations as well as some mosquito problems.						

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Spread insect bait and spray for mosquitoes	HIGH	When required	Town and County funds, Mosquito abatement funds come from property tax	Countywide	Approximately $3.00 per property owner per month	County Mosquito Abatement District	
	Objective: Reduce the severity of infestations							
	Action: The County has applied for a $6,000.00 grant to assist in purchasing 4 Mosquito magnets, propane tanks to run the magnets and to assist in salaries for the county employees to maintain the magnets.	HIGH	Spring and summer of 2004	$6,000.00 in grants	Countywide	$6,000.00	County employees	Several agricultural fields surround Daggett County; these fields have been subjected to insect infestation especially during the recent years of drought.
	Objective: Reduce the threat of West Nile Virus within Daggett County							
	Action: Educate the public on the importance of vaccinating their animals.	HIGH	Spring and summer of 2004	State and local funding	Countywide	$6,000.00	County employees	**Several of the Daggett County residents have horses that could be affected by the West Nile virus.**
	Objective: Reduce the severity of infestations	**Problem Identification:** Periodic Grasshopper infestations tend to be more sever on the edge of the developed town area and in the fields surrounding the town.						
	Action: Conduct aerial spraying to reduce infestations.	HIGH	As infestations occur	By private individuals in most cases		Varies, depending on acreage treated	Contractor	Many agricultural fields surround Daggett County and the Town of Manila. These fields have been subjected to insect infestation especially during the recent years of drought.
Landslide	**Objective:** Reduce potential landslide risk on highway 44 in areas of known landslide potential.	**Problem Identification:** There is a potential risk to pedestrians and vehicle traffic due to the Carter Creek rockslides, which are located in areas identified by the county as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures at risk	HIGH	Undetermined	Property owner	Carter creek landslide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Coordinate with all government agencies' that would assist in sloping of the hillside near Carter Creek. The county will need to contact the following agency's on the possibility of implementing some kind of protective netting or fencing that would eliminate the rock's from tumbling down on to Highway 44.	HIGH	Undetermined	Unknown	Daggett County Carter Creek	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Action: The county's and town's planning committee will review and update the zoning ordinances within the County and Town to make sure that individuals are not constructing new homes near potential landslide areas.	HIGH	Undetermined	Unknown	Unknown	Unknown	Unknown	Hold monthly planning and zoning meetings within the town and county.
Severe Weather	**Objective:** Reduce damage to structures through strict adherence to building codes	**Problem Identification:** Daggett experiences occasional, damaging high winds and snowstorms.						
	Action: Ensure that 80 MPH wind load requirement is met by builders	HIGH	Ongoing	Fees from building permits	Countywide	Minimal	Building inspector	Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events
	Objective: Reduce service disruptions and damage to power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						
	Action: Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.	HIGH	Ongoing	Possible grants	Manila	Minimal	County and town employees	Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						
	Action: Develop and enforce current local, state and national codes	HIGH	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage							

DAGGETT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: The local LEPC will provide semi-annual training for the citizens of Daggett County and the Town of Manila.	HIGH	Starting 2004	State and local	Manila	Minimal	County	Educate the public on how to reduce the risk of wildfires.

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Earthquake	**Objective:** Provide education on seismic hazards and mitigation, to Davis County residents and homeowners.	**Problem Identification:** Davis County is located in the heart of the Wasatch Fault between the shores of the Great Salt Lake and the foothills of the Wasatch Mountain Range. The majority of the population lives within 5 miles of the fault. The only major traffic artery running north and south, and numerous water and petroleum pipelines either cross over or run within ½ mile of the fault. 5 moderately sized petroleum refineries located in the south end of the county are subject to severe damage from ground movement and liquefaction. A major earthquake in the area would result in 100's of millions of dollars in damage to residential structures, industry, and of critical infrastructure, not to mention some loss of life.						Provide information to residents and business owners to encourage them to take appropriate measures to make homes and businesses less susceptible to damage from ground shaking. Education pertaining to earthquakes will be part of a holistic natural hazards education program, including wildfires, flooding, sever weather, and landslides.
	Action: Public Education	HIGH	Immediate	LEPC	Countywide	$2500.00	LEPC Membership	
	Objective: Increase quality and quantity of available natural hazards data to facilitate better decision-making.							Provide updated, detailed maps to city and county planning groups, emergency managers, and public to assist them in making educated decisions by understanding earthquake danger zones.
	Action: Update fault zone and liquefaction maps for the county	MED	Two years	Undetermined, potentially USGS or UGS	Countywide	Minimal	USGS Staff	
Earthquake	**Objective:** Provide fire department with building that meet current construction codes, ensuring response capability of fire apparatus and personnel after an earthquake.	**Problem Identification:** A number of critical structures, which contain fire apparatus within the county do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. These building exist in Clinton, South Weber and Layton.						
	Action: Retrofit or construct new fire department buildings	HIGH	4 Years	Grants and city budgets	Countywide, targeting Clinton City, South Weber, and Layton City.	$8 million	Contract	Refer to "Clinton City Fire Station Structural Analysis" for more information regarding the vulnerability assessment of the Clinton City fire station.
Wildfire	**Objective:** Increase the level of wildfire knowledge for home and business owners in the Urban Wildland Interface area.	**Problem Identification:** Much of the inhabitable land within Davis County is on the east bench. Numerous homes and subdivisions have been and are being constructed in these areas. Many of these structures border the Forest Service boundary or are in areas of old scrub oak growth. The potential for catastrophic damage from wildfire increases yearly.						

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Public awareness and education	HIGH	Immediate	LEPC	Targeting county URWIN communities	Minimal	LEPC membership, UFFSL, National Forest Service	This project is part of a holistic natural hazard education campaign within Davis County. Wildfire education will instruct on the principles of defensible space in coordination with the Utah Living With Fire Committee. Homeowners in the foothills abutting the Wasatch National Forest, along with other identified URWIN communities will be targeted.
	Action: Provide wildfire training to city and county planning and zoning officials and staff.	HIGH	Immediate	LEPC	Countywide	Minimal	LEPC membership, UFFSL, DES, National Forest Service.	City and county planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.
Wildfire	**Objective:** Re-establish effective firebreaks.	**Problem Identification:** In much of the county, there is little, if any, natural break between wildland Forest Service areas and residential areas. There are some old roads and "fire breaks" that are in ill repair, or have not been maintained for years. They have become ineffective as fire breaks and hazardous to fire apparatus.						
	Action: Widen and stabilize the firebreak between Farmington Canyon and Bountiful.	HIGH	Immediate	Grant, County budget, and Forest Service	Farmington, Bountiful, Centerville and unincorporated county developments along the Wasatch National Forest Boundary.	$200,000	County Public Works, Wasatch National Forest staff	This project is already in the planning stage. As funding is confirmed the project will commence.

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Widen and stabilize the firebreak north of Farmington Canyon to the Weber River.	HIGH	2 years	Grants, County Budget, and Forest Service	Farmington, Fruit Heights, and unincorporated county development along the Wasatch National Forest Boundary.	$500,000	County Public Works, Wasatch National Forest staff.	This area is considerably longer, but is almost entirely within existing forest service boundaries. This may result in a less aggressive project; however, some widening and stabilization can be accomplished.
Flooding	**Objective:** Increase the level of understanding in homeowners through education programs.	**Problem Identification:** The potential for flooding due to spring runoff, and especially from summer thunderstorms, is high in certain areas of the county. Existing flood plain maps do not indicate areas of flooding potential that exist, in large part due to development, that are not near creeks and the Great Salt Lake. Also not addressed is are the Weber Basin Irrigation Water Aqueduct and canals that are a potential source of flooding.						
	Action: Public education and awareness.	HIGH	Immediate	LEPC	Countywide	Minimal	LEPC Membership	This information and awareness campaign will be part of a holistic education campaign addressing the all-natural hazards, which will include all Davis County residents.
	Objective: Reduce loss of life and property damage due to flooding by providing current building code and NFIP maps to cities.							
	Action: Encourage city planners to update building codes.	HIGH	Immediate	None	Countywide	Minimal	LEPC Membership	There is evidence that not all cities in the county use updated code information concerning building of home and other structures in areas prone to flooding.
	Action: Update the county flood plain maps and include contour lines.	HIGH	One year	Federal Grants	Countywide	Unknown	DES, county personnel	Based on federal funding State DES in planning to start a flood plain map revision and update process this coming year. With cooperation from the county, we will request contour lines be added to these maps to give a realistic idea of where flooding may occur in other than historically flooded areas.

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flood	**Objective:** Lessen the impacts of flood damage caused by irrigation canal failure.							
	Action: Inspect irrigation canals.	MED	3 Years	Weber Basin Water District, Federal Grants	Communities with in Davis County down slope from Weber Basin Irrigation pipeline	Unknown	Weber Basin Water District, Contractors	Aging agriculture irrigation canals are prevalent throughout Davis county. As farming lands is converted to residential and businesses the farming infrastructure remains, supplying water to remaining farmers. The canals can break inundating down slope property.
Landslide	**Objective:** Educating planning commissions.	**Problem Identification:** The east bench of Davis County is home to numerous canyons, large and small. They were, of course, formed over thousands of years by debris flows and mudslides. Now, many hundreds of homes and other structures, pipeline, power lines, and roadways have been constructed on top of or through the alluvial fans produced by these events. Nature is not done constructing these canyons. Landslides and debris flows will continue to occur over time, thus threatening residents and critical infrastructure.						
	Action: Provide city-planning commissions with information concerning landslides and debris flows.	HIGH	One year	Unknown	Countywide	Minimal	LEPC Members	The Utah Geologic Survey will review geology reports submitted to counties and cities when requested. Additional the UGS can aid in writing geologic hazard ordinances. The city of Layton in Davis County has adopted geologic ordinances.
	Action: Encourage cities to adopt a standard of requiring geo-technical studies in identified landslide and debris flow areas.	HIGH	One year	Unknown	Countywide	Minimal	LEPC Members	
	Objective: Reduce loss of life and damage to property by providing a means to control debris and water from debris flows.	**Problem Identification:** There are a number of canyons that do not currently have debris basin constructed to contain debris flows. Others are insufficient in size. These need to be built or reconstructed in order to provide protection to residents. In addition, Weber Basin Water District maintains a large irrigation pipeline running from the mouth of Weber Canyon to east Bountiful. Any event that caused a break in the line would result in massive flooding due to the fact that there are no valves in the system.						
	Action: Construct additional Debris Basins and retrofit others.	MED	5 years	Federal grants, County funding, City funding	Countywide developments and future developments on alluvial fans in Davis County.	Estimated Cost: $10 million	County public works, city public works, contractors	Barnard Creek and other projects yet to be determined.
	Objective 2.2: Lessen the impacts of flood damage caused by irrigation canal failure.							

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Place check valves in the Weber Basin irrigation pipeline.	MED	3 years	Weber Basin Water District, Federal Grants	Communities with in Davis County down slope from Weber Basin Irrigation pipeline	$400,000	Weber Basin Water District, Contractors	Placing valves at strategic locations that can be automatically shut in the event of a break would result in less flood damage.
Severe Weather	**Objective:** Assist residents protect themselves from the affects of severe weather.	**Problem Identification:** Most presidential disaster declarations are the result to severe weather. Davis County is prone to the affects of severe weather as are many other counties in the state. These are usually thunderstorms and snowstorms. However, we are also prone to extremely severe wind events referred to as "East Winds." Historically, Davis County has experienced gusts of over 110 mph and sustained winds of 80+ mph. These can result in millions of dollars in damage. On average we experience at least one every year. Severe storms result in secondary and tertiary problems mostly dealing with power, heating and travel. Davis County has only one main north/south roadway thru the county. Severe weather has resulted and will continue to result in serious travel problems, as well as power and heating difficulties.							
	Action: Have all cities in the county participate in the Storm Ready program.	HIGH	1 year	City and county budgets	Countywide	$1,000.00	City and county Emergency Managers	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

DAVIS COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Encourage avalanche preparedness for county backcountry users.	HIGH	1 year	Unknown	Countywide	Minimal	City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Davis County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
Severe Weather	**Objective:** Harden communications capabilities to ensure post event functionality.	**Problem Identification:** As mentioned above, high winds can result in serious problems throughout the county. Communications for emergency responders have been severely hampered in the past by damage to communication infrastructure.						
	Action: Reinforce towers and infrastructure	MED	2 years	To be determined	Countywide	Unknown	UCAN, city and county personnel	
	Action: Establish alert and notification procedures/system to notify emergency responders, flood control, and emergency managers.	MED	1 year	Unknown	Countywide	Minimal	Emergency Management	Set up alert and notification groups within UNIS and City Watch.

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Dam Failure	**Objective:** Use technology to aid in prevention of flood loss due to dam failure	**Problem Identification**: Reduce down stream loss in Duchesne County due to dam failure.						Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to down stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Duchesne County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.
	Action: Digitize high hazard dam failure inundation maps	HIGH	Ongoing	State government	Countywide	500 dollars per dam	Utah Dam Safety Section, and AGRC	
	Action: Update Emergency Operations Plan to include GIS dam failure estimates	HIGH	Next EOP update	County	Countywide	Undetermined	County GIS and Emergency Manager	
	Action: Educate the local elected officials, developers, and citizens.	HIGH	Within the next two years	County	Countywide	Minimal	County employees	
	Action: Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**	HIGH	Ongoing	FEMA, State and Local	Countywide	Unknown	State and Local	
	Action: Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.	HIGH	Ongoing	Town and County funds	Countywide	Minimal	Water surveyor and newsletter editor	
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Current, past and future drought issues within Duchesne County.						
	Action: Educate the public on the need to be water wise	HIGH	Ongoing	County funding	Countywide	Minimal	Water surveyor and newsletter editor	Use a newsletter to educate the public
	Objective: Develop more water storage tanks within the County							
	Action: Conduct a feasibility study	HIGH	Ongoing	County funds	Countywide	Minimal	Water surveyor and newsletter editor	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Install new wheel lines to improve the water efficiency.	HIGH	Ongoing	Federal, and State funding	Countywide	Unknown	NRCS, UACD, USU, Extension, ect.	
	Action: Implement and enforce water laws that prohibit the use of extensive amounts of water.	HIGH	Ongoing	County funds	Countywide	Unknown	Water Surveyor and newsletter	
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	Town funds, State and Federal Government loans and/or grants	Altamont	To be determined	Altamont Town Staff, Professional Services, and Contractors	
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	Town and County funds	Altamont	Minimal	Water surveyor and newsletter	The Town should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Duchesne City	Unknown	City Staff, Professional Services, and Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funds	Duchesne City	Minimal	Water surveyor and newsletter editor	The City should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Myton City	Unknown	Myton City Staff, Professional Services, and Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funding	Myton City	Minimal	Water surveyor and newsletter	The City should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Roosevelt City	To be determined	Roosevelt City staff, Professional Services, Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funds	Roosevelt City	Minimal	Water surveyor and newsletter editor	The City should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	Town funds, State and Federal Government loans and/or grants	Tabiona	Unknown	Tabiona Town Staff, Professional Services, and Contractors	
	Objective: Conserve culinary water by conservation							

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	Town and County funds	Tabiona	Minimal	Water surveyor and newsletter editor	The Town should continue to maintain and implement a tiered water rate structure.
Earthquake	**Objective:** Provide for emergency response and relief.	**Problem Identification:** Transportation and utilities services could be severely impacted.						
	Action: Identify and maintain critical transportation and utility services.	HIGH	Ongoing	Local governments and possible grants	Countywide	Unknown-Determined by the extent of damage anticipated.	County staff	Critical transportation systems
	Objective: Public Awareness							
	Action: Conduct a public awareness campaign.	HIGH	Ongoing	Local governments and possible grants	Countywide	Unknown	Agency personnel and volunteers	Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.
	Objective: Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.	**Problem Identification:** Unknown number of seismically unsafe structures around the county.						
	Action: Structural and non-structural earthquake hazard assessment.	HIGH	Ongoing	Unknown	Countywide	Unknown	Unknown	
Flooding	**Objective:** Obtain Aerial photography with contours of each residential area in Duchesne County.	**Problem Identification:** Control flooding in residential areas of Duchesne County, Including but not limited to the Town of Altamont, Duchesne City, Roosevelt City, and the town of Tabiona.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	HIGH	Ongoing	Local, State and Federal grants	Countywide	Unknown	State, Local, and possibly Federal	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	HIGH	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Implement storm drainage plans throughout the residential areas of Duchesne County.							
	Action: Implement storm drainage plans throughout the residential areas of Duchesne County.	HIGH	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the finals plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Use technology to aid in prevention of flood loss.	**Problem Identification:** Control flooding in the Town of Altamont. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the town of Altamont.	HIGH	Within the next two years	FEMA, state and local.	Altamont	Unknown	County and Town Employees, Local Volunteers	
	Action: Place a restrictive clause in the Town Ordinances that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Town building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Implement a flood ordinance that will cover the County and Town with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Altamont	Unknown at this time	County and Town Employees, Local Volunteers	Past and future flooding
	Objective: Use technology to aid in prevention of flood loss.	**Problem Identification:** Control flooding in Duchesne City. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Duchesne City.	HIGH	Within the next two years	FEMA, state and local.	Duchesne City	Unknown	County and City Employees, Local Volunteers	
	Action: Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Duchesne City	Unknown at this time	County and City Employees, Local Volunteers	
	Objective: Use technology to aid in prevention of flood loss.	**Problem Identification:** Control flooding in Myton City. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Myton City.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Myton City	Unknown at this time	County and City Employees, Local Volunteers	
	Objective: Use technology to aid in prevention of flood loss.							
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Roosevelt City.	HIGH	Within the next two years	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Place a restrictive clause in the County and City Ordinances that will prohibit any new development in the floodplain.	HIGH	Within the next two years	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Roosevelt City	Unknown	County and City Employees, Local Volunteers	
	Objective: Use technology to aid in prevention of flood loss.							
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the town of Tabiona.	HIGH	Within the next two years	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Place a restrictive clause in the County and Town Ordinances that will prohibit any new development in the floodplain.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	Past and future flooding
	Action: County and town building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
	Action: County and town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Within the next two years	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and Town with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Tabiona	Unknown	County and City Employees, Local Volunteers	
Insect Infestation	**Objection:** Reduce the impact of insects	**Problem Identification:** Duchesne County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation.						

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Spread insect bait and spray for mosquitoes	HIGH	When required	Town and County funds, Mosquito abatement funds come from property tax.	Countywide	Approximately $3.00 per property owner per month	County Mosquito Abatement District	
	Objective: Reduce the severity of infestations							
	Action: Apply for grants to purchase Mosquito magnets and propane tanks to run the magnets.	HIGH	Spring and summer of 2004	$6,000.00 in grants	Countywide	$6,000.00	County employees	Several agricultural fields surround Duchesne County; these fields have been subjected to insect infestation especially during the recent years of drought.
	Objective: Reduce the threat of West Nile Virus within Duchesne County							
	Action: Educate the public on the importance of vaccinating their animals.	HIGH	Spring and summer of 2004	State and local funding	Countywide	Minimal	County employees	Several of the Duchesne County residents have horses that could be affected by the west nile virus.
	Objective: Reduce the severity of infestations	**Problem Identification:** Periodic Grasshopper infestations more sever in the rural areas of Duchesne County.						
	Action: Conduct aerial spraying to reduce infestations.	HIGH	As infestations occur	By private individuals in most cases	Countywide	Varies, depending on acreage treated	Contractor	Many agricultural fields surround Duchesne County. These fields have been subjected to insect infestation especially during the recent years of drought.
Landslide	**Objective:** Reduce potential landslides to residential and commercial areas.	**Problem Identification:** There is a potential risk to residential and commercial buildings due to rockslides, which are located in areas identified by the county as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures at risk	HIGH	Undetermined	Property owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Action: The county's, city's and town's planning committee will review and update the zoning ordinances within the County to make sure that individuals are not constructing new homes near potential landslide areas.	HIGH	Undetermined	Property owner	Countywide	Unknown	Unknown	Hold monthly planning and zoning meetings within the town and county.

DUCHESNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Reduce potential landslides to residential and commercial areas.	**Problem Identification:** In Duchesne County there are several areas namely Indian Canyon, Ravola Dugway, and Wolf Creek Pass that could have a potential risk to pedestrians and vehicle traffic due to landslides.						
	Action: Assess the probability of landslides and identify specific structures at risk	HIGH	Undetermined	Property owner	Countywide	Unknown	Unknown	
Severe Weather	**Objective:** Reduce damage to structures through strict adherence to building codes	**Problem Identification:** Duchesne County experiences occasional, damaging high winds and snowstorms.						
	Action: Ensure that 80 MPH wind load requirement is met by builders	HIGH	Ongoing	Fees from Building permits	Countywide	Minimal	Building Inspector	Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events
	Objective: Reduce service disruptions and damage to power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						
	Action: Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.	HIGH	Ongoing	Possible Grants	Countywide	To be determined	County and town employees	Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						
	Action: Develop and enforce current local, state and national codes	HIGH	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Specific areas of the county are susceptible to wildland fire danger.						
	Action: The local LEPC will provide semi-annual training for the citizens of Duchesne County.	HIGH	Starting 2004	State and local	Countywide	Minimal	County staff	Educate the public on how to reduce the risk of wildfires.

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
DAM FAILURE	**OBJECTIVE:** Obtain and evaluate accurate and up-to-date inundation maps for all major dams in the County	**Countywide Problem Identification** Orangeville and Castle Dale are directly downstream from Joe's Valley Dam and the communities of Cleveland, Elmo Town, (Green River City uses water from the Green River) and Huntington, as well as the bulk of northern Emery County can also be directly impacted from dam failure due to inevitable water shortages. Ferron City is directly downstream from Millsite Reservoir. Current cam inundation maps may not reflect risk. County should have central location for maps and review on a regular basis.						
	ACTION: Obtain funding for engineering evaluation of current dam inundation maps.	**MEDIUM**	Next five years	State and Federal grants, dam safety program	Countywide	Dependent on extend of evaluation	Contractors, BOR State Dam Safety	Evaluation of current dam inundation maps is essential for warning and notification systems
	OBJECTIVE: - Maintain Communication/Warning Systems for dam failure							
	ACTION: Evaluate existing warning systems for dam failure	**MEDIUM**	Next two years	County and State grants	Countywide	Unknown/Minimal	BOR, Dam Engineers, County Emergency Management	Evaluation of current communication and warning systems can be view as a baseline for future warning and communication needs.
	ACTION: Install additional warning systems where needed	**MEDIUM**	Next five years	Unknown	Countywide	Unknown	County, BOR, State Dam Safety	Development and funding of existing warning systems to include: sirens, reverse 911, satellite phones, and "call down tree"
	ACTION: Establish evacuation routes for dam failure	**MEDIUM**	2 years	None	Countywide	Minimal	County Sheriff, City Police, County Emergency Management	Identified evacuation routes will assist in response to dam failure and help educate public on evacuation measures.
	OBJECTIVE: Develop public information on dam failure to include evacuation routes and sheltering plans							

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Identify and maintain access and egress routes and sheltering plans	**MEDIUM**	Immediate	None	Countywide	Minimal	County Sheriff, City Police, County Emergency Management, School District	Include a map of identified routes for evaluation purposes on County website and in City and County public buildings.
	ACTION: Establish agreements for emergency shelters	**MEDIUM**	Immediate	None	Countywide	Minimal	County Emergency Management, Red Cross, School District	Pre identifying shelters will assist in evacuation process
DROUGHT	**OBJECTIVE:** Reduce excessive water used for landscaping	**Countywide Problem Identification** Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources and water storage						
	ACTION: Develop and enforce policies to limit the amount of area that can be used as water-intensive landscaping	**HIGH**	Ongoing	Minimal	Countywide	To be determined	County and Special Service District (CVSSD) or Water Districts	(Manila is in Dagget County. Not part of our AOG. Perhaps this is a reference to the West side of the county?).
	OBJECTIVE: Develop more water storage tanks in several areas in the county							
	ACTION: Conduct feasibility study.	**HIGH**	5 years	Grants	Countywide	Unknown	Unknown	Water storage is always an issue in times of drought. The ability to adequate store water lessens the impact in areas of the county

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Upgrade irrigation systems.	**Countywide Problem Identification** Earthen irrigation systems throughout the county.						
	ACTION: Improve canal to reduce losses to evaporation and leakage.	**MEDIUM**	Unknown (depends on funding)	State and Federal grants and loans	Countywide	Unknown	NRCS, UACD, USU Extension, etc. Irrigation Company	Several years of drought and a need for water conservation
	ACTION: Install field sprinkler systems (pressurized, secondary lines)	**MEDIUM**	Ongoing	Private	Countywide	Unknown	Private with assistance from Federal agencies	Better usage of agricultural water
	OBJECTIVE: Educate the public on efficient water usage	**Countywide Problem Identification** Lack of public awareness of efficient water usage.						
	ACTION: Use several ways in educating the public on efficient water usage.	**HIGH**	Ongoing	State, Federal grants, city and county funds, irrigation companies	Countywide	Minimal	LEPC, County, Cities and Towns	Create programs to make the public aware. Use newsletters and the newspapers
EARTHQUAKE	**OBJECTIVE:** Study the seismic resistance of critical structures within the county, i.e.,. Elementary school, high schools, public buildings, and highways	**Countywide Problem Identification** Emery County is the site of at least two active faults. Both are located on the western border of the county in Joe's valley and are named the Joe's Valley Fault. Joe's Valley appears to be highly vulnerable to such an event and an earthquake-induced failure of the dam would put Orangeville and Castle Dale in jeopardy. An updated analysis is needed to evaluate earthquake faults and subsequent risk of damage to buildings and infrastructure in the county.						
	ACTION: Structural and non-structural earthquake hazard assessment	**MEDIUM**	3 to 4 years	Federal grant	Countywide	Unknown	Unknown	Contact DESHS earthquake program specialist. Several seismographic tests have been done within the county most likely for oil.
	OBJECTIVE: Public Awareness	**Countywide Problem Identification** Residents uneducated about earthquakes.						

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Conduct public awareness campaign. Enhance earthquake instructions in school	**MEDIUM**	Ongoing	Federal and state grants, local sources	Countywide	Minimal	LEPC, volunteers and school administration	Contact DESHS earthquake program specialist.
FLOOD	**OBJECTIVE:** Identify additional flood prone areas in county	**Countywide Problem Identification** There is not enough current information on flood areas in Emery County to identify the problem at this time.						
	ACTION: Evaluate need for additional County flood mapping of potential flood hazard areas	**MEDIUM**	Unknown	FEMA	Countywide	Undetermined	State and FEMA personnel	Contact DESHS flood map specialist.
	ACTION: Participate in the FEMA Flood Map Modernization Program	**MEDIUM**	Ongoing	FEMA	Countywide	Some cost share	County Emergency Management and State Floodplain Office	Emery County has areas that should be reevaluated for flood hazards. Town of Cleveland and City of Green River have indicated their current flood map does not reflect the flood hazard and boundaries are inconsistent
	OBJECTIVE: Reduce the threat of flood from canal failures in the county	**Countywide Problem Identification** Unstable canals are a flood threat						
	ACTION: Perform technical analyses on irrigation canals	**MEDIUM**	Ongoing	Unknown	Countywide	Unknown	Private, County Engineer	Private canals and irrigation systems have proven to breach, fail, or flood.
	OBJECTIVE: - Promote purchase of flood insurance	**Countywide Problem Identification** Participation in the NFIP allows citizens to mitigate flood damage through purchasing of flood insurance. Residents are not aware flood insurance is available. Communities are not aware of flood damage prevention ordinance that are in place for development in floodplains						

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Obtain outreach materials on flood insurance.	**MEDIUM**	Immediately	None	Countywide	Printing of FEMA documents	County and City Floodplain Administrator, County Emergency Management	Flood insurance is an effective mitigation measure
	OBJECTIVE: Educate local LEPC committees and elected officials (no Floodplain Administrators in AOG area) on floodplain compliance							
	ACTION: Make training available on flood compliance and NFIP	**MEDIUM**	1 year	None	Countywide	None	County and City (no Floodplain Administrator s in AOG area)Building Officials, Planning and Zoning, State Floodplain Managers	Contact State Floodplain Manager and arrange training.
	ACTION: Develop pathways to capture falling rocks adjacent to residences	**LOW**	5 years	Federal, State, Local	County/City/ Town	$100,000	City and County	
SEVERE WEATHER	**OBJECTIVE:** Protect County from adverse effects of severe weather	**Countywide Problem Identification** Winter storms, summer thunderstorms, flash floods hail, and high winds over eastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists						
	ACTION: Participate in the Storm Ready program at the county level	**HIGH**	2 years	State and Federal	Countywide	Unknown	City and County LEPC Emergency Management	Set up within the County Emergency Management and encourage all cities to participate, all requirements of the NWS Storm Ready Program

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Encourage avalanche preparedness for county backcountry users	**HIGH**	1 year	Local State	Countywide	Minimal	County Emergency Management, State Hazard Mitigation Team, Utah Avalanche Forecast Center	Avalanches and avalanche preparedness are not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Emery County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year
	ACTION: Assess Emergency Operations Centers EOC's to ensure they are lightning - grounded, to include buildings with towers	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning
LANDSLIDE	**OBJECTIVE:** Minimize loss of life, damage to property and disruption in residents, commerce and government services caused by landslides through structural measures	**Countywide Problem Identification** There is a potential risk to structures located in areas identified by Federal and state agencies and depicted in GIS as landslide risk areas						
	ACTION: Build retaining fences and momentum absorbers along highways prone to landslide and rockfalls, including Highway 29 and Highway 10	**LOW**	5 years	Federal, State, Local	Countywide	$1,000,000	UDOT, County Road Dept.	Federal, State, Local

EMERY COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Dislodge large rocks along highways	**LOW**	Immediate	Federal, State, Local	Countywide	Variable	Unknown	Protect homes in areas at risk
	ACTION: Develop pathways to capture falling rocks adjacent to residences	**LOW**	5 years	Federal, State, Local	Countywide	$100,000	City, County, Towns	Identify areas that could accommodate pathways
PROBLEM SOILS	**OBJECTIVE:** Protect roadways	**Countywide Problem Identification** Problem soils are a risk to property and life due to its volatility.						
	ACTION: Increase width of slope adjacent to roadways	**LOW**	Extended	Federal, State, and Local	Countywide	Unknown	State, County, City	Allows for buffer
	ACTION: Educate homeowners about problem soil risk	**LOW**	2 years	Local	Countywide	$3,000	Local	County Building Official should have information available to citizens
	ACTION: Identify, monitor and control water on alkali soils.	**LOW**	Ongoing	Local	Countywide	Unknown	Local	Identifying areas of concern will help with planning.
INFESTATION	**OBJECTIVE:** Control insects.	**Countywide Problem Identification** Infestation of noxious insects and can impact the health, safety and welfare of County and its residents.						
	ACTION: Utilize insecticide spray	**LOW**	Ongoing	Federal, State. Local	Countywide	Unknown	State, Federal, Local	Insect abatement districts and federal insect control should be coordinated
	ACTION: Remove dead and diseased trees	**LOW**	Extended	Private	Countywide	Trees will be harvested by commercial enterprise	Private	This could be a part of the fire management program and limited spread of infestation

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Increase compliance with existing building ad fire codes	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						
	Action: Develop and enforce current local, state and national codes	**HIGH**	Ongoing	Local, State and Federal grants		Unknown	Local, State and Federal agencies	Implement and enforce rule, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Approximately 20 homes are at risk from wildfire						
	Action: Conduct an education program on reducing wildfire risks	**HIGH**	Ongoing	City and County	Panquitch	Minimal	Fire Chief and State Fire Warden	Educate homeowners using newsletters and personal contacts of importance of clearing combustibles from perimeters of their homes
	Objective: Reduce threat of utilities interruption due to wildland fire	**Problem Identification:** Fire is a threat to power facilities and transmission lines						
	Action: Safeguard facilities and poles		Ongoing	Local	Hatch	Undetermined	Task Force	Power and telephone transmission lines in Hatch travel via overhead lines through many developed and undeveloped areas. A wildland fire could disrupt services to customers by igniting poles or arcing. Facilities and transmission lines need to be evaluated and plans implemented to safeguard facilities and poles. Plans must be developed it isolate affected areas and maintain services to customers.
	Objective: Reduce threat of damage to a wildland fire	**Problem Identification:** Wildfire is a threat to the west and south side of the City						
	Action: Conduct an education program on reducing wildfire risks	**HIGH**	Ongoing	City and County	Tropic	Minimal	Fire Chief and State Fire Warden	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat to the community						

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Educate the residents of the community on how to make their properties fire safe	**HIGH**	Periodic	City and County	Cannonville	Minimal to Town	Town Staff, County Fire	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat due to grasslands drying out during extending dry periods.						
	Action: Educate residents of the value of maintaining firebreaks around their homes	**HIGH**	Periodic	Local	Henrieville	Minimal	City and County	During extended dry periods the grasslands dry out and represent a potential fire hazard
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat due to grasslands drying out during extended dry periods.						
	Action: Thin or remove vegetation causing exposure problem	**HIGH**	1 year	Moderate, no local funds	Escalante	Moderate	City and County	During extended dry periods the grasslands dry out and represent a potential fire hazard
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Power facilities and telephone poles are at greatest risk from wildfire.						
	Action: Thin vegetation along river or create a fire break to protect nearby facilities	**HIGH**	Ongoing	Moderate, local funds	Boulder/Antimony	Moderate	County and Cities	The dense Boulder Creek bottom cover provides an ideal location for a wildfire. To reduce or eliminate exposure to structures, redundant communications systems should be installed to provide necessary coverage.
Landslide	**Objective:** Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential	**Problem Identification:** There is a potential risk to structures located in areas identified in the FCAOG GIS as landslide risk areas						
	Action: Assess the probability of landslides and identify specific structures at risk	**HIGH**	Undetermined	Property Owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Objective: Provide for a second means of supplying culinary water to residents within Cities and Towns of Garfield County	**Problem Identification:** There is a low risk, but potential for landslide or land movement to impact water supply systems.						

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Establish and maintain a means to readily connect the City and Town's culinary water users to alternative water sources.	**MED**	Undetermined	Local governments and possible grants and loans	Countywide	To be determined	Panguitch City	In case City/Town's water supply is damaged, the communities would need to connect to emergency means. Use of water would need to be curtailed to essential services only.
Flood	**Objective:** Obtain aerial photography with contours for identified residential areas in Garfield County to assist in flood risk identification.	**Problem Identification:** Control flooding in unincorporated residential areas of Garfield County. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each identified residential area in the County	**HIGH**	3 months to 2 years, depending on number in areas	Local, State and Federal grants	Countywide	$700 per residential area, depending on size	County staff and Contractor	Aerial photography is needed in the development of Master Storm Drainage design.
	Objective: Design Master Storm Drainage Plans for residential areas in the County							
	Action: Design Master Storm Drainage Plan to handle storm water runoff	**HIGH**	3 months to 2 years, depending on number of areas worked on	Grants	Countywide	$10,000 per residential area, depending on size	County Staff and Contractor	Engineers design Master Storm Drainage Plans for residential areas for flooding.
	Objective: Develop a comprehensive storm drainage plan for Garfield County							
	Action: Implement storm drainage plans throughout the residential areas of Garfield County	**HIGH**	3 years plus, as soon as Plans are completed	State and Federal grants	Countywide	Unknown, will depend on final plans and requirement of facilities and structures.	County and Contractor	Construct storm drainage facilities and require all new developments to meet County storm drainage plan(s)
	Objective: Implement storm drainage plans through out residential areas of Garfield County.	**Problem Identification:** Control flooding in unincorporated residential areas of Garfield County. Flooding occurs from heavy rains and fast moving thunderstorms.						

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Implement storm drainage plans throughout the residential areas of Garfield County	**MED**	2 years	State and Federal grants	Countywide	Unknown, will depend on final plans and what facilities are required	City and Contractor	Construct storm drainage facilities and require all new developments to meet County storm drainage plan(s).
	Objective: Encourage 100% participation in the National Flood Insurance Program (NFIP).	**Problem Identification:** Flood insurance is not promoted actively promoted in the County.						
	Action: Assist Town of Antimony in joining NFIP	**HIGH**	1 year	None required	Countywide	None	County Emergency Management, County Floodplain Administrator, State Floodplain Manager	The Town of Antimony has mapped Special Flood Hazard Areas (SFHAs), but does not participate in the NFIP. Flood insurance is not available in the community
	Objective: Promote flood insurance throughout the County							
	Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.	**HIGH**	1 year	Minimal		Unknown	County Floodplain Administrator, State Floodplain Manager, DES	General public is usual not aware they can purchase flood insurance.
Earthquake	**Objective:** Provide for emergency response and relief	**Problem Identification:** Transportation and utilities services could be severely impacted by an earthquake affecting emergency response and relief activities						
	Action: Identify and maintain critical transportation and utility services	**MED**	Ongoing	Local governments and possible grants	Countywide	Unknown	County Public Works, County Emergency Management, UDOT, Utilities	Critical transportation and utility systems need to be maintained

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Raise awareness of problems and risk associated with earthquakes	**Problem Identification:** There is a high probability of rockfall caused by seismic events and possible liquefaction along river systems.						
	Action: Maintain adherence to Land Use Codes and restriction to building in identified sensitive areas	**MED**	Immediate and ongoing	None		None	County, City and Town Building Officials and staff	Problem associated with falling rocks can be identified in areas along Paria River, Escalante River, Calf Creek, Boulder Creek.
	Objective: Reduce threat to public safety during an earthquake	**Problem Identification:** Damage to residential structures and public facilities is likely during a seismic event						
	Action: Retrofit inadequate construction	**MED**	Long term	Private	Countywide	Expensive	County, City and Town Building Officials and Engineers, Contractors	Old inadequate construction in buildings, un-reinforced masonry, should be mitigated.
	Objective: Educate community on earthquake damage prevention practices	**Problem Identification:** Lack of public awareness about earthquake damage prevention practices						
	Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness	**MED**	2 year	Unknown, possible grants	Countywide	Unknown	County Emergency Management, DES	Having a community educated on earthquake damage prevention practices will ensure greater safety for its residents.
	Objective: Educate community on disaster preparedness and response							
	Action: Continue to support CERT Programs	**MED**	2 year	State and Federal grants	Countywide	$25,000	County Emergency Management, DES	CERT is proactive measure to educate public on earthquake hazard and community response to an event.
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action: Educate the public on the need to be water wise	**MED**	Ongoing	State grants, County funds	Countywide	Minimal	Water districts, County, State	Newsletter developed to educate general public on conserving water
	Objective: Conserve culinary water by conservation							

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Maintain and enforce rate policies that encourage water conservation	**MED**	Ongoing	State grants, County funds	Countywide	Minimal	Water districts, County, State	Evaluate the use of a tiered water rate structure.
	Objective: Meet current and future water needs of the community	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary and irrigation water resources.						
	Action: Develop additional source and storage as well as implement conservation plans	**HIGH**	Ongoing	State and Federal grants/loans, County funds	Countywide	To be determined	Water districts, County, State, Contractors	Garfield County has experienced several years of drought conditions. To meet the needs of the community's residential and business water users, vigilance is locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	**HIGH**	Ongoing	State grants, County funds		Minimal	Water districts, County, State	Evaluate the use of a tiered water rate structure.
Severe Weather	**Objective:** Protect County from adverse affects of severe weather	**Problem:** Snowstorms, summer thunderstorms, flash floods, hail, and high winds over central Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists						
	Action: County participation in the StormReady program.	**HIGH**	2 Year	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

GARFIELD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Encourage avalanche preparedness for county backcountry users.	**HIGH**	1 Year	Minimal	Countywide	Minimal	County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Sanpete County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	Alternate EOCs, Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.
Insect Infestations	**Objective R32.1** Reduce the impact of insects	**Problem Identification:** Western Garfield County is occasionally vulnerable to Mormon Cricket and Cutworm infestations as well as some mosquito problems						
	Action: Spread insect bait and spray for mosquitos	**LOW**	When required	City and County funds, abatement taxes	Countywide	Approximately $3.00/property owner/month	County Mosquito Abatement District	Insect infestation impacts agriculture as well as communities

GRAND COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
FLOODING	**OBJECTIVE** Continue to support and update Storm Water Management Plan	**Countywide Problem Identification** The rapid development of the county has caused a need to re-evaluate the system and establish a plan and level of service to manage stormwater. Development also directly impacts the historical drainage ways with culverts roads and structures						
	ACTION: Review and revise Storm Water Management Plan as development warrants	**HIGH**	Ongoing	County and impact fees	Countywide	Depends on extend of identified projects within the Plan	County, Private Contractors	The Storm Water Management Plan has protected the County from flood losses. This Plan also contains identified storm water basins and other structural control projects
	OBJECTIVE: Encourage 100% participation in the National Flood Insurance Program (NFIP).	**Problem Identification:** Flood occurs primarily from spring snowmelt in the higher elevations and summer flash flooding. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.						
	OBJECTIVE: Promote flood insurance throughout the County							
	ACTION: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings	**HIGH**	1 Year	Minimal	Countywide	Unknown	County Engineer, State Floodplain Manager, DES	General public is usually not aware they can purchase flood insurance
	OBJECTIVE: Reduce threat of unstable canals throughout the County. Identify county-wide canal systems							
	ACTION: Map and assess canal systems in the County for structural integrity	**HIGH**	3-5 years	Federal Grants	Countywide	Unknown	County Engineer, Public Work, County Information and Technology, County Emergency Management	Private and public canals are used for transportation and dispersion of water as well as flood control

GRAND COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Ensure Emergency Operations Centers (EOC(s)) are equipped to respond to flooding							
	ACTION: Obtain communication equipment that will allow for timely response to flooding	**HIGH**	1 year	Federal Grants	Countywide	$30,000	County Sheriff, County Emergency Management	Adequate communication capabilities are essential between all response agencies within the County.
	OBJECTIVE: Support updating of flood hazard data							
	ACTION: Support and encourage participation in the NFIP Flood Map Modernization Program	**HIGH**	Ongoing	Federal	Countywide	Unknown	County Engineer, State Floodplain Manager	Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County. County must join the NFIP to be able to participate in Map Mod.
SEVERE WEATHER	**OBJECTIVE:** Protect County from adverse effects of severe weather	**Countywide Problem Identification** Snowstorms, summer thunderstorms, hail, and high winds over southeastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists						
	ACTION: Participate in the Storm Ready program at the county level	**HIGH**	2 years	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program

GRAND COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Encourage avalanche preparedness for county backcountry users in the northeastern portion of the County	**HIGH**	1 year	State and Federal	Countywide	Minimal	County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness are not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Grand County. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year
	ACTION: Assess Emergency Operation Centers (EOC's) to ensure they are lightning-grounded, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	EOC's and alternate EOC's**,** Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning
SLOPE FAILURE (LANDSLIDE AND DEBRIS FLOW)	**OBJECTIVE:** Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.	**Countywide Problem Identification** There is a potential risk to structures located in areas identified by SEUALG GIS affiliates as landslide risk areas.						
	ACTION: Assess the probability of landslides and identify specific structures at risk	**MEDIUM**	Undetermined	Property Owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.

GRAND COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Remove risk to homes by removing rocks.	**Problem Identification:** Rockfall may impact structures within the County						
	ACTION: Remove large rocks overhanging existing developments.	**MEDIUM**	Undetermined	Not applicable	Countywide	Not applicable	City, County Planning	Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains
	ACTION: Remove potential rock hazards prior to building homes	**MEDIUM**	5 years	None	Countywide	Unknown	Planning Depts.	Prior to building, require builder/owner to secure or remove possible rock hazards
EARTHQUAKE	**OBJECTIVE:** Provide for emergency response and relief	**Countywide Problem Identification** Although there is a limited impact to earthquakes, there is an opportunity to evaluate transportation and utilities services could be impacted form secondary effects of earthquake						
	ACTION: Identify and maintain critical transportation and utility services	**LOW**	Ongoing	Local governments and possible grants	Countywide	Unknown, determined by extent of damage anticipated	County and City Staff	Critical transportation, utility and communications systems need to be maintained.
DROUGHT	**OBJECTIVE:** Conserve culinary water by educating the public	**Countywide Problem Identification** Cyclical periods of drought place a strain on community culinary water resources.						
	ACTION Educate the public on the need to be water wise	**MEDIUM**	Ongoing	City funds	Countywide	Minimal	Water purveyor and newsletter editor	Use newsletter to educate the public
	OBJECTIVE: Conserve culinary water by codes or regulations							
	ACTION: Maintain and enforce rate policies that encourage water conservation	**MEDIUM**	Ongoing	County funds	Countywide	Minimal	Water purveyor and newsletter editor	County should evaluate a tiered water system

GRAND COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: - Meet current and future water needs of community	**Problem Identification** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	ACTION: Develop additional source and storage and implement conservation plans.	**MEDIUM**	Ongoing	City funds, State and Federal Government loans and/or grants	Countywide	To be determined	County Staff, Professional Services, and Contractors	To meet the needs of a community's residential and businesses water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Reduce the risk of Wildland Fire throughout Iron County	**Problem Identification:** Iron County has a Moderate to Severe wildfire risk throughout the county. Areas of high concern are as follows: Brian Head Parowan Front Iron Town Comstock/Far West Cedar Highlands						
	Action: Create community fire safe councils and implement the "Community Fire Planning" process.	**HIGH**	On going	Obtain grant monies and alternative sources of funding through various grants and foundation.	Countywide	$5,000.00 per plan	Unknown	The "Community Fire Planning" process was implemented through the Utah Division of Forestry, Fire, and State Lands in support of on-going efforts under the National Fire Plan to educate and empower landowners to take action to reduce the threat of wildfires within a community.
	Action: Implement fuel modification projects	**HIGH**	On going	Grants and private landowners	Countywide	Variable based on acreage and type of materials being removed.	State, County, Cities, Towns and residents	Through the creation of defensible space in and around communities, the threat of catastrophic wildfires will be greatly reduced.
	Action: To educate and inform the community of fire prevention	**HIGH**	Immediate and on going		Countywide	$5,000.00 per year	County Planning and Zoning, Building Department, Fire Warden	Education is the key to informing homeowners about the risk of wildfires. Through a comprehensive education, program homeowners can take action independent to protect values at risk, and understand the effects of wildfires.
	Objective: Minimize the damage of a wildland fire and provide the appropriate emergency response.	**Problem Identification:** Brian Head Town is surrounded by federal and private lands that have suffered a severe beetle infestation. Fuel loading is 20 to 30 tons per acre and needs to be cleaned up to lessen the effects of a wildland fire on this community.						
	Action: Require all homeowners and businesses to provide a defense able space around there structures as provided in the international fire code.	**HIGH**	Continuing action. Twenty year plan	National Fire Plan and grants	Brian Head	$5,000.00	Brian Head Public Safety	International Fire Code and Fire Wise publications

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Provide the necessary emergency services to properly respond to the effects of a wildland fire.	**HIGH**	In Place	Brian Head Town and Iron County	Brian Head	$5,000.00	Brian Head Public Safety(police, fire, EMS) and other emergency services provided in Iron County	We feel that emergency services located in the Iron County region will be adequate to deal with the effects of a wildland fire in Brian Head Town.
	Objective: To clean brush from under trees and blade a fire zone protection around the town on county property.	**Problem Identification:** Kanarraville is surrounded by dry brush and juniper trees that have suffered 5 years of drought. The canyon winds from Kanarra Canyon increase the fire threat. The town is situated at the mouth of the canyon. The town has more than adequate water storage to fight fires. (350,000 + gal.)						
	Action: Work with landowners to clean a fire protection area around their properties.	**HIGH**	6 months to two years	From General Fund of the Town of Kanarraville, Inc./local property owners.	Kanarraville	$3,000.00	Contracted workers, local landowners, Town maintenance crew.	Landowners are to be contacted and a request made that dry grass be mowed. Out lying landowners will be asked to clear a fire protection zone. All city property will be mowed and underbrush cleaned out. Iron County will be requested to help with clearing the canyon.
Landslide	**Objective:** Minimize the possibility to reinitiate mass movement in the Landslide areas that are shown on the Kaliser, January 1978 Report.	**Problem Identification:** In the "Ground Surface Subsidence in Cedar City report by Bruce N. Kaliser in January 1978 indicates two areas in sections 26, 27, 33, and 34 of Township 36 South, Range 11 West and Sections 19, 20, 29, and 30 of Township 35 South, Range 10 West that were massive landslide deposit areas. The report stated that Developments of this terrain might reinitiate mass movement.						
	Action: Inform property owners developing in the area of the possibilities for landslides.	**MED**	As development is proposed	None	Cedar City	Unknown	City Staff and Property Owner	Bruce N. Kaliser, January 1978 Report on Ground Surface subsidence in Cedar City.
	Action: Required Geological and Geotechnical reports for any proposed developments in the designated landslide areas with the possibility of independent reviews of the reports.	**MED**	With development engineering plans for the area	Developer	Cedar City		Licensed Geology and Geotechnical Firms	Required by Cedar City Subdivision Ordinance Chapter 32
	Action: Require developers to install developments according to recommends for the Geological and Geotechnical reports provided and approved.	**MED**	As landslide areas develop	Developer	Cedar City		Developer and Contractor	

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flood	**Objective:** Reduce flood threat through Cedar City and Cedar Valley.	**Problem Identification:** Coal Creek at Cedar City is the outlet of a hydrologic basin of approximately 82 square miles. This basin ranges in elevation from 10,000+ to 5,000 ft. in the Cedar Valley. A 100 year storm would produce a flow of 5,000+ cfs through Cedar City and the unincorporated areas of Cedar Valley. The flow is highly variable. This flow is divided at the Woodbury split so about 1/3 goes west and 2/3 goes north.						
	Action: WEST ROUTE: Coal Creek Flooding in Cedar Valley With the project coming on Airport Road by Cedar City Corporation the small structure will be increased to the appropriate size, adequate to handle approximately 1,500 cfs, so this west route will go to Quichapa.	**HIGH**						The new structure on Hwy. 56 at the intersection with Lund Hwy. is being increased to handle approximately 1,500 cfs also. Iron County must presently realign and construct a new flood channel below this Hwy. 56 structure for approximately 1 mile. From there to Quichapa the existing channel must be widened in places and always maintained.
	Action: NORTH ROUTE: The north leg of this channel is in relatively good shape as far as structures are concerned until it reaches Midvalley Road. The structure there must be significantly enlarged. The channel on this leg must be improved thru the Flying "L" Ranch Subdivision; it must also be improved from the Brent Hunter Farm all the way past Regional Wastewater Treatment Plant and to Mud Springs.	**HIGH**	Within the next 3 years	County Public Works routine maintenance and Engineers budget.	Countywide		County Public Works	Flatten side slopes, construct new channel as necessary, clean willows, roses, Russian olive, and cottonwood trees, and debris that impedes flow. Rip rap may be advantageous in certain locations. Some rights-of-way must be obtained.
	Objective: Prevent these waters from doing damage to homes and/or farmlands.	**Problem Identification:** Floods from Fiddlers Canyon still have some potential of covering Cedar Valley lands.						
	Action: Prevent these waters from doing damage to homes and/or farmlands.	**HIGH**	Within the next 3 years	All possibilities are open			Public Works personnel	Construct a channel from the west side of the freeway to the north route of the Coal Creek flood channel.
	Objective: Keep these waters in the natural and historic flood channel.	**Problem Identification:** Excess spring runoff or thundershower waters from Summit Canyon cause flooding in Summit all too frequently. The main historic and natural flood channel is still discernible upon old aerial photos all the way from the northern town limits to the Little Salt Lake. Over the years the channel has become obstructed and is now functionally obsolete.						

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Keep these waters in the natural and historic flood channel.	**HIGH**	Within the next 10 years.	County Public Works and Engineers budget	Countywide		County Engineer and Public Works personnel	By survey, mark upon the ground the natural channel. Then construct and/or open it up so when necessary it will convey floodwaters thru the town and valley to the Little Salt Lake. Riprap may be necessary at some locations. Some easements may be necessary to obtain from the landowners.
	Objective: Keep these waters in the natural and historic flood channel.	**Problem Identification:** Excess spring runoff or thundershower waters from Parowan Canyon cause flooding in Parowan all too frequently. The main historic an natural flood channel is still discernible upon old aerial photos all the way from the western city limits to the Little Salt Lake. Over the years the channel has become obstructed and is now functionally obsolete.						
	Action: Keep these waters in the natural and historic flood channel.	**HIGH**	Within the next 3 years	County Public Works and Engineers budget	Countywide		County Engineer and Public Works personnel	By survey, mark upon the ground the natural channel. Then construct and/or open it up so when necessary it will convey floodwaters thru the Parowan Valley to the Little Salt Lake. Riprap may be necessary at some locations. Some easements may be necessary to obtain from the landowners.
	Objective: Prevent these flood waters from coming through residential areas. Iron County is responsible from the mouth of the canyon to the town boundary and again after it leaves the town boundary to west of I-15. Paragonah is responsible within the town boundary.	**Problem Identification:** Paragonah town has been flooded by waters from Red Creek much too often. It occurs mostly from July, August, and September thundershowers. Occasionally, excess spring runoff may pose significant threats.						

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Prevent these flood waters from going through residential areas.	**HIGH**	Within the next 2 years	Utah Army National Guard 115th Engineer Battalion, 348 East Main Street, Lehi, Utah 84043, will contribute equipment and personnel, but no cash outlay. Iron County and Paragonah town will purchase what materials are necessary.	Paragonah		Utah Army National Guard, Iron County, and Paragonah town personnel	Construct and/or widen and deepen the existing flood way from the mouth of the canyon to west of I-15. UDOT will assist with crossing on Old Hwy. 91.
	Objective: Keep the frontage road from being covered by floodwaters.	**Problem Identification:** Occasionally, there are times when these waters may cover the frontage road on the east side of I-15.						
	Action: Keep the borrow ditches and culverts on the frontage road clean and functional.	**MED**	This is an on going maintenance item.	County Public Works	Countywide		County Public Works personnel	Keep the borrow ditches and culverts clean.
	Objective: Prevent these waters from getting to the Hwy. 18 right-of-way.	**Problem Identification:** When there is above normal winter snowfall, the spring runoff waters from Holt Canyon will make it all the way to Hwy. 18 in the Escalante Valley. These waters within the Hwy. Right-of-way presents a safety hazard.						
	Action: Prevent these waters from getting to the Hwy. 18 right-of-way.	**MED**	Within the next 3 years	a) Iron County Public Works b) UDOT c) Natural Resource Conservation Service d) Involved land owners			Personnel for the above listed entities	Construct a diversion structure in the Holt Canyon drainage to take part of this water east and spread it on various farms and in storage ponds. Construct 5 ponds on the Sherwood Bracken land to retain water so it will percolate into the underground water basin. Construct ditches so if the 5th pond overflows then the water will be spread to various farmlands.
	Objective: To prevent these waters from reaching Beryl and causing problems	**Problem Identification:** If there is a heavy snow year and both the upper and lower Enterprise Reservoirs are relatively full, the spring runoff waters may reach almost to Beryl. This does not happen very often, but when it does it can be serious.						

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: To prevent these waters from reaching Beryl and causing problems	**HIGH**	This is an ever and on going issue.	Maintenance dollars and efforts.	Countywide		County Engineer and Public Works personnel	Prevent land use activities and growth from obstructing the natural drainage ways.
	Objective: Install flood control improvements along Coal Creek that would contain the design flood and protect the adjacent homes, businesses and City infrastructure.	**Problem Identification:** Coal Creek is the main drainage through Cedar City from Cedar Mountain. Flooding through the City along Coal Creek would damage homes, businesses and the City's infrastructure if the projected flows of 6,600 CFS were realized.						
	Action: Relocate the irrigation structure in Coal Creek that is currently located west of the SR-130 bridge structure.	**HIGH**	2004-2005	City and Federal Natural Resources Conservation Svc.	Cedar City		City Engineering Staff/NRCS Staff and Contractor	A Grant from the NRCS has been secured for this project.
	Action: Construct berms, levees, and other channel improvements that will contain the 100-year flood within the channel.	**HIGH**	2005-2006	City and Federal Natural Resources Conservation Svc.	Cedar City		City Engineering Staff/NRCS Staff and Contractor	A Grant from the NRCS has been secured for this project.
	Action: Obtain a Letter of Map revision from FEMA that will remove the flood zone designation from the property adjacent to Coal Creek.	**HIGH**	2006	City and Federal Natural Resources Conservation Svc.			City Engineering and Consultant	A Conditional Letter of map revision has been obtained from FEMA for the project. When the project is completed, the actual Letter of Map Revision can be obtained.
	Objective: Maintain the effectiveness of the flood control improvements in the Greens Lake Drainage to protect the affected development within the center of Cedar City.	**Problem Identification:** In 1962 Cedar City and the Soil Conservation Service constructed flood control facilities in the mouth of the Greens Lake drainage to protect the developments downstream from flooding from drainage above.						
	Action: Annually perform inspections of the Greens Lake flood control improvements to identify maintenance action items.	**HIGH**	February of Each Year	None	Cedar City		City Engineering Staff	Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.
	Action: Annually perform the maintenance identified from the inspection on the Greens Lake Flood Control Improvements.	**HIGH**	March thru April of each year	City Drainage Maintenance Budget			City Drainage Maintenance Crews	Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Clean grates on the Greens Lake Flood Control Improvements to ensure unobstructed flow.	**HIGH**	Monthly during the months of April through October and during all storms.	City Drainage Maintenance Budget	Cedar City		City Drainage Maintenance Crews	
	Objective: Maintain the effectiveness of the flood control improvements in the Dry Canyon Drainage to protect the affected developments.	**Problem Identification:** In 2001 Cedar City constructed flood control facilities in the mouth of the Dry Canyon drainage to eliminate the FEMA flood zones and protect the developments in the area from 100 year flooding from drainage above.						
	Action: Annually perform inspections of the Dry Canyon flood control improvements to identify maintenance action items.	**HIGH**	February of each year	None	Cedar City		City Engineering Staff	Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.
	Action: Annually perform the maintenance identified from the inspection on the Dry Canyon Flood Control Improvements.	**HIGH**	March thru April of each year	City Drainage Maintenance Budget	Cedar City		City Drainage Maintenance Crews	Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.
	Action: Clean Grates on the Dry Canyon Flood Control Improvements to ensure unobstructed flow.	**HIGH**	Monthly during the months of April through October and during all storms.	City Drainage Maintenance Budget	Cedar City		City Drainage Maintenance Crews	
	Objective: To clean and refurbish existing dikes to the north and south and one dike in the central area of town.	**Problem Identification:** Kanarraville Town is in the foothills of Kanarra Mountain and at the mouth of the Kanarra Canyon and main drainage from the mountain. The slope of the terrain to the east of Kanarraville increases the probability of flooding.						
	Action: To maintain the existing dikes so they operate at peak performance.	**HIGH**	6 months to 1 year	Town resources and general maintenance expenses	Kanarraville	$1,000 - $2,000	Contracted equipment operators, citizens, town maintenance	Rebuild central dam that was destroyed with the new water tank. Clean out brush from the north dam. Rebuild the top of the south dam levee.
	Objective: Reduce flood threat from Parowan Canyon within Parowan City.	**Problem Identification:** Flooding within Parowan City limits, along the creek.						

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Maintain and improve flood channel.	**HIGH**	2004-2005	Parowan City	Parowan		Parowan City Public Works/Electrical Departments	To maintain these flood channels on an annual basis and during storms.
	Action: Maintenance of channels and bridge openings.	**HIGH**	Immediate	Parowan City (minimal)	Parowan		Parowan City Public Works Crew	Keep all bridge openings and upstream channels free of debris to prevent constriction during high flows.
	Objective: Identify areas susceptible to flooding	**Problem Identification:** Existing flood maps are outdated and inaccurate.						
	Action: Work with DES on flood plain mapping study to determine areas of potential flood threat.	**HIGH**	3 to 5 years	Unknown	Parowan	Unknown	State and contractor	Parts of Parowan City have been listed with FEMA as designated flood hazard areas.
Earthquake	**Objective:** Minimize the damage caused by an earthquake of the destructive magnitude and provides the appropriate emergency response.	**Problem Identification:** The U.S. Geological Survey, Geologic Map of Brian Head Town is Township 36-37 Range 09 W. These maps show that we have Geological Faults that transverse our area.						
	Action: Require construction of all structures requiring a building permit to be constructed according to the 2000 International Building Code structural design requirements.	**HIGH**	As building permits are approved	Town General Fund	Brian Head	Town Building Department Staff	2000 International Building Code and the U. S. Geological Survey, Geological Map of the Brian Head area.	

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Provide the necessary emergency services to properly respond to earthquake damage.	**HIGH**	In place	Brian Head and Iron County	Brian Head		Brian Head Public Safety(Police, fire, EMS), and the Iron County Sheriff's Office, Iron County Ambulance and the Iron County Fire Department.	We feel that emergency services will be adequate to respond to damages caused by the effects of an earthquake.
	Objective: Minimize the damage caused by an earthquake of the destructive magnitude and provides the appropriate emergency response.	**Problem Identification:** The U.S. Geological Survey, Geologic Map of the Cedar City Quadrangle, Iron County, Utah shows two Geologic Faults running through Cedar City. The Hurricane Fault runs along the toe of the mountain on the east side of the City, The North Hills Fault approximately parallels I-15. Both faults run in an approximate north/south direction. Ground Motion Figures from the International Building Code indicate that the Cedar City area is susceptible to earthquake activity.						
	Action: Require construction of all structures requiring a building permit to be constructed according to the 2000 International Building Code structural design requirements.	**HIGH**	As building permits are approved	City General Fund	Cedar City		City Building Department Staff	2000 International Building Code and the U. S. Geological Survey, Geologic Map of the Cedar City Quadrangle, Iron County, Utah
	Action: Provide the necessary emergency services to properly respond to earthquake damage.	**HIGH**	In Place	Cedar City and Iron County	Cedar City		Cedar City Fire Department and Police Department, Iron County Sheriffs Department and Ambulance Service	While the timing of extent of earthquake damages cannot be predicted, it is felt the current level of emergency services would be adequate to respond to damages caused by a moderately significant earthquake.

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Drought	**Objective:** It will take many years of above average precipitation to make up for the many years of drought we have experienced. Estimates of overall pasture and range conditions are about 60% of normal. Conditions are extremely variable depending on what area of the county you are looking at. Any precipitation received in September 2003 was very random in distribution and did not make much of an impact on the overall drought.	**Problem Identification:** Assessment of range and pasture conditions in Iron County for the 2002/2003 growing season, simply put they were the worst in recorded history. Data shows that we only received 20-30 percent of our normal precipitation; this is characterized as exceptional drought. Range and pasture have been impacted by lack of precipitation. Growing conditions have been so poor many ranges produced no useable forage. There has been mortality of sagebrush and juniper trees due to the drought with conditions so dry in the spring even the cheatgrass did not grow.						
	Action: Many studies have been done and we are involved in a drought cycle. We are supposedly in the downhill side of the cycle. Hopefully, things will start to get back to normal and improve the drought situation.	**MED**	On going	Unknown	Countywide	Could cost farmers/livestock many dollars. Some may even face bankruptcy.	Unknown	Studies done over the generations of time. History records show this to be the worst drought ever seen in Iron County. Need to keep an eye on underground water levels, seeps and springs to see if there will be enough for livestock and agricultural use in the future.
Insect Infestation	**Objective:** The best thing would be to totally get rid of the problem. However, that will never happen. Our objective is to learn to control the insects by trying different types of insecticides.	**Problem Identification:** Grasshoppers and Mormon Crickets are present every year in Iron County. Most years grasshoppers are an economic pest in the New Harmony Flats area and on Cedar Mountain. Mormon Crickets have been especially bad in 2003, they were reported in the Urie Creek area of Cedar Mountain. There was also a severe grasshopper infestation. 2002-2003 seems to have been especially bad for grasshoppers with reports of them eating landscaping, vinyl screens on windows and even eating the handle grips of bicycles laid down in the grass.						

IRON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Cut grasses short near homes	**MED**	Yearly, on going	U. S. Department of Agriculture, Iron County	Countywide	$5,000.00	Landowners, farmers, County Agents	Something that has taken place in and around Southwestern Utah for decades. Our pioneer heritage even notes these infestations happening back then. Keeping grasses mowed short near homes would help keep some of the infestation away from subdivisions. Trying to control them has been difficult in the past due to problems with the endangered species act. There has been use of Dimilin in some of the harder hit areas of Iron County and it has proven to reduce the grasshopper populations in the areas that have been treated.
Radon Gas	**Objective:** Try to identify the areas that would be most susceptible to this problem and restricting building in these potential problem areas.	**Problem Identification:** The United States Geological Survey has evaluated the potential for radon gas within the boundaries of Iron County as low, less than 2 pCi/L to moderate, 2 to 4 pCi/L. The EPA recommends that all homes that measure 4 pCi/L and greater be mitigated. Radon Gas is a naturally occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through particles of soil and rock, and can accumulate under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.						
	Action: Try to identify the areas in the county that would have this problem. Homes that are already built in problem areas could possibly be fixed so that radon gas is not a problem to the owners.	**MED**	Best done at time of construction. Possible to retrofit.	Property owner/homeowners expense	Countywide	$400.00	County Building Department for advise.	Contact your local building department/contractor

JUAB COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Build dike structure up to divert flood.	Medium	Juab County EM, Levan Town	County, State, Federal	Levan Town and Juab County	$5,000	Depends on Funding	Will prevent property damage and casualties due to flood.
Flood	Build debris basins on both Pigeon and Chicken Creeks. Protect the road and the culinary water line up Chicken Creek Canyon.	Medium	Juab County EM, Levan Town	County, State, Federal	Levan Town and Juab County	$3,000,000	Depends on Funding	Will alleviate flood damage to roads and water mains.
Flood	Build levees along the eastside drainage and a dyke on the west side of town to prevent flooding from Currant Creek and Mona Reservoir.	Medium	Juab County EM, Mona Town	County, State, Federal	Mona Town and Juab County	$400,000	Depends on Funding	Will help prevent property damage and casualties due to flood.
Flood	Install curb, gutter and storm drain system.	Medium	Juab County EM, Eureka City	City, County, State, Federal	Eureka City	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.

JUAB COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.

JUAB COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
All Hazard	**Objective:** To increase the level of awareness for the residents of Kane County.	**Problem Identification:** The citizens of Kane County need to be made aware of the natural hazards that exist in their area. Through public awareness program earthquake safety, Africanized bee issues, and general individual preparedness programs will be presented.						
	Action: Conduct a Countywide community awareness campaign	**MED**	2 to 5 years	Public Funds	Countywide	$10,000.00	Emergency Services Personnel.	Create a base of natural hazard identification, risk assessment, and planning. Incorporated planning objective Countywide.
	Objective: To increase the level of awareness for the residents of Big Water.	**Problem Identification:** The citizens of Big Water need to be made aware of the natural hazards that exist in their area. Through public awareness program earthquake safety, Africanized bee issues, and general individual preparedness programs will be presented.						
	Action: Conduct a Big Water community awareness campaign	**MED**	2 to 5 years	Public Funds	Big Water	$5,000.00	Emergency Services Personnel.	The Town of Big Water is a somewhat isolated community. There is a greater need for a specific awareness program.
Wildfire	**Objective:** Protect residential areas from wildfire threat in the unincorporated areas of the county	**Problem Identification:** Specific areas of the county are susceptible to Wildland Fire threat. Specific areas of concern include: Glendale, Alton, Duck Creek, Strawberry Valley, Navajo Lake, and Meadow Spring.						
	Action: Identify, develop and support Firewise communities	**HIGH**	Ongoing	National Fire Plan Grant	Countywide	$5,000.00 per plan	County, State Forestry Fire and State Lands, US Forest Service	Firewise program is a community based fire mitigation program.
	Action: Implement fuel break, lot clean up and other recommendations of completed community fire plans	**HIGH**	5 years	Firewise grant	Countywide	$80,000.00 per year	Local, Private, County	Local support of Firewise communities is essential for a successful program.
	Objective: Minimize the effects of bark beetle infestation in order to reduce wild fire danger	**Problem Identification:** Beetle infestation is a concern in the areas of the County. Recent drought has weakened the trees allowing beetles to spread at an alarming rate. This is creating a fire hazard in the timber and in the pinion. This is also occurring in the subdivisions adjacent to areas of beetle kill.						
	Action: Identify those subdivisions that are impacted by beetle kill	**HIGH**	2 years	Unknown	Countywide	Unknown	Contractors, State and Federal Agricultural, USFS, State FFSL	Primary and secondary residential structures continue to encroach in areas of fire.
	Action: Implement fuel break, lot clean up and other recommendations of completed community fire plans	**HIGH**	5 years	Unknown, Firewise, other grants	Countywide	$80,000.00 per year	Private, County	Bark beetle infestation has created a severe fire hazard in these areas

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Improve Alton Town's ability to protect it's citizens and property from wildfire threat	**Problem Identification:** The current water system in Alton is constructed with 4" lines. The system is not adequate to protect the structures in town from a wildfire threat. Alton is listed as a community at risk from Wildfire.						
	Action: Upgrade the existing water distribution system to provide a capacity to fight Wildland Fires that threaten town	**HIGH**	As soon as possible, 1 – 2 years	Unknown, possible grants	Alton	Unknown	Private Contractor, Town	This is critical to the community' ability to fight fires.
	Objective: Protect the community from a Wildfire threat	**Problem Identification:** Glendale is susceptible to wind driven Wildland Fire						
	Action: Complete a community fire plan	**HIGH**	2-3 years	National Fire Plan Grant	Glendale	$5,000.00	County, State	Contact Keith Park to begin the planning process
	Objective: Protect area from wildland fire	**Problem Identification:** Weeds and trees in and along Kanab Creek from 500 North to Airport have created a fire hazards						
	Action: Evaluate the use of controlled burns in this area	**HIGH**	Winter Months	Unknown, possible County or State	Kanab	Dependent upon scope of project	Fire Department.	Every year or two a fire starts and is very hard to put out due to accessibility.
	Action: Build walking trails so fire department can us it to access area.	**HIGH**	When funds are available.	Grants	Kanab	$ 1,500,000	County, volunteers	Access into area hinders firefighting efforts
Flood	**Objective:** Promote flood insurance throughout the County	**Problem Identification:** Flood occurs primarily from spring snow-melt in the higher elevations and summer flash flooding. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.						
	Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.	**HIGH**	1 year	Minimal	Countywide	Unknown	County Engineer, State Floodplain Manager, DES	General public is usual not aware they can purchase flood insurance.
	Objective: Reduce threat of unstable canals throughout the County. Identify County-wide canal systems							

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Map and assess for structural integrity canal systems in the County	**HIGH**	3-5 years	Federal grants	Countywide	Unknown	County Engineer, County Public Works, County Information and Technology, County Emergency Management	Private and Public canals are used for transportation and dispersion of water as well as flood control.
	Objective: Reduce flooding threat in Kanab, Orderville and Glendale							
	Action: Clear debris and other material from streams prior to spring snow melt.	**HIGH**	Ongoing	None	Countywide	Unknown	County Public Works	Most flooding is attributed to debris-laden streams.
	Objective: Ensure EOC(s) are equipped to respond to flooding.							
	Action: Obtain communication equipment that will allow for timely response to flooding.	**HIGH**	1 year	Federal Grants	Countywide	$30,000	County Sheriff, County Emergency Management	An alternate EOC(s) also need dequate communication capabilities is essential between all response agencies within the County.
	Objective: Support updating of flood hazard data							
	Action: Support and encourage participation in the NFIP Flood Map Mod Program.	**HIGH**	Ongoing	Federal	Countywide	Unknown	County Engineer, State Floodplain Manager	Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.
	Objective: Evaluate current t flooding problems within Glendale Town	**Problem Identification:** There is a flood control problem on the east side of town.						
	Action: Contract with engineering firm to evaluate flood hazard	**MED**	5 years	Grants, federal	Glendale	$3,000,000.00	Contract	More information is needed to assess the hazard and then develop a strategy and obtain funding

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Reduce flood threat in Kanab.	**Problem Identification:** 100 North Street to Toms Canyon. At the present time, one of the areas of greatest concern near existing development is along 100 North Street to Toms Canyon. The estimated 100-year flow (most of which originates in undeveloped areas) is 1.588 cfs. The flow capacity of 200 North Street at one foot above the top of curb is approximately 800 cls which leaves 788 efs which should be carried in a storm drain to reduce the danger and risk of damage during periods of high runoff.						
	Action: Install adequate storm drain for excess flows.	**HIGH**	When funding is available.	Grants.	Kanab	$1,018,500.	Contract	An 84-diameter storm drain approximately 4,850 feet in length is needed to carry the 788 cfs discussed.
	Objective: Reduce flood threat in Kanab below 300 S.	**Problem Identification:** Savage Point Drainage Basin**.** The Savage Point Drainage basin is comprised of 125 acres, the majority of which is steep, impervious areas.						
	Action: Increase storage capacity of drainage basin	**HIGH**	When funding is available.	Grants.	Kanab	$150,000.00	Contrac	This detention basin is not designed to eliminate flooding potential but would alleviate the problem.
	Objective: Stop erosion to Heaton property.	**Problem Identification:** The Heatons have allowed the city to direct storm water onto their field so they can irrigate with it. When there is more water than can be absorbed we need a pipe to take the excess to the creek.						
	Action: Install pipe to divert excess storm water	**LOW**	In the next two years.	Grants or general funds.	Kanab	$60,000.00	Contract	Make sure required permitting is in place prior to diverting storm water into the stream.
	Objective: Reduce flood threat to Highway 89 and land below.	**Problem Identification:** Pugh Canyon This area has a runoff of (1,670 efs) and will need detention pond and storm drain facilities.						
	Action: Install detention pond and storm drains	**HIGH**	When funding is available.	Grants	Kanab	$4,746,000	Contract	This will protect structures and infrastructure from flooding.
	Objective: Reduce flood threat in Kanab Creek Ranchos	**Problem Identification:** Kanab Creek Ranchos (Heaton Dr.) The run off from this area runs through most of the home and the City Park in the Ranchos.						
	Action: Develop adequate storm water system in area	**HIGH**	When funding is available.	Grants	Kanab	$100,000.00 to $160,000.00	Contract	Area is susceptible to storm water flooding following a severe thunderstorm
	Objective: Minimize the effects of storm runoff	**Problem Identification:** Runoff due to severe storms is a flooding problem, which occurs somewhat regularly throughout the town.						
	Action: Construct infrastructure improvements to contain storm runoff	**MED**	Unknown	Unknown	Orderville	$3,000,000.00	Contractors, City and County	Construct curb & gutter, sidewalks with driveway access and line with concrete, and clean and maintain drainage washes, install debris grates on culverts

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Severe Weather	**Objective:** Protect County from adverse affects of severe weather	**Problem Identification:** Winter storms, summer thunderstorms, hail, and high winds over southern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.						
	Action: County participation in the StormReady program.	**HIGH**	2 Year	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.
	Action: Encourage avalanche preparedness for county backcountry users in the northeastern portion of the County	**HIGH**	1 Year	Minimal	Countywide	Minimal	County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Kane County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	EOCs and alternate EOCs **,** Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.
Landslide	**Objective:** Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.	**Problem Identification:** There is a potential risk to structures located in areas identified by the FCAOG GIS as landslide risk areas.						

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Assess the probability of landslides and identify specific structures at risk	**HIGH**	Undetermined	Property owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Objective: Remove risk to homes by removing rocks.	**Problem Identification:** Rockfall may impact structures within the County						
	Action: Remove large rocks overhanging existing developments.	**MED**	Undetermined	Not applicable	Countywide	Not applicable	City, County Planning	There are several areas in Kanab and Johnson Canyon where rocks overhang existing structures. Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains.
	Action: Remove potential rock hazards prior to building homes.	**MED**	5 year	None	Countywide	Unknown	Planning Departments	Prior to building, require builder/owner to secure or remove possible rock hazard.
Earthquake	**Objective:** Provide for emergency response and relief	**Problem Identification:** Transportation and utilities services could be severely impacted.						
	Action: Identify and maintain critical transportation and utility services	**HIGH**	Ongoing	Local governments and possible grants	Countywide	Unknown-Determined by the extent of damage anticipated.	County and City staff.	Critical transportation systems need to be maintained.
	Objective: Raise awareness of problems that could occur as a result of an earthquake.	**Problem Identification:** Many communities within the County are surrounded by rocky slopes. Kanab Creek and the East Fork of the Virgin River run through areas with structures. There is a high probability of rockfall caused by seismic events and possible liquefaction along the river areas.						
	Action: Maintain adherence to Land Use codes and restrictions to building in sensitive areas.	**HIGH**	Immediate and ongoing	Not applicable	Countywide	Not applicable	Town staff.	Some of the problems identified include falling rocks, diversion of the Kanab Creek and the Virgin River due to landslides.
	Objective: Reduce threat to public safety during an earthquake	**Problem Identification:** Damage to structures and utilities are likely during a seismic event.						

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Retrofit inadequate construction.	**HIGH**	10 years+	Private	Countywide	Extreme	County Inspection Department, County Engineering Department, Private Engineers.	Old and inadequate construction, buildings with un-reinforced masonry to be mitigated.
	Objective: Educate community on earthquake damage prevention practices	**Problem Identification:** Lack of public awareness about earthquake damage prevention practices.						
	Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness.	**HIGH**	1 year+	None identified	Countywide	$50,000	Fire Department, Inspection Department	Having a community with residents educated on earthquake damage prevention practices will ensure greater safety of all residents of the County.
	Objective: Educate community on earthquake damage prevention practices							
	Action: Educate the public on damage prevention practices for earthquakes	**HIGH**	2 years	Grants from state and Federal governments	Countywide	$50,000-$75,000	Emergency Management and volunteers	Continue to establish a C.E.R.T. program in the County Earthquakes are taught as being the biggest hazard facing those in the area. Teaching the C.E.R.T. class should get the message out to residents.
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action: Educate the public on the need to be water wise	**HIGH**	Ongoing	City funds	Countywide	Minimal	Water purveyor and newsletter editor	Use a newsletter to educate the public
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation		Ongoing	County funds	Countywide	Minimal	Water purveyor and newsletter editor	County should evaluate a tiered water system.

KANE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Meet current and future water needs of community	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional source and storage as well as implement conservation plans implemented.	**HIGH**	Ongoing	City funds, State and Federal Government loans and/or grants	Countywide	To be determined	County Staff, Professional Services, Contractors	To meet the needs of a community's residential and businesses water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.
Insect Infestation	**Objective:** Reduce the impact and severity of insects	**Problem Identification:** Mormon crickets, cutworms and mosquito are a problem						
	Action: Spread insect bait and spray for mosquitoes	**LOW**	When required	City and County funds, Mosquito abatement funds come from property tax	Countywide	Approximately $3.00 per property owner per month	Abatement District	Abatement Districts are critical in the controlling of insects
	Action: Conduct aerial spraying to reduce infestations	**LOW**	As infestations occur	By private individuals in most cases	Countywide	Varies, depending on acreage treated	Contractor	Agricultural fields are been subject to insect infestation especially during the recent years of drought.
	Objective: To increase the level of awareness for the residents of Kane County.	**Problem Identification:** Lack of public knowledge on insect infestation problems.						
	Action: Conduct a Countywide community awareness campaign	**MED**	2 to 5 years	Public Funds	Countywide	$10,000.00	Emergency Services Personnel.	The citizens of Kane County need to be made aware of insect infestation issues that may affect their area. Through a public awareness program such as on Africanized bees, general individual preparedness will be improved.

MILLARD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Chalk Creek flood control Project.	High	Fillmore City, Millard County EM	City, County, State, Federal	Fillmore City, Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Minor Flood Channeling along county roads.	Medium	Millard County Road Dept.	County, State, Federal	Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Clean Scipio Canal.	Medium	Scipio Town, Millard County EM	Town, County, State, Federal	Scipio Town, Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.

MILLARD COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

MORGAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flood	**Objective:**To Reduce Flood Threat To Morgan County	**Problem Identification:** Morgan County has two major rivers (East Canyon, Weber) that threaten communities during spring runoff.						
	Action: Maintenance of channels and bridge openings	HIGH	Immediate	Routine maintenance	Countywide	Minimal	County Road Dept.	Keep channels free of debris and clear out gravel bars, watch for constriction during high flow.
	Action: Work with Weber Basin to increase flood storage area	HIGH	Two-Three years	Undetermined/Potentially Grants	Countywide	Unknown	Emergency Management /Contract	Work with Weber Basin to increase the percentage of area that is allotted for flood storage.
	Action: Advise Residents and Develop Outreach Materials on the Availability of Flood Insurance	HIGH	Immediate	Unknown	Countywide	Minimal	Emergency Management, County and Morgan City Floodplain Administrator, State Floodplain Manager	Inform residents to the potential risk of flooding and advise them that flood insurance is available.
	Objective: Identify countywide canal systems							
	Action: Map and assess for structural integrity canal systems in the County	MED	3-5 years	Federal Grants	Countywide	Unknown	County and City Public Works, Canal Companies, County Engineering	Private and Public canals are used for transportation and dispersion of water as well as flood control. They also represent a hazard to structures and infrastructures.
Earthquake	**Objective:** Decrease the Negative Effect of Earthquakes Within the County	**Problem Identification:** Critical facilities (public safety, commercial buildings, schools) need to be made less vulnerable from the impact of earthquakes to allow a more timely response, and to decrease the impact to lives.						
	Action: Begin an Earthquake awareness campaign to include awareness of availability of earthquake insurance	HIGH	1-2 years	County	Countywide	Minimal	Emergency Management/ Contract	Work in conjunction with National Earthquake Awareness Week to put together a county awareness week.

MORGAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Facilitate a Pre-Earthquake damage assessment. To evaluate retro fix critical facilities	HIGH	1 year	City/County	Countywide	Moderate	County Engineer's/Contract	Inspect commercial buildings to see which ones are up to earthquake code.
	Action: Work with the county's businesses to ensure proper earthquake preparedness training	HIGH	1-5 years	County/grant	Countywide	Minimal	Emergency Management / Contract	Devise training schedule to ensure that all county businesses are properly trained.
Dam Failure	**Objective:** To Increase Community Awareness of the (Federal, State and Private) Dam's That Will Impact The County	**Problem Identification:** Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.						
	Action: Educate community of evacuation routes	MED	1-2 years	County	Countywide	Minimal	Emergency Management	Work with public media to inform the community of proper evacuation routes.
	Action: Improve Emergency Notification Systems/Public Awareness Dam Information	MED	Over the next five years	Bureau of Reclamation	Countywide	High/ Extensive	Emergency Management/ Bureau of Reclamation	To work with the Bureau of Reclamation to install an early warning electronic notification system
	Action: Improve Inundation Maps	MED	Immediate	Bureau of Reclamation	Countywide	Moderate	Emergency Management/ Bureau of Reclamation	Improve current maps and have them digitally formatted
Drought	**Objective:** Develop and promote water conservation measures.	**Problem Identification:** The residents' of Morgan County are unaware of the water conservation options that are available to them.						
	Action: Promote water conservation utilizing Drought Contingency Plan	LOW	Immediate	County/grant	Countywide	Minimal	Emergency Management/ Contract/Soil Conservation/ Extension	Join with the State's "Slow – The – Flow" campaign
	Action: Promote the use of the secondary water system	LOW	Immediate	Secondary Water Board	Countywide	Minimal	Secondary Water Board / Emergency Management / City	Work with the Secondary Water board and the city to improve the use of the new secondary water system.
Severe Weather	**Objective:** Lessen The Impact of Severe Storms to Resident's and Businesses Within Morgan County	**Problem Identification:** Snowstorms, Hail, Thunderstorm/Lighting, Heavy Rain, Wind and Avalanche impact Morgan County. This is intensified by Morgan County's remote location.						

MORGAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Increase residents' awareness of the need for food storage for use during severe storms.	MED	1-3 years	County/grants	Countywide	Minimal	Emergency Management / Extension	Use public media to increase the resident's awareness of the effect of severe storms and road closures could have on them and their families.
	Action: Increase residents' awareness of where emergency shelters are located	MED	1-3 years	County/grants	Countywide	Minimal	Emergency Management/ Contract	Use public media to increase awareness of locations of shelters that are available.
	Action: Have all cities in the county participate in the Storm Ready program	MED	1 year	County	Countywide	Minimal	County Emergency Management, NWS, and State DESHS	National Weather Service Storm Ready Program is a proven proactive severe weather mitigation activity.
	Action: Encourage avalanche preparedness for county backcountry users.	MED	1 year	County	Countywide	Minimal	County Emergency Manager, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Morgan County. Most avalanche victims die in avalanches started by themselves or someone in there party. Therefore, education can limit the number of avalanche related searches each year.
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						

MORGAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Develop and enforce current local, state and national codes.	HIGH	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Reduce overall risk from wild fire through education programs. Especially in the Mt. Green, Trappers Loop, area east of Porterville, and East Canyon.							
	Action: Public awareness through "Fire Wise" programs.	HIGH	2-3 years	Unknown	Countywide targeting URWIN areas	Minimal	Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL	Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires, earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County fire department/district in the past have pushed wildland fire prevention and protection techniques with success. Other fire department/districts have used door hangers discussing defensible space.
	Action: Provide wildfire training to city and county planning and zoning officials and staff.	HIGH	Immediate	Unknown	Countywide	Minimal	UFFSL, DES, National Forest Service.	County Planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.
Landslide	**Objective:** Educating planning commissions	**Problem Identification: Morgan** County has a significant threat of landslides. The community of Mt. Green and Trappers Loop Road (Highway 167) as well as critical pipeline routes can be impacted by landslides.						

MORGAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Provide City and County Planning Commissions with information concerning landslides.	LOW	1-2 years	Operating budgets	Countywide Mt. Green	Minimal	County Engineer/UGS	Decision-makers (Elected Officials) are critical in overall planning process and in the support of long-term natural hazard planning efforts.
	Objective: Monitor historical landslide areas.							
	Action: Evaluate current landslide maps to verify accuracy.	MED	Unknown	Grants/UGS	Countywide	Unknown	Emergency Services, County Engineer, UGS, and USGS	Currently available mapping on active landslides within Morgan County may not reflect accurately the risk on the ground.

PAIUTE INDIAN TRIBE OF UTAH NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Reduce the threat of Wildfire	**Problem Identification:** Man-made or lightening caused fires have occurred at times on the Hurricane Hills about 8 miles South of Cedar City on the East side of I-15						
	Action: Draft a Community Fire Plan	**HIGH**	Next fiscal year	Tribal and Federal funds	Cedar Band	Minimal	Regional Fire Planner	Contact Keith Parke
	Objective: Reduce the threat of Wildfire	**Problem Identification:** Man-made or lightening caused fires have occurred at times on the Hurricane Hills about 8 miles South of Cedar City on the East side of I-15						
	Action: Draft a Community Fire Plan	**HIGH**	Next fiscal year	Tribal and Federal funds	Indian Peaks Band	Minimal	Regional Fire Planner	Contact Keith Parke to draft the Plan, include firebreaks in Plan
	Objective: Reduce the negative impacts of wildfire on the residents of the Shivwits Band	**Problem Identification:** A wildfire threatened the residential area of the Shivwits Band during the summer of 2003 which included evacuation of the community						
	Action: Complete a Community Fire Plan of the Shivwits residential area	**HIGH**	6mo.-1 year		Shivwits Band	Minimal or no cost	BLM/State/Tribe	Contact Keith Parke to draft the Plan
Flood	**Objective:** Minimize flooding on the West side of the Hurricane Hills located on Tribal land	**Problem Identification:** The Cedar Band land including homes is located in a watershed area which floods regularly on normal years						
	Action: Create a diversion channel and retention basin along dry creek	**HIGH**	Next fiscal year	Tribal & federal	Cedar Band	Unknown	Tribal & county staff	Construct a diversion channel and retention basin
	Objective: Prevent future roadway erosion	**Problem Identification:** The roadway leading to the water tank washes out regularly						
	Action: Add culverts to keep water off of the road	**HIGH**	3 years	State & federal	Indian Peaks Band	Unknown	State & federal	Dig and add culverts to divert water, pave the road to the water tank
	Objective: minimize flooding	**Problem Identification:** Increase threat of flooding due to drought conditions						
	Action: Conduct a study to determine the location of flood water flows	**MED**	3 years	State & federal	Indian Peaks Band	Unknown	State & federal	Contact state and federal agencies, contract for the study
	Objective: Reduce the threat of flooding along Wildcat Wash	**Problem Identification:** Wildcat Wash has the potential to impact Shivwits residents with flood waters.						

PAIUTE INDIAN TRIBE OF UTAH NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: To store and carry flood waters safely through the residential area	**HIGH**	6 mo. To 3 years	UDOT, Washington County	Shivwits	Undetermined	Washington County/UDOT	Enlarge culverts carrying Wildcat Wash flows under Old Highway 91, repair and/or replace the detention basin on the Wash
	Objective: To reduce the threat of flood water inundation along Highway 91 at the Anasazi Valley turn off	**Problem Identification:** After a significant rainstorm the area near the turn off to Anasazi Valley along Highway 91 becomes inundated and blocks access to the Shivwits Band community						
	Action: Provide a way for flood waters to travel from one side of the highway to the other without threatening the roadway	**MED**	2-5 years	UDOT, Washington County	Shivwits	Undetermined	UDOT, Washington County	Install a culvert under the roadway
Earthquake	**Objective:** Reduce threat from earthquakes	**Problem Identification:** The Cedar band is located along the Hurricane Fault and is therefore subject to earthquake at any time						
	Action: Continue to follow building codes in construction techniques	**HIGH**	Ongoing	Tribal source	Cedar Band	Minimal	Tribal, counties, state	Continue to use Tribal Housing office to conduct building inspections
	Objective: Protect structures and utilities from earthquake damage	**Problem Identification:** The Hurricane fault branches off onto Reservation Land. The lower southeast corner of the Reservation, where homes are proposed, may be subject to liquefaction						
	Action: Have a study done to determine liquefaction danger and severity of the fault	**HIGH**	Undetermined	Federal grant	Indian Peaks Band	Unknown	Unknown	Contact FEMA to initiate a discussion about the study
Problem Soils	**Objective:** To reduce structural damage to residences	**Problem Identification:** Blue clay has been a problem in the residential area of the Shivwits Band						
	Action: Require or request basic soil suitability testing for any new development	**HIGH**	on-going	Tribe	Shivwits Band	Minimal	Tribe	Inform home-owner of the potential problem, suggest a contact with a soils engineer to perform testing
Radon Gas	**Objective:** Minimize radon gas levels in existing and future homes	**Problem Identification:** The Cedar Band is sitting on a moderate to low Radon area						
	Action: Conduct field test of radon levels in homes	**HIGH**	Next fiscal year	Tribal	Cedar Band	Minimal	Tribal	Obtain testing hardware to test each home on band land.
	Objective: Minimize radon gas levels in existing and future homes	**Problem Identification:** The Indian Peaks Band is sitting on a moderate to low Radon area						
	Action: Conduct field test of radon levels in homes	**MED**	Next fiscal year	Tribal	Indian Peaks Band	Minimal	Tribal	Obtain testing hardware to test each home on band land.

PIUTE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Build flood ponds for Marysvale Town.	Medium	Marysvale Town, Piute County EM	Town, County, State, Federal	Marysvale Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control channel to divert flood from Revenue Gulch to Bullion Creek.	Medium	Marysvale Town, Piute County EM	Town, County, State, Federal	Marysvale Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control dykes between Circleville Town and the Sevier River.	Medium	Circleville Town, Piute County EM	Town, County, State, Federal	Circleville Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Dredge Sevier River near Circleville Town.	Medium	Circleville Town, Piute County EM	Town, County, State, Federal	Circleville Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control pond in Kingston Canyon	Medium	Kingston Town, Piute County EM	Town, County, State, Federal	Kingston Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.

PIUTE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.

PIUTE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

RICH COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
Multi-Hazard	Goal 2	All Jurisdiction	Prepare for Severe Weather Events	Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)	Medium	2006		Minimal	NOAA
Flooding	Goal 1 & 2	Woodruff, Laketown	Mitigate impacts related to flooding.	Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.	High	2005		Minimal	UDESHS, ACOE
Flooding	Goal 1 & 2	Jurisdictions with identified flood hazards	Make better informed decisions.	Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.	Medium	2009	FEMA, UDESHS, Local	$2,500 to $65,000 each	Consultants, FEMA, UDESHS, Public Works
Wildfire	Goal 2	Garden City, Unincorporated Rich County	Become "Firewise" communities.	Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).	High	2007		Minimal	BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.
Wildfire	Goal 2	Garden City, Unincorporated Rich County	Build citizen capacity	Educate and train property owners in Wildland/Urban interface areas on how to protect their property from wildfire.	High	2006	Local	Minimal	BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Dam Failure	**Objective:** Review current State Dam Safety information on all identified high hazard dams in the County	**Problem Identification:** National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.						Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section in currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Salt Lake County in future emergency management planning.
	Action: Include dam inundation maps in current County and City EOPs.	MED	3-5 Years	Undetermined	County Wide	$10,000.00	Emergency Services Bureau	
Drought	**Objective:** Limit unnecessary consumption of water throughout the County	**Problem Identification:** Salt Lake County is currently in the fifth year of drought conditions. Measures must be taken to conserve and address water shortages for both culinary and agricultural use.						County as well as the State are experiencing severe drought conditions. Increasing water demand will result in water shortages at some point in non-drought years.
	Action: Continue to encourage water conservation utilizing and promoting Jordan Valley Water Conservation outreach material with each City in the County.	HIGH	Ongoing	Undetermined	Countywide	Undetermined	Local Water Districts	
Drought	**Objective:** Address agricultural water shortages in the County							While agricultural areas are limited in County, there still remain concerns for economic hardship for livestock and crop farmers.
	Action: In areas of agricultural use livestock water rotation has been setup (Herriman, Riverton, Draper and South Jordan, West Valley City and other areas in the Unincorporated County).	MED	Ongoing	Undetermined	Herriman, Riverton, Draper, West Valley, and South Jordan	Undetermined	Emergency Services, USDA Farm Services Agency, And State Agriculture	
Drought	**Objective:** Encourage the development of secondary water systems							To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.
	Action: Coordinate with current water systems and develop and secondary waters systems plan for drought	MED	Immediate	Undetermined local sources	Countywide	Undetermined	Water Districts	

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Drought/Wildfire	**Objective:** Study the areas and determine which fire resistant natural vegetation can be used in these areas of concern.	**Problem Identification:** Severe drought continues to maximize the potential for urban wildland interface fires in areas of the Cottonwood Canyons, Emigration Canyon, Rose Canyon, and Neff's Canyon (Unincorporated County) and Traverse/South Mountain and Bear Mountain (Draper City)						Residential property owners need to be educated on the most fire resistant forms of vegetation that can be placed around homes to reduce the threat from wildfire.
	Action: Develop outreach document specific to fire resistant natural vegetation.	HIGH	Ongoing		Targeting URWIN communities adjacent to Forest Service boundary.	$5000.00	County, US Forest Service, Dept. of Agriculture, Utah Living With Fire Committee	
Earthquake	**Objective:** Provide redundancies in countywide communication systems.	**Problem Identification:** Numerous geologic hazards exist in the Salt Lake City metropolitan area, which can constrain land use. Active fault zones pose the threat of earthquakes, while steep mountains adjacent to the city create a potential for landslides, debris flows, rock falls, and snow avalanches. Streams and the fluctuating level of the Great Salt Lake create serious flood and ground-water problems. Considered as a whole, geologic hazards in the Salt Lake City metropolitan area confront planners with a variety of safety and economic issues that must be addressed before wise development can take place. Limited communication or lack of communication capabilities is always a shortfall during an emergency.						Current countywide communications systems need to be reevaluated.
	Action: Assess current countywide communications and interoperable emergency/warning systems	HIGH	1-2 years	Federal Grants	Countywide	$ 3,000,000.00	Emergency Services	
Earthquake	**Objective:** Ensure adequate coordination of disaster response and recovery activities.							It is essential to have functional EOC to better coordinate disaster response and recovery activities
	Action: Assess EOC's (countywide)	HIGH	2-3 years	Federal Grants	Countywide	$ 3,000,000.00	Emergency Services	
Earthquake	**Objective:** Provide information on earthquake potential effects to homeowners and developers.							Current earthquake data specific to the County needs to be centralized and easily accessible.
	Action: Update current earthquake maps (liquefaction and fault) and incorporated into the County GIS system.	MED	Ongoing	Unknown	Countywide	Undetermined	Emergency Services, County GIS, County Geologist, and UGS	
Earthquake	**Objective:** Improve public education regarding earthquake risks to improve quality of construction.							Knowledge of construction requirements in high hazard areas

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Ensure current natural hazard ordinance(s) are online, linked to Emergency Services website, and easily accessible and can be download.	HIGH	Ongoing	Unknown	Countywide	Undetermined	Emergency Services, County Planning and Zoning, Permitting	prior to the permit process.
Flooding	**Objective:** Encourage 100% participation in the National Flood Insurance Program	**Problem Identification:** Although located in a semi-arid region, Salt Lake City is subject to cloudburst and snowmelt floods. The Jordan River's three main northern tributaries are diverted into storm sewers beneath the city. During May and June 1983, a sudden warming trend rapidly melted a record mountain snow pack. The resulting runoff quickly exceeded the capacities of the storm sewers, and floodwaters were then diverted onto city streets. The flooding in 1983, and to a lesser extent in 1984, caused flood-control agencies to build sediment basins, install stream-bank protection, and dredge stream channels to reduce flood hazards. The Federal Emergency Management Agency (FEMA) has rated flood plains along the Jordan River and its tributaries for expected flood heights and areas susceptible to 100-year flood-frequency inundation have been delineated on County-wide FEMA Flood Insurance Rate Maps (FIRMs). These maps are updated as development occurs and channel obstructions, culvert modifications, and other changes alter potential flood heights and velocities. Salt lake County ordinances require the lowest flood grades (including basements) in new construction to be a minimum of 1 foot (0.3 m) above the appropriate FEMA flood elevation.							Flood insurance is not available in these communities limiting disaster assistance and participation in future mitigation grants.
	Action: Assist Holladay City and the Town of Alta to apply for participation in NFIP (National Flood Insurance Program).	MED	1 Year	None required	Alta and Holladay City	None		
Flooding	**Objective:** Provide current FIRMs for emergency planners.							Countywide digitized flood maps need to updated in a timely and efficient manner and local emergency planners made aware of how to access and interpret the data.
	Action: Update & digitize floodplain maps	MED	2-3 years	County Public Works/Flood Control, State Floodplain Office, and FEMA	Countywide	Unknown	County Flood Control, County GIS, and FEMA	
Flooding	**Objective:** Identify countywide canal systems							Private and Public canals as well as the Salt Lake Aqueduct are used for transportation and dispersion of water as well as flood control.
	Action: Map and assess for structural integrity canal systems in the County	MED	3-5 years	Federal grants	Countywide	Unknown	Public Works Engineering	
Flooding	**Objective:** Identify dry dams/reservoirs that may have the potential for failure.							A dry dam is used for flood control or temporary irrigation storage
	Action: Map and assess all dry dams/reservoirs in the county	LOW	3-5 years	Federal Grants	Countywide	Unknown	Works Engineering, Utah Dam Safety Section.	

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Landslide	**Objective:** Reduce the threat of landslides/debris flow following wild fires.	**Problem Identification:** Slope instability has not been a major problem in the Salt Lake area, but as development moves higher into the foothills and nearby canyons slope stability is becoming a major issue affecting future development. Types of slope instability in the Salt Lake area include rock fall, debris flow and debris flood, rotational and transitional slumps, and earth flows. During unusually wet springs in 1983 and 1984 numerous slope failures in the Wasatch Range resulted in debris flows and floods that caused extensive damage to urban areas north of Salt Lake City (Anderson and others, 1984). Similar failures occurred in canyons adjacent to Salt Lake City, but none reached developed areas. In Salt Lake County, 56 percent of all slope failures have occurred on hillsides where slopes range between 31 and 60 percent. That statistic prompted Salt Lake County in 1986 to lower the maximum allowable build able slope from 40 percent to 30 percent. Even so, 23 percent of observed slope failures have occurred on slopes of 30 percent or less.						Post fire debris flows have caused significant damage to communities impacted by wild fire.
	Action: Develop protocol for working with State and Federal agencies in developing impact of post fire debris flow hazard.	MED	Unknown	Federal Grants	Countywide	Unknown	Emergency Services, National Weather Service, NRCS, USFS, and UGS	
Landslide	**Objective:** Monitor historical landslide areas.							Currently available mapping on active landslides within Salt Lake County may not reflect accurately the risk on the ground.
	Action: Evaluate current landslide maps to verify accuracy.	MED	Unknown	Federal Grants	Salt Lake City Draper City	Unknown	Emergency Services, County Geologist, UGS, and USGS	
Landslide	**Objective:** Improve public awareness regarding high-risk landslide areas.							Allows communities, residents, developers, planners and emergency managers access to information
	Action: Have landslide maps readily available on line through County EM website	MED	Unknown	Federal Grants	High risk communities	Unknown	Emergency Services/County Geologist, UGS, and USGS	
Severe Weather	**Objective:** Become NWS Storm Ready Community	**Problem Identification:** Snowstorms over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists. The region is characterized by intense vertical relief with the Great Salt Lake and surrounding lowlands located near 4300 ft MSL while the adjoining Wasatch Mountains to the east reach as high as 11,000 ft MSL. This relief has major impact on winter storms and results in large contrasts in average annual snowfall. For example, Salt Lake City International Airport (4280 ft MSL) receives an average annual snowfall of 65" while Alta ski area (8750 ft MSL) observes 520". Populated terrain benches surrounding the Salt Lake, which are located 150-200 m higher than the airport, have annual accumulations near 100".						Becoming a Storm Ready Community is a positive public outreach and preparedness effort that involves the entire County.

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Contact NWS/SLC Office and begin process of becoming a Storm Ready Community.	LOW	Unknown	None	Countywide	Unknown	Emergency Services/National Weather Service	
Severe Weather	**Objective:** Improve response times to severe weather alerts.							
	Action: Incorporate NWS on light boards on freeway system.	LOW	Unknown	Federal Grants	Countywide	Unknown	Emergency Services/National Weather Service/UDOT	
Severe Weather	**Objective:** Address Countywide needs of special populations that may be impacted by severe weather conditions.							Secondary events due to severe weather such as power outages and the shoveling of snow can have a great impact on the elderly population.
	Action: Create outreach materials (what to do when severe weather strikes) specific to this group and insert the information into County-wide phone books, and phone books specific to 55+ age group developed in County Aging services.	LOW	Unknown	Federal Grants	Countywide	Unknown	Emergency Services/National Weather Service	

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Encourage avalanche preparedness for county backcountry users.	LOW	1 year	Minimal	Countywide	Minimal	City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Salt Lake County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
Severe Weather	**Objective:** Prevent damage to critical facilities							
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	MED	2-3 years	Federal Grants	Countywide	Unknown	Emergency Services/County Facilities	
Wildfire	**Objective:** Reduce overall risk from wild fire through education programs.	**Problem Identification:** Utah's typical fire season is the dry period from May through October. Lightning causes the largest numbers of wildfires. The recent wildfires in the western States, the 1994 Tyee fire in Washington, the 1993 Southern California fire siege, and the 1991 Oakland Hills fires are examples of the growing fire threat which results from the Wildland/Urban Interface. The Wildland/Urban interface is defined as the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Since 1985, approximately 9,000 homes have been lost to urban/wildland interface fires across the United States. In 1990 Salt Lake County created a wildland program shortly after a wildland fire threatened Emigration Canyon, a major urban interface area at the county's eastern boundaries. The fire began in a day use picnic area known as Afleck Park, possibly the result of an unattended campfire. The fire quickly spread to the west and up the side of the mountain, with only one ridge between it and Emigration Canyon. The incident lasted for five days, in which time 5500 acres were burned, but fortunately, no one was injured and no structures were lost.							Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires, earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah

SALT LAKE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Public awareness through "Fire Wise" programs.	HIGH	2-3 years	Unknown	Countywide	Unknown	Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL	specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County and City fire departments in the past have pushed wildland fire prevention and protection techniques with success. Fire departments have used door hangers discussing defensible space, participated in Emigration Canyon public wildfire awareness exercises, and offered free home fire proofing evaluations.
Wildfire	**Objective:** Educate homeowners on the need to create open space free of burnable fuels near structures in urban wild land areas.							Defensible space is the process of preparing ones home to be easily defended by the fire department in the event a wildfire occurs.
	Action: Defensible space	HIGH	Ongoing	Local	Identified URWIN communities	$ 5000.00	Emergency Services, County and City Fire Departments.	

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
WILDFIRE	**OBJECTIVE** Provide fire breaks around residences and commercial business that may be at risk of wildfire by blading and other methods	**Countywide Problem Identification** Provide fire breaks around residences and commercial business that may be of threat from a wildfire. Most of the area does not have a high impact potential from wildfire						
	ACTION: Blade firebreaks as needed	**MEDIUM**	Ongoing	Local, Chapter, Tribal, and Federal Funds	Countywide	$5,000 annually	Local, Chapter, Tribal and Federal Agencies	Work with Chapter officials to determine areas for firebreaks
	OBJECTIVE: Reduce the wildfire threat in Navajo Mountain and Aneth/Red Mesa areas	**Countywide Problem Identification:** Specific areas of the Utah strip are susceptible to wildland fire danger.						
	ACTION: Thin Tamarisk/undergrowth along river bottom.	**MEDIUM**	1 year	Federal Grant	Countywide	Unknown	Bluff Fire Dept.	**ACTION:** Thin Tamarisk/undergrowth along river bottom.
	ACTION: Map areas on the Utah Strip of the Navajo Nation that may have wildland fire threat	**LOW**	Next fiscal year	Local, Tribal and Federal	Countywide	Minimal	Local, Chapter, Tribal and Federal Agencies	Review fire reports from previous years to determine threat areas
LANDSLIDE	**OBJECTIVE:** Map areas on the Utah portion of the Navajo Nation that have had historical incidents of landslides	**Countywide Problem Identification:** Potential landslides on the Utah portion of the Navajo Nation, particularly those areas that have had prior threats or incidents						
	ACTION: Review historical information and reports, interviews with citizens.	**MEDIUM**	FY 2005	Local, Tribal and Federal funding	Countywide	$1,000	Local, Chapter, Tribal and Federal Agencies	Historical information and interviews.

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Reduce potential of landslides on county and state highways.	**Countywide Problem Identification:** Potential risk of structures in mountainous areas to be damaged by landslides.						
	ACTION Remove material, enlarge culverts, re-route existing highways.	**MEDIUM**	Undetermined	Local, State, Chapter, Tribla and Federal	Countywide	Unknown	Local, Chapter, Tribal and Federal Agencies	Soil surveys and other engineering surveys, historical
EARTHQUAKE	**OBJECTIVE:** Increase public awareness	**Countywide Problem Identification** Unknown number of seismically unsafe structures around the Utah portion of the Navajo Nation. The risk based on historical incidents has not been high.						
	ACTION: Conduct pubic awareness campaign	**LOW**	Ongoing	Federal and State grants, local sources	Countywide	Unknown	Agency personnel and volunteers	Contact DESHS Earthquake Program Specialist. Enhance earthquake instructions in schools
	OBJECTIVE: Organize Community Emergency Response Teams (CERT).							
	ACTION: Assist with the organization of Community Emergency Response Teams among the Navajo Nation, if it is determined to be a local priority	**LOW**	Ongoing	Federal, Tribal, and State Grants	Countywide	Unknown	Tribal, State and local government	Navajo Nation Department of Emergency Management, Utah Chapters, and Utah
FLOOD	**OBJECTIVE:** Identify flood prone areas on the Utah portion of the Navajo Nation.	**Countywide Problem Identification:** Identify and map areas that are prone to flood based on historical reports and incidents and encourage flood loss reduction measures						
	ACTION: Mapping of potential flood areas.	**HIGH**	FY 2005	Unknown	Countywide	$5,000	Local, Chapter, Tribal and State	Contact DESHS Flood Mapping Specialists

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Reduce or eliminate flooding impacts on State and County highways based on historical incidents	**Countywide Problem Identification** Reduce impact on State and County Highways from Flooding						
	ACTION: Identify areas at risk from flooding	**HIGH**	Ongoing	State, Local, Federal	Countywide	Unknown	County and State	County Road and UDOT, NNDOT and Engineers
	OBJECTIVE: Repair numerous reservoirs throughout the Utah portion of the Navajo Nation	**Countywide Problem Identification** Many reservoirs have been filled in and/or broken through out the years and have not been repaired.						
	ACTION: Repair and or clean out reservoirs throughout the Utah portion of the Navajo Nation	**MEDIUM**	Ongoing	State, Federal, Tribal	Countywide	Unknown	Federal, Chapter, Tribal	Chapter and Farm Service Agency Personnel
	OBJECTIVE: Promote flood insurance throughout the County	**Problem Identification:** Reduce economic loss due to flooding.						
	ACTION: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings	**HIGH**	1 year	State, Federal, County	Countywide	Minimal	County and City (non in AOG area) State Floodplain Manager	General public is usually not aware they can purchase flood insurance.
DROUGHT	**OBJECTIVE:** Develop more water storage tanks and systems for culinary and agriculture use on the Utah portion of the Navajo Nation	**Countywide Problem Identification** Water Storage.						
	ACTION Conduct feasibility study	**HIGH**	Unknown	Unknown	Countywide	Unknown	County, Chapter, Tribal, Federal, HIS	Chapter, Tribal and Farm Service Agency personnel
	OBJECTIVE: Develop more reservoirs on Utah portion of Navajo Nation	**Countywide Problem Identification** Water storage for animals						

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Develop new reservoir	**MEDIUM**	Ongoing	State and Federal Grants	Countywide	Unknown	NRCS, UACD, USU Extension, Tribal	NRCS, Chapter, USU Extension, Tribal
	OBJECTIVE: Increase drought awareness education	**Countywide Problem Identification** Lack of public awareness of efficient water usage						
	ACTION: Use several ways to educate the public on efficient water usage	**HIGH**	Ongoing	State, Federal grants, Federal programs, NTUA	Countywide	Unknown	NRCS, UACD, USU Extension, HIS, NTUA	Research problem areas, Create programs to make the public aware, Use newsletters and newspapers. Hold field trips.
INFESTATION	**OBJECTIVE:** Have government agencies develop better insect control methods on federal grounds	**Countywide Problem Identification** Infestations of Army Cut-Worms and other insects on the Utah portion of the Navajo Nation.						
	ACTION: Improve insect control methods on reservation lands	**MEDIUM**	5 years	Federal	Countywide	Unknown	APHIS, Tribal, other Federal and State agencies	Educate landowners to control methods and more into their lifecycles.
SEVERE WEATHER	**OBJECTIVE:** Reduce power outages	**Countywide Problem Identification:** Wind damage to property and resulting loss of power to areas on the Utah portion of the Navajo Nation, prepare residents to have 72 hours kits and provide for residents and animals in the event of severe weather, such as high winds, winter storms, mud from rains and snow storms, etc.						
	ACTION: Improve power infrastructures to minimize power outages	**MEDIUM**	Ongoing	Multiple groups	Countywide	Unknown	Private, local utilities, UPL and NTUA	Contact utilities on current situation. Gather data on power outage, and frequency of outages.
	OBJECTIVE: Provide education to residentsof the Utah portion of the Navajo Nation	**Countywide Problem Identification:** Education for residents.						

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Provide education to residents including 72-hour kits, etc	**HIGH**	Ongoing	County, State, Tribal, Federal	Countywide	$5,000	Chapters, County, Tribal, Federal, and USU Extension	CERT Teams, Health Officials, and Newsletters
	OBJECTIVE: Protect County from adverse effects of severe weather	**Countywide Problem Identification:** Snowstorms, summer thunderstorms, hail, and high winds over southeastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.						
	ACTION: Participate in the Storm Ready program at the county level	**HIGH**	2 years	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.
PROBLEM SOILS	**OBJECTIVE:** Reduce damage to crops, grazing lands, etc. from wind erosion.	**Countywide Problem Identification:** Wind Erosion						
	ACTION: Improve conditions to reduce soil erosion	**MEDIUM**	Ongoing	USDA, government programs	Countywide	Unknown	NRCS, UACD, USU Extension	
ROCK SLIDES	**OBJECTIVE:** Minimize safety risk and property damage to Bluff Town due to Rockslide .	**Countywide Problem Identification:** Rock slides are a safety risk in Bluff						
	ACTION Develop an Emergency rockslide reaction plan	**MEDIUM**	1 year	Federal Grant	Bluff and Countywide	Unknown	Bluff Fire Dept.	With help with coordinating an emergency response
HAZ MAT SPILL	**OBJECTIVE:** Protect lives and property from haz mat spills on US 191 in Bluff near Bluff Elementary School	**Countywide Problem Identification:** A vehicle transporting hazardous material may easily flip over on US 191 in Bluff near the sharp corner by Bluff Elementary School, forcing an evacuation of the school and several residences in town and re-route traffic through town. Protect lives and property from haz mat spills						
	ACTION: Post better signage	**MEDIUM**	1 year	Federal Grant	Countywide	Unknown	Bluff Fire Dept.	

SAN JUAN COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Erect cement protective railing around corner	**MEDIUM**	1 year	Federal Grant	Countywide	Unknown	Bluff Fire Dept.	
	ACTION: Develop an Emergency HAZMAT Team	**MEDIUM**	1 year	Federal Grant	Countywide	Unknown	Bluff Fire Dept.	
	ACTION: Coordinate with UDOT, County HAZMAT Team	**MEDIUM**	1 year	Federal Grant	Countywide	Unknown	Bluff Fire Dept.	
	OBJECTIVE: Prevent White Mesa Uranium Mill contaminates from entering the town's sole source of drinking water							
	ACTION: Garner continuing support of community to prevent additional radioactive waste from being stored at White Mesa Mill	**LOW**	Ongoing	Unknown	Countywide	Unknown	Bluff Service Areas	

SANPETE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Construct flood control levees along Uinta/Gammett and Fountain Green Creeks.	Medium	Fountain Green City, Sanpete County EM	City, County, State, Federal	Fountain Green City, Sanpete County	$1,000,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Extend existing levee at mouth of Wales Canyon south.	Medium	Wales Town, Sanpete County EM, FS	City, County, State, Federal	Wales Town, Sanpete County	$150,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install SNOTEL site in the watershed of Canal Creek at 7,500' elevation.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Place a Stream Gauge on Canal Creek at the upper diversion.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Increased ability to warn inhabitants in these cities; Decreased risk of property damage and casualties due to flooding.
Flood	Perform watershed calibration study and a FLO 2D study of Canal Creek.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Storm Water Management Plan/Infrastructures	Medium	Ephraim City, Sanpete County EM	City, County, State, Federal	Ephraim City, Sanpete County	$35,000	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood channels in Ephraim City.	Medium	Ephraim City, Sanpete County EM	City, County, State, Federal	Ephraim City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

SANPETE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Construct channels for flood mitigation in Fairview City.	Medium	Fairview City, Sanpete County EM	City, County, State, Federal	Fairview City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Purchase generator for 2nd water pump	Medium	Fairview City, Sanpete County EM	City, County, State, Federal	Fairview City, Sanpete County	$10,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Dig flood control ditch east of Fayette Town.	Medium	Fayette Town, Sanpete County EM	Town, County, State, Federal	Fayette Town, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Increase size of culvert pipe at Fayette Town.	Medium	Fayette Town, Sanpete County EM	Town, County, State, Federal	Fayette Town, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Level out creek bed to mitigate flooding in Gunnison.	Medium	Gunnison City, Sanpete County EM	City, County, State, Federal	Gunnison City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood diversion canal at mouth of Manti Creek Canyon.	Medium	Manti City, Sanpete County EM	City, County, State, Federal	Manti City, Sanpete County	Unknown	Depends on Funding	Decreased risk of casualties and property damage to hydroelectric power plant and 50 homes ($5,250,000) due to flooding;
Flood	Dig flood control channels near Mt. Pleasant City.	Medium	Mt. Pleasant City, Sanpete County EM	City, County, State, Federal	Mt. Pleasant City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.

SANPETE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.

SANPETE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

SEVIER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Strengthen canal outside Aurora City.	Medium	Aurora City, Sevier County EM	City, County, State, Federal	Aurora City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Build Utah Department of Transportation (UDOT) bridge above state canal north of Aurora City.	Medium	Aurora City, Sevier County EM, UDOT	City, County, State, Federal	Aurora City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Rebuild flood retention ponds in Glenwood Town.	Medium	Glenwood Town, Sevier County EM	Town, County, State, Federal	Glenwood Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Update flood map for Glenwood Town	Medium	Glenwood Town, Sevier County EM, FEMA	Town, County, State, Federal	Glenwood Town, Sevier County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Perform a flood engineering study for Koosharem Town.	Medium	Koosharem Town, Sevier County EM	Town, County, State, Federal	Koosharem Town, Sevier County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Construct concrete barriers and built up beams in Joseph Town.	Medium	Joseph Town, Sevier County EM	Town, County, State, Federal	Joseph Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade existing culverts to mitigate flood in Salina City.	Medium	Salina City, Sevier County EM	City, County, State, Federal	Salina City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install storm drain system in Redmond Town.	Medium	Redmond Town, Sevier County EM	Town, County, State, Federal	Redmond Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

SEVIER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Maintain flood retention walls for Richfield City.	Medium	Richfield City, Sevier County EM	City, County, State, Federal	Richfield City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade storm drain system in Richfield City.	Medium	Richfield City, Sevier County EM	City, County, State, Federal	Richfield City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct small debris basin in Bertelson Canyon to mitigate flooding in Monroe City.	Medium	Monroe City, Sevier County EM	City, County, State, Federal	Monroe City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.

SEVIER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

SUMMIT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flood	**Objective:** Encourage 100% participation in the National Flood Insurance Program (NFIP).	**Problem Identification:** Flood occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.						
	Action: Assist Town of Francis in joining NFIP	**HIGH**	1-year	None required	Francis	None	County Emergency Management, County Engineer, State Floodplain Manager	FEMA has yet to map the Town of Francis with Special Flood Hazards (SFHA). The community does not participate in the NFIP therefore flood insurance is not available.
	Objective: Promote flood insurance throughout the County							
	Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.	**HIGH**	1-year	Unknown	Countywide	Minimal	County Engineer, State Floodplain Manager, DES	General public is usual not aware they can purchase flood insurance.
	Objective: Reduce threat of unstable canals throughout the County. Identify County-wide canal systems							
	Action: Map and assess for structural integrity canal systems in the County	**HIGH**	3-5 years	Federal grants	Countywide	Unknown	County Engineer, County Public Works, County Information and Technology, County Emergency Management	Private and Public canals are used for transportation and dispersion of water as well as flood control.
	Objective: Reduce flooding threat in Oakley, Woodland, Wanship, Hoytsville, Coalville, Peo, Francis and Henefer.							

SUMMIT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Clear debris and other material from streams prior to spring snow melt.	**HIGH**	Ongoing	Unknown	Oakley, Woodland, Wanship, Hoytsville, Coalville, Peo, Francis, and Henefer	Unknown	County Public Works	Most flooding is attributed to debris-laden streams.
	Objective: Ensure EOC(s) are equipped to respond to flooding.							
	Action: Obtain communication equipment that will allow for timely response to flooding.	**HIGH**	1 year	Federal Grants	Countywide	$30,000	County Sheriff, County Emergency Management	An alternate EOC is being considered in Kamas. Adequate communication capabilities are essential between all response agencies within the County.
	Action: Support and encourage participation in the NFIP Flood Map Mod Program.	**HIGH**	Ongoing	Federal	Countywide	Unknown	County Engineer, State Floodplain Manager	Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with Fire-wise development "Best Practices".						
	Action: Develop and enforce current local, state and national codes	**HIGH**	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Building continues to be of concern in Urban Wildfire Interface Areas (URWIN). Especially in the following areas: Pine Mountain – Oakley, Samak – Kamas, Sage Mountain – Echo, Mountainland and developed areas near Bear River Service on Mirror Lake Highway.						
	Action: Conduct an education program (Firewise) on reducing wildfire risks	**HIGH**	Ongoing	County	Countywide	Minimal	Fire District(s), County Emergency Management, State FFSL	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes

SUMMIT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Develop a firebreak road in Pine Mountain Subdivision in Oakley	**HIGH**	3-years	County, State and Federal	Oakley	Unknown	Private land owners, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service	Wildfires have the potential to threaten this area. This will assist in protecting the community by providing a firebreak
	Action: Continue to work with current Firewise communities (Pinebrook, The Colony's, Summit Park) on their wildfire risks	**HIGH**	Ongoing	County, State and Federal Grants	Pinebrook, The Colony's, and Summit Park	Minimal	County Emergency Management, State FFSL, US Forest Service	It is essential we continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.
Landslide	**Objective:** Reduce potential landslide risk on commercial, residential structures, and infrastructure (pipelines and utilities) in areas of known landslide potential.	**Problem Identification:** There is a potential risk to structures located in areas identified by the MAG GIS as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures and infrastructure at risk	**MED**	Undetermined	County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Action: Include landslide data in County Information and Technology GIS system and include on County website.	**MED**	Undetermined	County, possible grants	Countywide	To be determined	County GIS Staff, UGS	General public and developers will have access to landslide data.
Earthquake	**Objective:** Provide for emergency response and relief	**Problem Identification:** Summit County will be impacted indirectly from an earthquake on the Wasatch Front. Transportation and utilities services to and from the County could be severely impacted.						

SUMMIT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Identify and maintain critical transportation and utility services	**LOW**	Ongoing	Grants	Countywide	Unknown-Determined by the extent of damage anticipated.	County staff	Critical transportation systems need to be maintained.
	Objective: Through the CERT Program, educate community on earthquake damage prevention practices	**Problem Identification:** Lack of public awareness about earthquake damage prevention practices.						
	Action: Educate the public on damage prevention practices for earthquakes	**MED**	2-years	State and Federal Grants from state and Federal governments	Countywide	$50,000-$75,000	County Emergency Management and volunteers	Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action 1: Educate the public on the need to be water wise	**LOW**	Ongoing	State and Federal	Countywide	Minimal	Water Districts	Use a newsletter to educate the public
	Action: Coordinate with current water systems and develop a secondary water systems plan for drought	**LOW**	Immediate	Undetermined local sources	Countywide	Minimal	Water Districts	To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.
Severe Weather	**Objective:** Protect County from adverse affects of severe weather	**Problem:** Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.						
	Action 1: County participation in the StormReady program.	**HIGH**	2-years	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

SUMMIT COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Encourage avalanche preparedness for county backcountry users.	**HIGH**	Ongoing	State and Federal	Countywide	Minimal	County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Summit County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	Proposed alternate EOC (Kamas), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.

TOOELE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Drought	**Objective 1:** Take actions to maintain adequate culinary water supplies	**Problem Identification**: Large areas that lack sufficient precipitation to maintain ground water levels within the County, affecting culinary, agricultural and commercial/industrial uses.						
	Action: Develop a public awareness campaign to encourage water conservation.	HIGH	Ongoing	Apply for available local, state, and federal grants	Countywide	TBD	County USU Extension, Health Department, Emergency Management and auxiliary personnel.	Multi-agency coordination effort
	Action: Establish economic incentives for water conservation.	HIGH	Ongoing	Grants available through state government	Countywide	TBD	City Officials, Local water systems	Awareness to city and local officials
	Objective 2: Protect water aquifers							
	Action: Create and enforce zoning (land use) to protect primary recharge areas.	MED	Ongoing enactment of ordinances	Local government funding	Countywide	TBD	Existing planners, planning commissions, engineers, and public officials	Educate planners and formal adoption of ordinances
	Action: Watch countywide inventory data from public, private, and monitoring wells.	MED	Ongoing	Local funds supplemented by grants made available	Countywide	TBD	Health Department, USGS, and Emergency Management personnel coordinated effort	Data has been available, but intra-agency coordination needs to be improved
Wildland Fire	**Objective 1:** Take actions to enforce the codes that are currently in place.	**Problem Identification:** Lack of code enforcement within and awareness of the Wildland Urban Interface.						

TOOELE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Find personnel qualified to inspect property with regard to Wildfire Protection Standards	HIGH	6 months	N/A	Countywide	Minimal	City and county fire departments, Emergency Management and Engineering	Regular Fire Warden duties stand in the way of inspection.
	Objective: Educate persons living or working in these areas about the hazard.							
	Action: Present Fire Wise workshops for residents of high-risk areas.	MED	Ongoing	N/A (Fire Wise materials are provided free of charge)	At risk communities	Minimal	Fire Warden, fire personnel and county planners	People are not being informed of potential hazards.
	Action: Inform people seeking building permits and realtors showing homes in these areas of the risk.	MED	Ongoing	Local government funding	At risk communities within Tooele County	TBD	Fire Warden, fire personnel and county planners	Potential homebuilders and buyers are not aware of the risk or the building codes to help mitigate the risk.
	Action: Determine the specific areas where the Wildfire Protection Standards are in effect and make it available to the public in a graphic form.	MED	6-12 months	Unknown	Countywide	TBD	County GIS Dept. and Emergency Management Staff	Knowledge of these areas is vague and only passed on verbally.
Severe Weather	**Objective:** Educate more citizens about recognizing and knowing the dangers of severe weather hazards.	**Problem Identification**: Severe weather related incidents result in a large number of disaster declarations and emergency response needs.						
	Action: Increase Weather Spotter training	MED	Ongoing	Unknown	Countywide	Minimal	Emergency Management Staff and National Weather Service Staff	Weather Spotters add increased forewarning of severe weather.

TOOELE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Increase Amateur Radio Operator Involvement in weather observations.	MED	Ongoing	Unknown	Countywide	Minimal	HAM Radio Club, Emergency Management Staff	HAM operators typically discuss weather in all communications. **Note:** Tooele County is a NWS Storm Ready county and therefore we have done just about everything possible to mitigate severe weather incidents. This objective is just one more step beyond what we have already accomplished.
Infestation	**Objective:** Establish continuous funding sources for countywide insect control	**Problem Identification**: Negative economic impacts from grasshopper, Mormon Cricket, and other types of insects.						
	Action: Provide historical data and other information to raise awareness levels of elected and appointed officials regarding infestation impacts and ripple effects.	MED	Ongoing	Local Funds	Countywide targeting agricultural	Minimal	USDA APHIS, UDAF, USU Extension and local governments	Insect infestations are cyclic while insect control funding is not.
	Objective 2: Utilize historical data to forecast infestation cycles and monitor pest populations to implement early prevention strategies.							
	Action: Review research data and develop additional insect monitoring sites	MED	Ongoing	USDA APHIS, UDAF, and USU Extension	Countywide	Minimal	USDA APHIS, UDAF, and USU Extension	Understanding insect infestation cycles and early detection through monitoring can greatly reduce insect damage.
Earthquake	**Objective:** Reduce the threat to life and property within anticipated fault zones.	**Problem Identification:** Development on identified fault traces increase the risk to life and property following an earthquake.						
	Action: Develop and implement land use ordinances.	HIGH	Ongoing	Local governmental funding	Countywide	Minimal	Existing planners, planning commissions, engineers, and public officials.	Existing faults have already been identified and are monitored.

TOOELE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective 2: Take advantage of continuing education opportunities for planners and policy officials							
	Action: Attend ACT-21 classes	HIGH	Ongoing	Local government funding	Countywide	Minimal	Existing planners, planning commissions, engineers, and public officials	ATC-21 Training is a pre-earthquake assessment of buildings course helpful in determining the potential danger of a building.
	Action: Collect building data for input into computer earthquake models.	HIGH	6-12 Months	Unknown	Countywide	Minimal	Emergency Management Staff, Planners, and Inspectors	No current data on building inventory for use in damage and cost loss models in the event of an earthquake.

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Dam Failure	**Objective:** Use technology to aid in prevention of flood loss due to dam failure	**Problem Identification**: Reduce down stream loss in Uintah County due to dam failure.						
	Action: Digitize high hazard dam failure inundation maps	HIGH	Ongoing	State government	Countywide	500 dollars per dam	Dam Safety Section, and AGRC	Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to down stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Duchesne County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.
	Action: Update Emergency Operations Plan to include GIS dam failure estimates	HIGH	Next EOP update	County	Countywide	Undetermined	County GIS and Emergency Manager	
	Action: Educate the local elected officials, developers, and citizens.	HIGH	Within the next two years	County	Countywide	Minimal	County employees	
	Action: Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**	HIGH	Ongoing	FEMA, State and Local	Countywide	Unknown	State and Local	
	Action: Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.	HIGH	Ongoing	Town and County funds	Countywide	Minimal	Water surveyor and newsletter editor	
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Current, past and future drought issues within Uintah County.						
	Action: Educate the public on the need to be water wise	HIGH	Ongoing	County funding	Countywide	Minimal	Water surveyor and newsletter editor	Use a newsletter to educate the public
	Objective: Develop more water storage tanks within the County							
	Action: Conduct a feasibility study	HIGH	Ongoing	County funding	Countywide	Minimal	Water surveyor and newsletter editor	

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Install new wheel lines to improve the water efficiency.	HIGH	Ongoing	Federal, and State funding	Countywide	Unknown	NRCS, UACD, USU, Extension, ect.	
	Action: Implement and enforce water laws that prohibit the use of extensive amounts of water.	HIGH	Ongoing	County funding	Countywide	Unknown	Water surveyor and newsletter editor	
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Ballard City	To be determined	Ballard City staff, Professional Services, Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funds	Ballard City	Minimal	Water surveyor and newsletter editor	The city should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Naples City	To be determined	Naples City staff, Professional Services, Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funding	Naples	Minimal	Water surveyor and newsletter editor	The City should continue to maintain and implement a tiered water rate structure.

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Meet current and future water needs of community. Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional water storage tanks as well as implement conservation plans.	HIGH	Ongoing	City funds, State and Federal Government loans and/or grants	Vernal	To be determined	Vernal City staff, Professional Services, Contractors	
	Objective: Conserve culinary water by conservation							
	Action: Maintain and enforce rate policies that encourage water conservation	HIGH	Ongoing	City and County funding	Vernal	Minimal	Water surveyor and newsletter editor	The City should continue to maintain and implement a tiered water rate structure.
Earthquake	**Objective:** Provide for emergency response and relief.	**Problem Identification:** Transportation and utilities services could be severely impacted.						
	Action: Identify and maintain critical transportation and utility services.	HIGH	Ongoing	Local governments and possible grants	Countywide	Unknown-Determined by the extent of damage anticipate.	Town staff	Critical transportation systems
	Objective: Public Awareness							
	Action: Conduct a public awareness campaign.	HIGH	Ongoing	Local governments and possible grants	Countywide	Unknown	Agency personnel and volunteers	Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.
	Objective: Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.	**Problem Identification:** Unknown number of seismically unsafe structures around the county.						
	Action: Structural and non-structural earthquake hazard assessment.	HIGH	Ongoing	Unknown	Countywide	Unknown	Unknown	Critical transportation systems

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flooding	**Objective:** Obtain Aerial photography with contours of each residential area in Uintah County.	**Problem Identification:** Control flooding in residential areas of Uintah County, Including but not limited to Ballard City, Naples City, and Vernal City. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	HIGH	Ongoing	Local, State and Federal grants	Countywide	Unknown	State, Local, and possibly Federal	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	HIGH	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.
	Objective: Implement storm drainage plans throughout the residential areas of Uintah County.							
	Action: Implement storm drainage plans throughout the residential areas of Uintah County.	HIGH	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the finals plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Use technology to aid in prevention of flood loss.	**Problem Identification:** Control flooding in Ballard City. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for Ballard City.	HIGH	Within the next two years	FEMA, state and local.	Ballard City	Unknown	County and City Employees, Local Volunteers	
	Action: Place a restrictive clause in the City Ordinances that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local.	Ballard City	Unknown at this time	County and City Employees, Local Volunteers	

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local.	Ballard City	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Ballard City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local	Ballard city	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local	Ballard City	Unknown at this time	County and Town Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local	Ballard City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local	Ballard City	Unknown at this time	County and City Employees, Local Volunteers	Past and future flooding
	Objective: Use technology to aid in prevention of flood loss.	**Problem Identification:** Control flooding in Naples City. Flooding occurs from heavy rains and fast moving thunderstorms.						

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Naples City.	HIGH	Within the next two years	FEMA, state and local.	Naples City	Unknown	County and City Employees, Local Volunteers	
	Action: Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local	Naples City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local	Naples City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local.	Naples City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local	Naples City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local	Naples City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local	Naples City	Unknown	County and City Employees, Local Volunteers	

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local.	Naples City	Unknown	County and City Employees, Local Volunteers	
	Objective: Use technology to aid in prevention of flood loss.							
	Action: Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Vernal City.	HIGH	Within the next two years	FEMA, state and local.	Vernal City	Unknown	County and City Employees, Local Volunteers	
	Action: Place a restrictive clause in the County and City Ordinances that will prohibit any new development in the floodplain.	HIGH	Within the next year	FEMA, state and local.	Vernal City	Unknown	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.	HIGH	Ongoing	FEMA, state and local	Vernal City	Unknown	County and City Employees, Local Volunteers	
	Action: County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.	HIGH	Ongoing	FEMA, state and local	Vernal City	Unknown	County and City Employees, Local Volunteers	
	Action: The County Emergency Managers will research grant opportunities for potential funding.	HIGH	Ongoing	FEMA, state and local.	Vernal City	Unknown at this time	County and City Employees, Local Volunteers	

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Implement a flood ordinance that will cover the County and City with flood insurance.	HIGH	Ongoing	FEMA, state and local.	Vernal City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.	HIGH	Ongoing	FEMA, state and local.	Vernal City	Unknown at this time	County and City Employees, Local Volunteers	
	Action: Enforce Zoning laws.	HIGH	Ongoing	FEMA, state and local	Vernal City	Unknown at this time	County and City Employees, Local Volunteers	
Insect Infestation	**Objective:** Reduce the impact of insects	**Problem Identification:** Uintah County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation.						
	Action: Spread insect bait and spray for mosquitoes	HIGH	When required	County funds, Mosquito abatement funds come from property tax	Countywide	Approximately $3.00 per property owner per month.	County Mosquito Abatement District	
	Objective: Reduce the severity of infestations							
	Action: Apply for grants to purchase Mosquito magnets and propane tanks to run the magnets.	HIGH	Spring and summer of 2004	$6,000.00 in grants	Countywide	$6,000.00	County employees	Several agricultural fields surround Uintah County; these fields have been subjected to insect infestation especially during the recent years of drought.
	Objective: Reduce the threat of West Nile Virus within Uintah County							
	Action: Educate the public on the importance of vaccinating their animals.	HIGH	Spring and summer of 2004.	State and local funding	Countywide	Minimal	County employees	Several of the Uintah County residents have horses that could be affected by the West Nile virus.

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Reduce the severity of infestations	**Problem Identification:** Periodic Grasshopper infestations more sever in the rural areas of Uintah County.						
	Action: Conduct aerial spraying to reduce infestations.	HIGH	As infestations occur.	By private individuals in most cases	Countywide	Varies, depending on acreage treated	Contractor	Many agricultural fields surround Uintah County. These fields have been subjected to insect infestation especially during the recent years of drought.
Landslide	**Objective:** Reduce potential landslides to residential and commercial areas.	**Problem Identification:** There is a potential risk to residential and commercial buildings due to rockslides, which are located in areas identified by the county as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures at risk	HIGH	Undetermined	Property Owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Action: The county's, city's and town's planning committee will review and update the zoning ordinances within the County to make sure that individuals are not constructing new homes near potential landslide areas.	HIGH	Undetermined	Unknown	Countywide	Unknown	Unknown	Hold monthly planning and zoning meetings within the town and county.
	Objective: Reduce potential landslides to residential and commercial areas.	**Problem Identification:** In Uintah County there are several areas namely, Blue Mountain, Diamond Mountain, and Dry Fork Canyon that could have a potential risk to pedestrians and vehicle traffic due to landslides.						
	Action: Assess the probability of landslides and identify specific structures at risk	HIGH	Undetermined	Property owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
Severe Weather	**Objective:** Reduce damage to structures through strict adherence to building codes	**Problem Identification:** Uintah County experiences occasional, damaging high winds and snowstorms.						
	Action: Ensure that 80 MPH wind load requirement is met by builders	HIGH	Ongoing	Fees from Building permits	Countywide	Minimal	Building Inspector	Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events
	Objective: Reduce service disruptions and damage to power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						
	Action: Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.	HIGH	Ongoing	Possible grants	Countywide	To be determined	County and town employees	Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.

UINTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						
	Action: Develop and enforce current local, state and national codes	HIGH	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Specific areas of the county are susceptible to wildland fire danger.						
	Action: The local LEPC will provide semi-annual training for the citizens of Uintah County.	HIGH	Starting 2004	State and local	Countywide	Minimal	County	Educate the public on how to reduce the risk of wildfires.

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flood	**Objective:** Support the National Flood Insurance Program (NFIP), Flood Map Modernization Program, to update flood risk and flood maps in the County	**Problem Identification:** Flooding occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.						
	Action: Support State Floodplain Manager in the Flood Map Modernization Program	**HIGH**	Next three years	Dependent on if cost share is required.	Countywide	Dependent on scope of individual mapping projects.	City/County Emergency Management, County/City Engineer(s), State Floodplain Manager, Contractors.	The State has designated Utah County as the number one priority community in the State for updated flood maps. County needs to support this designation.
	Objective: Promote flood insurance throughout the County							
	Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings. Especially after wildfires where post fire debris flows are of concern.	**HIGH**	1 year	Minimal	Countywide	Unknown	County Engineer/Floodplain Administrator, County Emergency Management, State Floodplain Manager, DES	General public is usual not aware they can purchase flood insurance even if they are located outside of a Special Flood Hazard Area. This information is especially critical when post fire debris flow potential has been identified and homes are located on alluvial fans.
	Objective: Reduce threat of unstable canals throughout the County. Identify County-wide canal systems							

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Map and assess for structural integrity canal systems in the County	**HIGH**	3-5 years	Federal grants	Countywide	**Unknown**	County Engineer, County Public Works, County Information and Technology, County Emergency Management	Private and Public canals are used for transportation and dispersion of water as well as flood control.
	Objective: Ensure EOC(s) are equipped to respond to flooding.							
	Action: Obtain communication equipment that will allow for timely response to flooding.	**HIGH**	1 year	Federal Grants	Countywide	$30,000	County Sheriff, County Emergency Management	Support response from alternate EOC. Adequate communication capabilities are essential between all response agencies within the County.
	Objective: Minimize future flood damage in the unincorporated County	**Problem Identification:** Utah County is one of the smallest counties in the state terms of size and unincorporated population – with less than 5 percent of its residents live in the unincorporated county. The County does participate in the National Flood Insurance Program and the mapping is scheduled to be updated. No major rivers threaten large unincorporated urban developments. Therefore, no structural flood control projects are warranted at this time. One exception to this is the small development, south of Payson, known as Spring Lake, that is vulnerable to flooding and debris flows. A large debris flood event occurred here in 2002 (following the adjacent Mollie Wildfire in 2001 which made conditions "ripe" for this type of event). Post fire hillside stabilization measures should reduce the flood threat to Spring Lake. General flood threats in the unincorporated county include the Utah Lake tributaries, and other potential flood sources such as Utah Lake itself.							

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to regulate development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as limiting development on alluvial fans. New development near canals should be mitigated to limit losses due to canal failures. The county should require developers in these potential hazard areas to submit site specific mitigation plans to minimize potential losses. Costs associated with mitigating the potential hazard should be borne by the developer.	**HIGH**	3 to 5 years	Developer	Unincorporated County	Minimal	County staff	
	Objective: Minimize future flood damage in Cedar Hills.	**Problem Identification:** Cedar Hills is developing rapidly – mostly with large single-family homes. It faces a significant flood threat, especially on the east side of town, from Heisett's Hollow and adjacent, fairly large unnamed drainages to the north and south. Although not currently participating in the NFIP, this community should definitely be considered at rather high risk of flooding and should be included in any Utah County map updates or revisions.						
	Action: A potentially viable alternative would be to construct a detention/debris basin at the mouth of Heisett's Hollow.	**HIGH**	Unknown	Unknown	Cedar Hills	One million	Unknown	
	Action: As with similar communities, the relatively moderate threat of flooding in many parts of the community indicates that nonstructural zoning is preferable to structural measures unless a historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Cedar Hills	Unknown	Unknown	
	Objective: Minimize future flood damage in Eagle Mountain.	**Problem Identification:** Eagle Mountain is located about 6 miles southwest of Lehi just south of Highway 73. Also one of the state's newer communities, it is growing very rapidly. As of 2003, Eagle Mountain now has a population of about 8,000 residents compared to the 2,000 identified in the 2000 Census. Channel modifications have been made to Tickville Gulch and its tributary West Canyon Wash that flow through the north part of the community. There are also numerous unnamed drainages along the east side of Eagle Mountain that drain Lake Mountain. These drainages range in size from about 1 to 3 square miles and therefore would pose a moderate level of threat during an infrequent flood event.						
	Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding near Tickville Gulch and West Canyon Wash.	**HIGH**	Unknown	Unknown	Eagle Mountain	$10k-$30k per structure	City & county staff	

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: As with similar, growing communities, the relatively low to moderate threat of flooding to most of the homes indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Eagle Mountain	Unknown	City & county staff	
	Objective: Minimize future flood damage in Elk Ridge.	**Problem Identification:** Also a relatively new community, Elk Ridge is situated just southeast of Payson. Elk Ridge is flanked by Loafer Canyon on the east and other unnamed drainages through the rest of the community. Development for the most part, appears to be sited up and away from the channels. However if the channels/culverts were to become blocked by debris or if wildfire were to occur in the surrounding mountain, devastating flood, mud, and debris flows are possible. (A wildfire was experienced in the area during the summer of 2003.)						
	Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.	**HIGH**	Unknown	Unknown	Elk Ridge	$10k-$30k per structure	City & county staff	
	Action: As with similar, growing communities, the moderate threat of flooding indicates zoning would be less costly than structural measures (unless an historic flood problem is known to exist -see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Elk Ridge	Unknown	City & county staff	
	Objective: Minimize future flood damage in Goshen.	**Problem Identification:** Although not participating, this community appears to have little flood threat - unless Goshen Reservoir has problems in the future (earthquake or slope stability issues).						
	Action: As with similar small communities, the relatively low threat of flooding indicates that nonstructural zoning is preferable to structural measures unless a historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Goshen	Unknown	City & county staff	
	Objective: Minimize future flood damage in Santaquin.	**Problem Identification:** Although Santaquin has a NSFHA designation based on its old town boundaries, it clearly has a very high flood, mud, and debris flow threat in the newer part of town – east of Interstate 15 – that needs to be addressed. It appears that virtually all development east of I-15 is at risk due to its location right on top of major alluvial fans. They are known as Tributaries 4, 5, and 6 (north to south). Although development for the most part, appears to be sited up and away from the channels, during the 2002 debris flow event (preceded by the 2001 Mollie Wildfire), the channels became blocked by debris and a devastating flood, with mud and debris flows occurred – putting the lives of many in community at very high risk. (Amazingly no one was injured or killed in the disaster.) Debris flow boundaries delineated by the Utah Geological Survey (attached) should be used as a minimum to approximate the flood threat until detailed analyses can be made.						

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Detention/debris basins are urgently needed if the town is going to continue to allow development "in harms way".	**HIGH**	Unknown	Unknown	Santaquin	Approximately $500k - $1 million each – Total $2.5 million	City, Federal agency staff.	
	Action: As with similar growing communities, nonstructural zoning is less costly than structural measures to prevent future damages (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Santaquin	Unknown	City staff.	
	Objective: Minimize future flood damage in Saratoga Springs.	**Problem Identification:** Like Santaquin, this community has also grown very rapidly and is also designated as a NSFHA. It appears to face a moderate flood threat from Tickville Gulch on the north and at least a dozen other drainages along the east side of town (in addition to the threat from Utah Lake).						
	Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.	**HIGH**	Unknown	Unknown	Saratoga Springs	$10k-$30k per structure	City staff	
	Action: As with similar, growing communities, the low to moderate threat of flooding indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Saratoga Springs	Unknown	City staff, DES	
	Objective: Minimize future flood damage in Vineyard	**Problem Identification:** Although there is no flood threat from any rivers, creeks, or streams, Utah Lake is within the corporate boundary-leaving Vineyard at some risk. A 1997 COE reconnaissance study (Provo River and Tributaries) determined that the 100-yr elevation of Utah Lake would be approximately 4494.5 MSL. Most of Vineyard is well above this elevation so the relative risk is minimal.						
	Action: As with similar communities, the relatively low threat of flooding indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Vineyard	Minimal	City & DES staff	
	Objective: Minimize future flood damage in Woodland Hills.	**Problem Identification:** Also a relatively new community, Woodland Hills is situated southeast of Payson, in the southeast corner of Utah County. Woodland Hills is flanked by Maple Canyon on the east and is threatened by Broad and Snell Hollows, as well as another unnamed drainage through the rest of the community. Development for the most part, appears to be sited up and away from the channels. However if the channels/culverts were to become blocked by debris or if wildfire were to occur in the surrounding mountain, devastating flood, mud, and debris flows are possible – putting the community at very high risk.						

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.	**HIGH**	Unknown	Unknown	Woodland Hills	$10k-$30k per structure	City staff	
	Action: As with similar, growing communities, the moderate threat of flooding indicates that nonstructural zoning would be preferable to structural measures (and less costly - unless an historic flood problem is known to exist - see discussion on zoning in the County's mitigation section above).	**HIGH**	Unknown	Unknown	Woodland Hills	Minimal	City & DES staff	
Dam Failure	**Objective:** Obtain most up to date and accurate information on dams in County to protect lives and property from dam failure.	**Problem Identification:** National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means. Deer Creek and Jordanelle Dams are of specific concern in the County.						
	Action: Include dam inundation maps in current County EOP.	**MED**	3-5 years	Undetermined	Countywide	$ 10,000.00	County Emergency Management, BOR and State Dam Safety	Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section is currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Utah County in future emergency management planning.
	Objective: Early warning systems (sirens) are critical to protecting lives from Jordanelle/Deer Creek dam failure.							
	Action: Continue to test warning sirens along Provo River	**MED**	Ongoing	BOR and County, Provo and Orem City	Countywide	Unknown	County/City Emergency Management and Public Works, UDOT, BOR, Sheriff and local Police.	Current siren system needs to be tested on a regular basis and allow local responders to participate in the testing. This will create better planning and awareness at the local level.

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Increase and ensure compliance with existing building and fire codes, especially in the rural areas of the County where secondary residences are upgraded or new construction.	**Problem Identification: N**on-compliance with Firewise development practices.						
	Action: Develop and enforce current local, state and national codes	**HIGH**	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Building continues to be of concern in Urban Wildfire Interface Areas (URWIN). Especially in the following areas: Identified high hazard areas along foothills adjacent to Wasatch Front, eastern Utah County adjacent to Highway 6 to include Solider Summit, and areas along Highway 89 South into Sanpete County						
	Action: Conduct an education program (Firewise) on reducing wildfire risks	**HIGH**	Ongoing	County	Countywide	Minimal	Fire District(s), County Emergency Management, State FFSL	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes. Currently, Sundance is the only recognized Firewise Community in the County.
	Action: Work with State Forestry Fire and State Lands and US Forest Service to identify areas where fire breaks and be designed, implemented and maintained.	**HIGH**	3-years	County, State and Federal	Countywide	Unknown	Private land owners, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service	Wildfires have the potential to threaten high-density population communities along the Wasatch Front.

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Using Sundance as a model Firewise community, promote the Firewise Program in the County.	**HIGH**	Ongoing	County, State and Federal Grants	Countywide	Minimal	County Emergency Management, State FFSL, US Forest Service	It is essential to continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.
	Objective: Reduce potential landslide risk on commercial, residential structures, and infrastructure (pipelines and utilities) in areas of known landslide potential.	**Problem Identification:** There is a potential risk to structures located in areas identified by the MAG GIS as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures and infrastructure at risk especially in the historical Thistle Landslide area.	**MED**	Undetermined	County Engineer, County Emergency Management, County Public Works, Utilities, UDOT, Developers and Property Owners	Countywide	Unknown	Unknown	Additional soil surveys and other engineering surveys are needed.
	Action: Include landslide data in County Information and Technology GIS system and include on County website.	**MED**	Undetermined	County, possible grants	Countywide	To be determined	County GIS Staff, UGS,	General public and developers will have access to landslide data.
	Objective: Reduce loss of life and limit damage to property. Provide education on seismic hazards and mitigation to Utah County residents and homeowners.	**Problem Identification:** Utah County will be impacted directly from an earthquake on the Wasatch Fault. There are also other smaller faults that could generate significant damage. Transportation and utilities services within County could be severely impacted.						
	Action: Develop and promote earthquake public education program.	**HIGH**	Immediate	County/State	Countywide	$2500.00	County Emergency Management, State Earthquake Program	Provide information to residents and business owners to encourage them to take appropriate measures to make homes and businesses less susceptible to damage from ground shaking. Education pertaining to earthquakes will be part of a holistic natural hazards education program, including wildfires, flooding, sever weather, and landslides.

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Through the CERT Program, educate community on earthquake damage prevention practices							
	Action: Educate the public on damage prevention practices for earthquakes	**MED**	2 years	State and Federal Grants from state and Federal governments	Countywide	$50,000-$75,000	County Emergency Management and volunteers	Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.
	Objective: Increase quality and quantity of available natural hazards data to facilitate better decision-making.							
	Action: Update fault zone and liquefaction maps for the county to a better scale	**MED**	Two Years	Undetermined, potentially USGS or UGS	Countywide	Minimal	USGS & UGS Staff	Provide updated, detailed maps to city and county planning groups, emergency managers, and public to assist them in making educated decisions by understanding earthquake danger zones.
	Action: Develop better ground acceleration maps for building officials	**MED**	Three Years	UGS, USGS, State Earthquake Program, Utah Seismic Safety Commission	Countywide	Unknown, some cost share for printing.	UGS	Current ground accelerations maps are too small and difficult to read. Better maps create better decision-making.
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action: Educate the public on the need to be water wise	**LOW**	Ongoing	State and Federal	Countywide	Minimal	Water Districts	Use a newsletter to educate the public
	Action: Coordinate with current water systems and develop a secondary water systems plan for drought	**LOW**	Immediate	Undetermined local source	Countywide	Minimal	Water Districts	To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.
Severe Weather	**Objective:** Protect County from adverse affects of severe weather	**Problem Identification:** Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.						

UTAH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: County participate in the StormReady program.	**HIGH**	2 years	State and Federal	Countywide	Minimal	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.
	Action 2: Encourage avalanche preparedness for county backcountry users.	**HIGH**	Ongoing	Funding already in place	Countywide	Minimal	**C**ounty Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Utah County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Flooding	**Objective:** Encourage 100% participation in the National Flood Insurance Program (NFIP).	**Problem Identification:** Flood occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.						
	Action: Assist the Town of Wallsburg in joining NFIP	**HIGH**	1-year	None required	Wallsburg	None	County Emergency Management, County Engineer, State Floodplain Manager	FEMA has yet to map the Town of Wallsburg with Special Flood Hazards (SFHA). The community does not participate in the NFIP therefore flood insurance is not available.
	Objective: Promote flood insurance throughout the County							
	Action: Create outreach documents promoting flood insurance for inclusion in local newspaper(s), libraries, and other public buildings.	**HIGH**	1-year	Minimal	Countywide	Minimal	County Engineer, State Floodplain Manager, DES	General public is usual not aware they can purchase flood insurance.
	Objective: Reduce threat of unstable canals throughout the County. Identify County-wide canal systems							
	Action: Map and assess for structural integrity canal systems in the County	**HIGH**	3-5 years	Federal grants	Countywide	Unknown	County Engineer, County Public Works, County Information and Technology, County Emergency Management	Private and Public canals are used for transportation and dispersion of water as well as flood control.
	Objective: Reduce flooding threat in Midway, Heber, Charleston, and Wallsburg.							

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Clear debris and other material from streams prior to spring snow melt.	**HIGH**	Ongoing	Unknown	Countywide	Unknown	County Public Works	Most flooding is attributed to debris-laden streams.
	Objective: Ensure EOC(s) is equipped to respond to flooding.							
	Action: Obtain communication equipment that will allow for timely response to flooding.	**HIGH**	1-year	Federal Grants	Wasatch County	$30,000	County Sheriff, County Emergency Management	An alternate EOC is being considered in Kamas. An adequate communication capability is essential between all response agencies within the County.
	Objective: Support updating of flood hazard data							
	Action: Support and encourage participation in the NFIP Flood Map Mod Program.	**HIGH**	Ongoing	Federal Funding	Countywide	Unknown	County Engineer, State Floodplain Manager	Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Non-compliance with best firewise practices.						
	Action: Develop and enforce current local, state and national codes	**HIGH**	Ongoing	Local Budgets	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Building continues to be of concern in Urban Wildfire Interface Areas (URWIN).						

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Conduct an education program (Firewise) on reducing wildfire risks	**HIGH**	Ongoing	County	Countywide	Minimal	Fire District(s), County Emergency Management, and State FFSL	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes and defensible space. The Utah Living With Fire Committee has created a Utah specific wildfire education-training package. GIS analysis conducted by Mountainland Association of Government indicates the county has 775 structures costing $116,250,000 vulnerable to wildfire in Wasatch County.
	Action: Complete mitigation detailed in the wildfire plan prepared for the community of Interlaken Estates.	**HIGH**	3-years	County, State and Federal	Interlaken Estates	Unknown	Private land owners, Interlaken Community Fire Council, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service	Wildfires have the potential to threaten this area. These community specific mitigation strategies will assist in protecting the community.
	Action: Continue to coordinate with current Firewise communities.	**HIGH**	Ongoing	County, State and Federal Grants	Urwin Communities in Wasatch County	Minimal	County Emergency Management, State FFSL, US Forest Service	It is essential we continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Landslides	**Objective:** Reduce potential landslide risk on commercial, residential structures, and infrastructure (pipelines and utilities) in areas of known landslide potential.	**Problem Identification:** There is a potential risk to structures located in areas identified by the MAG GIS analysis and UGS study as landslide risk areas. Several areas in Wasatch County are particularly vulnerable they include the Provo river area down stream from Deer Creek Reservoir, Timber Lakes area, and several communities on the west side of Heber Valley.						
	Action 1: Assess the probability of landslides and identify specific structures and infrastructure at risk	**MED**	Undetermined	County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners	Countywide		UGS, USGS	Soil surveys and other engineering surveys are needed.
	Action: Include landslide data in County Information and Technology GIS system and include on County website.	**MED**	Undetermined	County, possible grants	Countywide	To be determined	County GIS Staff, UGS,	General public and developers will have access to landslide data.
	Action: Map landslide risk areas for inclusion in site development ordinances. These ordinances should include at a minimum a natural hazards disclosure clause.	**MED**	Undetermined	County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
Earthquake	**Objective:** Provide for emergency response and relief.	**Problem Identification:** Wasatch County will be impacted indirectly from an earthquake on the Wasatch Front. Transportation and utilities services to and from the County could be severely impacted.						
	Action: Identify and maintain critical transportation and utility services	**LOW**	Ongoing	Grants	Countywide	Unknown Determined by the extent of anticipated damage.	County	Critical transportation systems need to be maintained.
	Objective: Through the CERT Program, educate community on earthquake damage prevention practices	**Problem Identification:** Lack of public awareness about earthquake damage prevention practices.						

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Educate the public on damage prevention practices for earthquakes	**MED**	2-years	State and Federal Grants from state and Federal governments	Countywide	$50,000-$75,000	County Emergency Management and volunteers	Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.
Drought	**Objective:** Conserve culinary water by educating the public	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action: Educate the public on the need to be water wise	**LOW**	Ongoing	State and Federal	Countywide	Minimal	Water Districts	Use a newsletter to educate the public
	Action: Coordinate with current water systems and develop a secondary water systems plan for drought	**LOW**	Immediate	Undetermined local source	Countywide	Minimal	Water District	To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.
Severe Weather	**Objective 1.1** Protect County from adverse affects of severe weather	**Problem Identification:** Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.						
	Action: County participation in the Storm Ready program.	**HIGH**	2-years	State and Federal	Countywide	Unknown	City and County Emergency Management	Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Encourage avalanche preparedness and education for county backcountry users.	**HIGH**	1-year	In place state and federal funding	Countywide	Minimal	County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.	Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry, these figures when taken cumulatively result in avalanches be Utah's most deadly natural disaster. While the avalanche terrain is mainly on US Forest Service land the search and rescue efforts are conduct by City and County staff for the lost individual. Introductory avalanche awareness training could lessen search and rescue costs to Wasatch County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.
	Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.	**HIGH**	2-3 years	Federal Grants	Countywide	Unknown	County Emergency Management	Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.
Dam Failure	**Objective:** Obtain most up to date and accurate information on dams in County to protect lives and property from dam failure.	**Problem:** National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means. The towns of Charleston, Midway, and Heber are down stream from the Jordanelle Reservoir. Dam failure inundation study show significant flooding to all three towns.						

WASATCH COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Include dam inundation maps in current County EOP.	**MED**	3-5 Years	Undetermined	Charleston, Midway, Heber.	$ 10,000.00	County Emergency Management, BOR and State Dam Safety	Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section in currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Wasatch County in future emergency management planning.
	Action: Evaluate need and associated cost to have dam failure early warning sirens for communities of Charleston, Heber, and Midway.	**MED**	3- 5 years	Undetermined	Charleston, Heber, and Midway	Unknown	County Emergency Management, County Public Works, and BOR	Charleston, Heber, and Midway could be directly impacted by a dam failure.
	Action: Maintain rigorous dam safety inspections.	**MED**	Ongoing	Operating budgets of inspecting agencies.	Charleston, Heber, and Midway	Unknown	County Emergency Management, County Public Works, and BOR	Charleston, Heber, and Midway could be directly impacted by a dam failure.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Wildfire	**Objective:** Increase compliance with existing building and fire codes.	**Problem Identification:** Continuing non-compliance with existing building codes and fire codes.						
	Action: Develop and enforce current local, state and national codes	**HIGH**	Ongoing	Local, state and federal grants	Countywide	Unknown	Local, state and federal agencies	Implement and enforce rules, regulations and codes
	Objective: Educate homeowners on how to reduce risk of wildfire damage	**Problem Identification:** Approximately 10 homes are at risk from wildfire						
	Action: Conduct an education program on reducing wildfire risks	**HIGH**	Ongoing	Enterprise City	Enterprise City	Minimal	Fire Chief	Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes
	Objective: Reduce threat of utilities interruption due to a wildland fire	**Problem Identification:** Fire is a threat to power facilities and transmission lines						
	Action: Safeguard facilities and poles	**HIGH**	Ongoing	Local	Hurricane	Undetermined	Public Works Crews, Hurricane City Fire Department, 138 Task Force	Power and telephone transmission lines in Hurricane City travel via overhead lines through many developed and undeveloped areas. A wildland fire could disrupt services to customers by igniting poles or arcing. Facilities and transmission lines need to be evaluated and plans implemented to safeguard facilities and poles. Plans must be developed to isolate affected areas and maintain services by rerouting services to customers.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat to the west side of the City (west end of Kayenta)						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Develop a fire break road between Ivins and the Shivwits Indian Reservation	**HIGH**	1-year	Private, City, State, Federal	Ivins	$10,000 with survey	Private land owners, Ivins, Reservoir water users, Ivins Public Safety	Past wildfires have been a threat from the west end of the county. A fire access road needs to be provided between Ivins City and the Shivwits Indian Reservation. This will assist in protecting the community by providing a firebreak.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat to several large tracts of property in the community						
	Action: Educate the residents of the community on how to make their properties fire safe.	**HIGH**	Periodic	U.S. Forest Service	New Harmony	Minimal to town	Town Staff, U.S. Forest Service	Wildfire is a periodic problem in the New Harmony area, with the Sequoia Fire in 2002 burning 8,200 acres nearby. A few large tracts in town containing residences could have problems from similar fires in the future. The residents of the Town need to be alerted to the dangers of wildfire and be given measures, which they can utilize to minimize damage.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Wildfire is a threat due to grasslands drying out during extended dry periods.						
	Action: Educate residents of the value of maintaining firebreaks around their homes	**HIGH**	Immediate	Local, BLM	Rockville	Minimal	Town, BLM	Rockville lies at the west end of Zion Canyon and is an area of large trees surrounded by open fields of grass bordered by rocky slopes. During extended dry periods the grasslands dry out and represent a potential fire hazard.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** Interface zones along the Virgin River and other river drainages are causing an exposure to wildfire threat.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Thin or remove vegetation causing exposure problem.	**HIGH**	1-year	Moderate, no local funds	St. George	Moderate	No local, possible assistance with BLM/U.S. Forest Service	Vegetative areas along the Virgin River have been subjected to several fires over a number of years. The most recent one damaged several properties and structures. This interface area needs to be thinned and separated from exposure to structures.
	Objective: Reduce threat of damage due to a wildland fire	**Problem Identification:** The Zion River RV park and power facilities and telephone poles are at greatest risk from wildfire.						
	Action: Thin vegetation along river or create a fire break to protect nearby facilities.	**HIGH**	Ongoing	Moderate, BLM, local funds	Virgin	Moderate	No local, possible assistance with BLM	The dense river bottom cover provides an ideal location for a wildfire. This interface area needs to be thinned and separated with a firebreak to reduce or eliminate exposure to structures. Redundant communications systems should be installed to provide necessary coverage.
	Objective: Thin out Virgin River vegetation (tamarisks) and create fire breaks	**Problem Identification:** Thick vegetation, mostly tamarisks, along Virgin River near homes.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Cut and chip tamarisks for fire breaks.	**HIGH**	2-years	Grants	Washington City	$30,000 - $40,000	Washington City Fire Dept. and BLM fuels crew	Cut 50 ft. to 60 ft. fire breaks from banks to river. Thin out vegetation near homes by river. Major issues surrounding this objective are that the U.S. Army Corps of Engineers wants to preserve vegetation for bank stabilization and it would reduce wildlife habitat. The general public will support fire safety, but those concerned with the existing environment will likely not favor the reduction of wildlife habitat. The tamarisks, however, are an introduced, water-guzzling, weed-type tree. While this project is good for fire safety of the homes nearby, the U.S. Army Corps of Engineers will likely want to preserve vegetation for bank stabilization.
Landslide	**Objective:** Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.	**Problem Identification:** There is a potential risk to structures located in areas identified by the FCAOG GIS as landslide risk areas.						
	Action: Assess the probability of landslides and identify specific structures at risk	**HIGH**	Undetermined	Property owner	Countywide	Unknown	Unknown	Soil surveys and other engineering surveys are needed.
	Objective: Provide for a second means of supplying culinary water to the residents of La Verkin.	**Problem Identification:** There is potential risk of landslide affecting Toquerville Spring, which would severely impact water delivery.						
	Action: Establish and maintain a means to readily connect the City's culinary water users to alternative water sources.	**HIGH**	Undetermined	Local Governments and possible grants/loans	La Verkin	To be determined	LaVerkin City, Toquerville City, Hurricane City	In case Toquerville Springs is damaged, the communities of LaVerkin and Toquerville would need to connect to Cottam Well and Hurricane City water sources. Use of water would need to be curtailed to essential services only.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Minimizing construction in areas of rockfall and landslides.	**Problem Identification:** Several homes within Rockville are located close to rocky slopes and are subjected to potential landslides and rockfalls.						
	Action: Continue to modify land use code to reduce threat to residences.	**HIGH**	Undetermined	Not applicable	Rockville	Not applicable	Rockville Town Planning Commission, Rockville Town Council	In October 2001, a 16 foot wide boulder that came loose from a nearby hillside rolled into a home in Rockville. The huge rock destroyed the homeowner's bedroom and bathroom and came with 2ft of his head as he slept. According to Dixie State College geologist Professor Kelly Bringhurst, the rock beneath the sandstone is shale and is very weak and boulders break off and just occasionally tumble down.
	Objective: Remove risk to homes by removing rocks.	**Problem Identification:** Rockfall areas are next to residential areas.						
	Action: Remove large rocks overhanging existing developments.	**HIGH**	Undetermined	Not applicable	St. George	Not Applicable	City Community Development Staff, Planning Commission, City Council	There are several areas in St. George where rocks overhang existing developments, i.e. in the Bloomington development. Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains.
	Objective: Remove rockfall risk to areas being considered for new development.	**Problem Identification:** Rockfall areas are next to residential areas.						
	Action: Remove potential rock hazards prior to building homes.	**MED**	5-years	None	St. George	Unknown	City Planning Department	Prior to building, require builder/owner to secure or remove possible rock hazard.
	Objective: Provide for a second means of supplying culinary water to the residents of Toquerville.	**Problem Identification:** There is potential risk of landslide affecting Toquerville Spring, which would severely impact water delivery.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Establish and maintain a means to readily connect the City's culinary water users to alternative water sources.	**HIGH**	Undetermined	Local Governments and possible grants/loans	Toquerville	To be determined	Toquerville City, LaVerkin City, Hurricane City	In case Toquerville Springs is damaged, the communities of Toquerville and LaVerkin would need to connect to Cottam Well and Hurricane City water sources. Use of water would need to be curtailed to essential services only.
	Objective: Provide for a secondary means of providing water and essential services	**Problem Identification:** There is potential risk of landslide on the hillside along S.R. 9 near the Jesse Lee residence and the 101 Rancho area of Virgin, as well as the well at Anderson Junction along with the water lines running from there to the town.						
	Action: Develop plan for providing essential services should access be disrupted and water disrupted.	**HIGH**	Ongoing	Local Governments and possible grants	Virgin	To be determined	Town of Virgin, Utah Department of Transportation	In case damage to the Anderson Junction well/spring, the communities of Virgin, LaVerkin and Toquerville would be curtailed to use of water for essential services only. The potential for damage to the 101 Rancho area would necessitate a plan to reroute traffic and repair the damage to S.R. 9. Damage repair would be coordinated as needed.
Flood	**Objective:** Obtain Aerial photography with contours of each residential area in Washington County.	**Problem Identification:** Control flooding in unincorporated residential areas of Washington County, (Approximately 12 areas). Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	**HIGH**	3 months to 2 years (depending on number of areas).	Local, State and Federal grants.	Countywide	$7000.00 per residential area, depending on size	County Staff and contracted staff.	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	**HIGH**	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Implement storm drainage plans throughout the residential areas of Washington County.							
	Action: Implement storm drainage plans throughout the residential areas of Washington County.	**HIGH**	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the final plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Implement storm drainage plans throughout the residential areas of Diamond Valley.	**Problem Identification:** Control flooding in the Diamond Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms. Aerial photography completed and the planning phase is almost completed.						
	Action: Implement storm drainage plans throughout the residential areas of the Diamond Valley subdivision.	**HIGH**	2-year	State and Federal grants	Countywide	Unknown, will depend on the final plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Implement storm drainage plans throughout the residential areas of Winchester Hills.	**Problem Identification:** Control flooding in the Winchester Hills subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms. Aerial photography completed and the planning phase is almost completed.						
	Action: Implement storm drainage plans throughout the residential areas of Winchester Hills.	**HIGH**	2-years	State and Federal grants	Countywide	Unknown, will depend on the final plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Obtain Aerial photography with contours of each residential area in Apple Valley.	**Problem Identification:** Control flooding in the Apple Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	**HIGH**	3 months to 2 years (depending on funding).	Local, State and Federal grants	Countywide	$7,000.00 per residential area, depending on size	County Staff and contracted staff.	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	**HIGH**	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.
	Objective: Implement storm drainage plans throughout the residential areas of Washington County.							
	Action: Implement storm drainage plans throughout the residential areas of Washington County.	**HIGH**	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the final plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Obtain Aerial photography with contours of each residential area in Dammeron Valley.	**Problem Identification:** Control flooding in the Dammeron Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	**HIGH**	3 months to 2 years (depending on funding).	Local, State and Federal grants	Countywide	$7,000.00 per residential area, depending on size	County Staff and contracted staff.	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	**HIGH**	3 months to 2 years, (depending on completion of photography)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.
	Objective: Implement storm drainage plans throughout the residential areas of Washington County.							
	Action: Implement storm drainage plans throughout the residential areas of Washington County.	**HIGH**	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the final plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Obtain Aerial photography with contours of each residential area in Sky Ranch.	**Problem Identification:** Control flooding in Sky Ranch Subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.						
	Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.	**HIGH**	3 months to 2 years (depending on number if areas).	Local, State and Federal grants	Countywide	$7000.00 per residential area, depending on size	County Staff and contracted staff.	Aerial Topography is needed for master storm drainage design.
	Objective: Design master storm drainage plans for residential areas.							
	Action: Design master storm drainage plans to handle storm water runoff through residential areas.	**HIGH**	3 months to 2 years, (depending on number of areas worked on)	Grants	Countywide	$10,000.00 per residential area, depending on size	County Staff and contracted staff.	Engineers design master storm drainage plans for the residential areas.
	Objective: Implement storm drainage plans throughout the residential areas of Washington County.							
	Action: Implement storm drainage plans throughout the residential areas of Washington County.	**HIGH**	2 years or as soon as the storm drainage plans are finished.	State and Federal grants	Countywide	Unknown, will depend on the finals plans and what is required for facilities	County and contracted staff	Construct storm drainage facilities and require all new developments to meet county storm drainage plans.
	Objective: Reduce the threat of flood damage to structures in the City	**Problem Identification:** There is localized flooding near 100 East Main Street and 300 South Center Street. These threaten 2 commercial buildings and 3 residences.						
	Action: Catch and channel flood waters from the high school and send them to Spring Creek.	**HIGH**	3-5 years	Washington County School District, FEMA funds, City Funds	Enterprise	$70,000-$90,000	City and Contractor	This will help alleviate both the 100 East and the 300 South problems.
	Objective: Reduce the threat of flood damage to structures in the City	**Problem Identification:** There is localized flooding near 100 East Main Street and 300 South Center Street. These threaten 2 commercial buildings and 3 residences.						
	Action: Divert storm water at 200 East and Main Street into existing storm drain catch basin at 200 East 100 North.	**MED**	1-5 years	City Funds and grants	Enterprise	$12,000-$15,000	City and Contractor	This will help alleviate only the 100 East Main Street problem.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Insure that the water from Ashcreek Springs and the Ashcreek Drainage remain a quality source of culinary water.	**Problem Identification:** Ashcreek Springs has been contaminated by flooding from time to time.						
	Action: Protect the spring source and install and maintain anti-backflow valves.	**HIGH**	Ongoing	Local governments and possible grants	Hurricane	Undetermined	Hurricane City Public Works, LaVerkin City Public Works, Contractor	Hurricane City has experienced contamination of the culinary water system due to flooding during heavy rain storms in the Ash Creek Drainage. Ongoing maintenance of facilities needs to be done to protect the source.
	Objective W26.1 Reduce flooding at the "Old Town" drainage area located between 200 East and 200 West.	**Problem Identification:** There is flooding in the "Old Town" area of Ivins.						
	Action: Create a Special Improvement Project for storm drainage and roadway improvements.	**HIGH**	Ongoing	Special Improvement District	Ivins	$2,046,000	Ivins City	This will eliminate flooding to the homes in the area.
	Objective: Reduce flooding in the area 500 East and 600 West along Center Street.	**Problem Identification:** The roadway and homes on the south side of Center Street between 500 and 600 East in Ivins floods with mud and debris.						
	Action: Retain storm water in the street.	**HIGH**	On-going	Special Improvement District	Ivines	$15,000	Ivins City	Construct settling ponds off of Center Street, increase the size of boxes, and divert water along the street through construction of curb and gutter.
	Objective: Preventing flooding in area near 200 West and 100 North.	**Problem Identification:** Area around 200 West and 100 North subject to flooding from storm runoff.						
	Action: Upgrade and expand storm drain system. Keep said systems clear and clean.	**HIGH**	Ongoing	Local governments	LaVerkin	To be determined	LaVerkin City	Upgrading and expanding the storm drain system and ensuring it is kept clear will eliminate flooding to the homes in the area.
	Objective: Reduce flooding threat in portions of New Harmony.	**Problem Identification:** Flooding in the Prince Subdivision is a problem.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Acquire a sandbagging machine along with empty bags and sand.	**HIGH**	Immediate	Local governments	New Harmony	$1,500-$2,000	Residents, Boy Scouts, Other volunteers	Flooding has been a problem in the Prince Subdivision since the subdivision was developed prior to New Harmony adopting a Subdivision Ordinance and Zoning Ordinance. Other developed areas in town are also subject to occasional flooding. Having ability to fill sandbags will provide short-term solution to preventing damage to residences.
	Objective: Reduce flooding threat in New Harmony.	**Problem Identification:** Flooding throughout town caused by clogged channels and bridge openings in town.						
	Action: Maintain channel and bridge openings in town.	**HIGH**	Ongoing	Local governments	New Harmony	Unknown, Minimal to moderate	Residents	If the drainages in and around the Town are kept clear on an ongoing basis the likelihood of flooding is diminished.
	Objective: Reduce flooding threat in New Harmony.	**Problem Identification:** Specific flooding threats throughout town have not been quantified and thoroughly studied by a qualified engineering professional.						
	Action: Commission an engineering study to determine the feasibility of implementing flood and drainage control measures for the town of New Harmony.	**HIGH**	6 months to 1 year	Local and grant funds (unknown source)	New Harmony	Approximately $15,000 (local $1,000; grant $14,000)	Town staff and Consulting Engineer	Project will include floodplain mapping and study to determine specific flood threats in town.
	Objective: Reduce flooding threat in New Harmony.	**Problem Identification:** Problems quantified in engineering studies need to be implemented to alleviate flooding problems in town.						
	Action: Implement flood control project(s) identified by consulting engineer to reduce flooding in town.	**HIGH**	1-1 ½ years	Grant from unknown source	New Harmony	$70,000-$100,000	Contractor	Specific flood control projects will not be able to be identified until engineering studies determine what needs to be done.
	Objective: Reduce flooding threat in Rockville.	**Problem Identification:** While the Virgin River poses a potential flood threat to the community, the drainage ditches from the tops of the surrounding plateaus represent a real flood hazard.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Keep ditches clean.	**HIGH**	Immediate and ongoing	Local governments	Rockville	Minimal	Town personnel, residents	Not much can be done by the community to lessen the threat of the Virgin River, but the town can ensure that the ditches in town are kept free from obstructions.
	Objective: Reduce flooding threat in St. George.	**Problem Identification:** Heavy rains in the City limits along the drainages can cause problems by damaging homes and property by overflowing of the Santa Clara and Virgin Rivers.						
	Action: Clear debris and other material from riverbeds.	**HIGH**	Within 2 years	None	St. George	Use volunteer groups or persons performing mandated civic time.	City personnel, volunteers	Homeowners and other small groups can be responsible for areas near their homes.
	Objective: Reduce flooding threat in St. George.	**Problem Identification:** The Santa Clara River and Virgin River cannot carry capacity due to silt build up.						
	Action: Dredge out river bottoms.	**HIGH**	5 years	Federal government	St. George	Unknown	U.S. Army Corps of Engineers	Dredge these two river channels. The Army Corps of Engineers has worked on the Fort Pierce River (Wash) in the past.
	Objective: Improve drainage conditions along Pecan Drive in Toquerville.	**Problem Identification:** There are drainage problems along Pecan Drive.						
	Action: Install curb and gutter on Pecan Street.	**HIGH**	3 months	Class C road funds and general funds	Toquerville	$60,000	City Staff, contractor	Improving Pecan Street will control water flow and protect residences.
	Objective: Improve drainage along S.R 17 in Toquerville.	**Problem Identification:** There are drainage problems along Pecan Drive.						
	Action: Install additional drain pipe.	**MED**	3 months	Class C road funds and general funds	Toquerville	$60,000	City Staff, contractor	Some work has been done by Toquerville City. Additional issues need to be addressed.
	Objective: Resolving drainage issues in Chola Creek Subdivision.	**Problem Identification:** There are drainage problems in the Chola Creek Subdivision.						
	Action: Implement the drainage work needed in the subdivision.	**MED**	Immediate	Private developer	Toquerville	Unknown	Private developer	Toquerville City is currently working with the land owner regarding drainage situation in the subdivision.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Reduce flooding threat in portions of the town of Virgin.	**Problem Identification:** The sites identified for greatest risk is the property located at the 101 Rancho area, the Zion River RV Park, the North Creek area, and other property along the Virgin River flow.						
	Action: Clear debris and other material from waterways.	**HIGH**	Ongoing	Local government and possible grants	Virgin	To be determined.	Virgin town and any other professional assistance needed.	Keeping the waterways clear of sludge buildup will help protect portions of the town from flooding.
	Objective: Reduce potential flood risks.	**Problem Identification:** Property owners/developers wanting to develop within flood plains of the Virgin River, Mill Creek, and along storm washes.						
	Action: Update FEMA Flood Insurance Rate Maps.	**HIGH**	5 years	Grants	Washington City	$50,000	FEMA	FEMA flood maps are inaccurate and out of date. The City is experiencing development pressures along the floodplains. Funding of this activity would be positively pursued if grants are received. Otherwise may be cost prohibitive to update maps all at once.
	Action: Require Letter of Map Amendment (LOMA)/Letter of Map Revision (LOMR) for suspected inaccurate floodplains prior to development design.	**HIGH**	On-going	Developers	Washington City	Case by case	Developer's consulting engineers with review by FEMA and Washington City Community Development Department.	Allow developers to submit LOMAs/LOMRs to FEMA for approval for a more accurate delineation of floodplain and their design development. Property owners and developers may feel that this requirement for LOMAs/LOMRs may be too restrictive.
	Action: Do not allow development in the Virgin River and Mill Creek floodplains	**HIGH**	On-going	N/A	Washington City	N/A	Washington City Community Development Department	Do not allow major development in the Virgin River and Mill Creek floodplains, other than open space and recreational uses and possible floodplain stabilization.
Earthquake	**Objective:** Provide for emergency response and relief	**Problem Identification:** Transportation and utilities services could be severely impacted.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Identify and maintain critical transportation and utility services	**HIGH**	ongoing	Local governments and possible grants	La Verkin	Unknown-Determined by the extent of damage anticipated.	City staff.	Critical transportation systems need to be maintained.
	Objective: Raise awareness of problems that could occur as a result of an earthquake.	**Problem Identification:** Rockville is surrounded by rocky slopes and the Virgin River runs through the town. There is a high probability of rockfall caused by seismic events and possible liquefaction along the river areas.						
	Action: Maintain adherence to Land Use codes and restrictions to building in sensitive areas.	**HIGH**	Immediate and ongoing	Not applicable	Rockville	Not applicable	Town staff.	Some of the problems identified include falling rocks, diversion of the Virgin River due to landslides.
	Objective: Reduce threat to public safety during an earthquake.	**Problem Identification:** Damage to structures and utilities are likely during a seismic event.						
	Action: Retrofit inadequate construction.	**HIGH**	10 years+	Private	St. George	Extreme	City Inspection Department, City Engineering Department, Private Engineers.	Old and inadequate construction, buildings with un-reinforced masonry to be mitigated.
	Objective: Educate community on earthquake damage prevention practices	**Problem Identification:** Lack of public awareness about earthquake damage prevention practices.						
	Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness.	**HIGH**	1 year+	None Identified	St. George	$50,000	Fire Department, Inspection Department	Having a community with residents educated on earthquake damage prevention practices will ensure greater safety of City residents.
	Action: Educate the public on damage prevention practices for earthquakes	**HIGH**	2 years	Grants from state and Federal governments	St. George	$50,000-$75,000	Emergency Management and volunteers	Starting up a C.E.R.T. program in the St. George City area. Earthquakes are taught as being the biggest hazard facing those in the area. Teaching the C.E.R.T. class should get the message out to residents.
	Objective: Map all earthquake faults in Washington City and groundshaking hazard areas	**Problem Identification:** There are unmapped earthquake faults and ground shaking hazard areas.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Create a Geologic Hazards Map showing earthquake faults and groundshaking hazard areas.	**HIGH**	6 months – 1 year	City General Fund	Washington City	$5,000	Consultants, Washington City Public Works and Community Development Depts.	Not all earthquake faults within the city have been mapped. For public safety, need to map faults and areas that could be impacted with rockfall, etc. due to groundshaking. The map will be a guide for siting homes and buildings
Drought	**Objective R9.1** Conserve culinary water	**Problem Identification:** Cyclical periods of drought place a strain on community culinary water resources.						
	Action: Educate the public on the need to be water wise	**HIGH**	Ongoing	City funds	Enterprise	Minimal	Water purveyor and newsletter editor	Use a newsletter to educate the public
	Action: Maintain and enforce rate policies that encourage water conservation	**HIGH**	Ongoing	City funds	Enterprise	Minimal	Water purveyor and newsletter editor	The City should continue to maintain and implement a tiered water rate structure.
	Objective: Meet current and future water needs of community	**Problem Identification:** Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.						
	Action: Develop additional source and storage as well as implementing conservation plans	**HIGH**	Ongoing	City funds, State and Federal Government loans and/or grants	Hurricane	To be determined	Hurricane City Staff, Professional Services, Contractors	Hurricane is in a desert climate and has experienced several years of drought conditions. To meet the needs of the community's residential and business water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.
	Objective: Meet current and future water needs of community	**Problem Identification:** Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Develop additional source and storage as well as provide ongoing plans and education.	**HIGH**	Ongoing	City funds and possible grants	LaVerkin	To be determined	Water and Public Works Departments	LaVerkin has experienced several years of drought conditions. Source supply and storage need to keep pace with population growth. An education program needs to be implemented to educate water users on methods to conserve available water resources.
	Objective: Conserve irrigation water by improving the area of irrigation water delivery and efficiency.	**Problem Identification:** Currently the Rockville Ditch and Pipeline Companies provide water to most areas of town. Because of its design, the system is not as efficient as it could be.						
	Action: Determine how the irrigation delivery system could be improved to provide comprehensive service as well as more efficient means of delivery.	**HIGH**	Ongoing	Private irrigation companies	Rockville	To be determined	Irrigation water purveyor	Rockville has experienced several years of drought conditions. The distribution of irrigation water in Rockville is by a combination or open ditches and non pressurized pipe. Not all properties in town can utilize this. A pressurized system is a consideration, however the cost of such a system may be high.
	Objective: Conserve culinary water through education and continued water conservation policies.	**Problem Identification:** Currently the Rockville Ditch and Pipeline Companies provide water to most areas of town. Because of its design, the system is not as efficient as it could be.						
	Action: Continue the practice of providing written educational materials with water bills and educational materials at the post Office/Community Center, etc	**HIGH**	Ongoing	Private irrigation companies	Rockville	To be determined	Irrigation water purveyor	A continued program of providing education on methods of water conservation will help ensure adequate supply of culinary water.
	Objective: Excessive water used for landscaping	**Problem Identification:** Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources.						
	Action: Develop and enforce policies to limit the amount of area that can be used as water requiring landscape.	**HIGH**	Ongoing	None	St. George	To be determined	City Planning Staff	St. George City removed water-requiring landscape from around the City office building and replaced it with water conserving desert landscape. This should be encouraged throughout the city where appropriate.

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Objective: Reduce use of culinary water	**Problem Identification:** Limited water supplies during the extended years of drought have placed a strain on availability of community culinary water resources.						
	Action: Continue to enforce policies to reduce water usage.	**HIGH**	Ongoing	None	Toquerville	None	City staff	In 2003, Toquerville implemented a mandatory even/odd day watering schedule between June 1st and October 31st .
	Objective: Conserve water resources.	**Problem Identification:** Community is suffering, as is all of southwestern Utah through and extended, severe drought.						
	Action: Enforce existing City water conservation ordinance.	**HIGH**	On-going	N/A	Washington City	N/A	Washington City Public Works Department	The City has already adopted a water conservation ordinance.
	Action: Adopt a time-of-day outdoor watering ordinance.	**HIGH**	Spring 2004	N/A	Washington City	N/A	Washington City Public Works Department	The existing water conservation ordinance does not include provisions for designated times in which outdoor watering should take place
	Action: Create new water sources.	**HIGH**	20 years	Bonding/City	Washington City	$1,000,000 or more	Washington City Public Works Department/Consultants	The City needs to identify new water resources for its increasing population and to better plan for future periods of drought. Difficulties may be that some citizens do not approve of the City committing to additional bonding.
Problem Soil	**Objective:** Lessen the risk to buildings from collapsible soils	**Problem Identification:** South Fields area has collapsible soils.						
	Action: Require soils testing prior to building and following engineer's requirements	**HIGH**	Ongoing	Local Government and possible grants	Hurricane	To be determined	Building Department, City Engineer, Public Works	The South Fields area of the community is located on a dry lake bed. Sink holes have developed in areas where no testing and mitigation has been completed.
	Objective: Lessen the risk to buildings from problem soils	**Problem Identification:** The Rockville Sensitive Lands Overlay Map has identified problem areas such as slopes, flood plains and wetlands.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Restrict building in areas identified as having problem soils	**HIGH**	Ongoing	Town funds	Rockville	Minimal	Town, Engineering Consultant	The overlay map identifies likely problem areas. Site-specific studies would identify risks and issues specific to a given parcel.
	Action: Maintain land use code chapters dealing with sensitive lands	**HIGH**	Ongoing	Town funds	Rockville	Minimal	Town, Engineering Consultant	The town has codes on the books. These need to be enforced and amended as needed.
	Objective: Reduce potential building foundation settling risks.	**Problem Identification:** Expansive soils are found throughout the City.						
	Action: Enforce existing City ordinances requiring geotechnical studies and require recommended mitigation measures from studies.	**HIGH**	On-going	Developers	Washington City	Case by case	Developer's consultant's with review by Washington City Public Works and Community Development departments.	All developments require geotechnical studies to ensure stable foundations for buildings. There are many areas of expansive soils throughout the City.
Severe Weather	**Objective:** Reduce damage to structures through strict adherence to building codes	**Problem Identification:** Enterprise experiences occasional, damaging high winds.						
	Action: Ensure that 80 MPH wind load requirement is met by builders	**HIGH**	Ongoing	Building permit fees	Enterpirse	Minimal	Building Inspector	Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events
	Objective: Reduce service disruptions and damage to power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						
	Action: Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.	**HIGH**	Ongoing	Hurricane City Power, Possible Grants	Hurricane	To be determined	Hurricane City Power, 138 Task Force	Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.
	Objective: Provide adequate clearances for power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Conduct regular line maintenance.	**HIGH**	Ongoing	Local government and possible grants	LaVerkin	To be determined	Water and Public Works Departments	Occasional severe seasonal winds pose risk of damage to power poles and transmission lines by high winds.
	Objective: Reduce structural damage from windstorms, occasional hailstorms.	**Problem Identification:** Periodic severe thunderstorms and occasional periods of rain over several days cause flooding. Severe windstorms and occasional hailstorms cause structural damage.						
	Action: Assure adherence to building codes.	**HIGH**	Ongoing	Building Permit Fees	New Harmony	Minimal, by builder	County Building Department	Due to its geographic location the town is subject to occasional severe windstorms and thunderstorm activity with associated hail.
	Objective: Improve electrical power system reliability by reducing risk from damage by trees falling in windstorms.	**Problem Identification:** Strong winds can cause trees to fall on power lines, causing power outages						
	Action: Prune trees back from power lines.	**HIGH**	3 year plan	City Power Department	St. George	Not determined, minimal to moderate	City Power Department	Due to its geographic location the town is subject to occasional severe windstorms and thunderstorm activity with associated hail.
	Objective: Improved public awareness about flood hazards in the community.	**Problem Identification:** Occasional heavy rains bring problems with flooding						
	Action: Prepare educational materials and presentations about “100 year flood events” that occur in the area. Distribute this information and/or conduct educational programs for the public.	**MED**	2 years	City/FEMA/Army Corps of Engineers	St. George	Minimal	Can be done through the CERT program	Most people are not aware of what the term “100 year flood event” or building in a100 year flood zone really means.
	Objective: Reduce service disruptions and damage to power lines	**Problem Identification:** Power lines are at risk from seasonal high winds.						
	Action: Ensure that adequate clearance for power lines is provided and conduct ongoing line maintenance through Utah Power.	**HIGH**	Ongoing	Commercial power provider	Virgin	To be determined	Utah Power employees	Occasional strong winds have caused utilities disruption due to damage to power poles and transmission lines by high winds.
Insect Infestations	**Objective:** Reduce the impact of insects	**Problem Identification:** South and west sides of the City are occasionally vulnerable to Mormon Cricket and Cutworm infestations as well as some mosquito problems.						

WASHINGTON COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	Action: Spread insect bait and spray for mosquitoes	**HIGH**	When required	City and County funds. Mosquito abatement funds come from property tax.	Enterprise	Approximatel y $3.00 per property owner per month	County Mosquito Abatement District	
	Objective: Reduce the severity of infestations	**Problem Identification:** Periodic Grasshopper infestations more sever on edge of developed town area and in field surrounding town.						
	Action: Conduct aerial spraying to reduce infestations	**HIGH**	As infestations occur	By private individuals in most cases	New Harmony	Varies, depending on acreage treated	Contractor	New Harmony is surrounded by many agricultural fields. These have been subjected to insect infestation especially during the recent years of drought.

WAYNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Flood	Span culinary water lines over Sand Creek to avoid flood damage to lines.	Medium	Torrey Town, Wayne County EM	Town, County, State, Federal	Torrey Town, Wayne County	Unknown	Depends on Funding	Decreased risk of damage to culinary water lines due to flooding.
Flood	Construct culverts to prevent washing out north of Bicknell.	Medium	Bicknell Town, Wayne County EM	Town, County, State, Federal	Bicknell Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install larger pipe on Bull Creek in Hanksville Town.	Medium	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade flood dyke that drains into Bull Creek.	High	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Improve drainage system to prevent flooding in Hanksville Town.	Medium	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct new reservoir to prevent flooding in Lyman Town.	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Improve High Line Ditch to increase its flood capacity	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	$300,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct a mile long deflector levee.	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	$300,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.

WAYNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.

WAYNE COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Project**	**Priority**	**Responsible Agency**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Estimated Completion Date**	**Benefits**
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

WEBER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
Earthquake	**OBJECTIVE:** Reduce the impact of non-structural events following an earthquake	**PROBLEM IDENTIFICATION:** Non-structural hazards in the Weber County schools are a threat to students, facility, and employees and cause an increase in recovery activities following an earthquake.						
	ACTION: Develop and implement a manual similar to Salt Lake City school districts.	HIGH	Immediate	School Districts, State Earthquake Program Grant School Districts, County Emergency Management	Countywide	Minimal if using SLC School District template	School District	Train and exercise local school districts on the non-structural methods identified in the document.
	ACTION: Develop a training document for schoolteachers showing non-structural mitigation activities for classrooms.	HIGH	Ongoing	County Emergency Services, State Earthquake Program County Emergency Services, School District	Countywide	Minimal	School District, Emergency Management	Show methods, techniques, and equipment and associated costs for non-structural mitigation in the classroom.
	OBJECTIVE: Reduce the impact of non-structural events following an earthquake.	**PROBLEM IDENTIFICATION:** Critical facilities (public safety, utilities, water/waster water/sewer, schools, hospitals), need to be made less vulnerable from the impacts of earthquakes to allow to a more timely and efficient response and recovery.						
	ACTION: Develop an earthquake vulnerability study for identified critical facilities.	HIGH	Ongoing	County Emergency Services, (FEMA Grants)	Countywide	Unknown and dependent on scope of project.	County Emergency Services and other County/City Agencies	Identify critical infrastructure and rank accordingly to assist in upgrades to facilities.
	OBJECTIVE: Increased awareness of high liquefaction areas	**PROBLEM IDENTIFICATION:** Areas of high liquefaction (western Weber county: Hooper, Far West, West Warren, West Haven, Marriott-Slaterville, Plain City) are experiencing increased growth.						
	ACTION: Include current liquefaction maps on the County website.	HIGH	Within the year	County Emergency Services and County Engineer	Countywide	Minimal	County Emergency Services, County Engineer, GIS and Web	Public information on hazard and risk.

WEBER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Promote natural hazards ordinance limiting development in high-risk areas.	**PROBLEM IDENTIFICATION:** Development on identified fault traces increase the risk to life and property.						
	ACTION: Make available copy of county natural hazards ordinance for cities within the county.	HIGH	Within the year	County Emergency Services and County Engineer	Countywide	Minimal	County Emergency Services and County Engineer	Weber County has a Natural Hazard Ordinance to address development in high-risk areas. Cities within the County should be made aware of this Ordinance and hopefully implement the same regulatory ordinance in their community.
Flood	**OBJECTIVE:** Have federal flood insurance available within communities and adopt flood loss prevention ordinances.	**PROBLEM IDENTIFICATION:** Communities not involved in the NFIP.						
	ACTION: Encourage the communities of Washington terrace and Huntsville to participate in the NFIP.	MED	Ongoing	None Required	Countywide	None Required	State Floodplain Manager, City Officials, Building Officials	This will make FEMA review and identify flood hazards in the area and will allow for a more accurate flood risk assessment. It will also allow citizens to buy federal flood insurance.
	OBJECTIVE: Implement and fund identified stormwater projects to lessen impact of flooding in the county.	**PROBLEM IDENTIFICATION:** Stormwater issues continue to be a critical flood issue in the county.						
	ACTION: Include current stormwater plans and projects in hazard mitigation plan.	MED	Ongoing	Project specific, funding from County, Stormwater, State and Federal Programs.	Countywide	Minimal	County Stormwater, County Engineer	Weber County's Stormwater Program is actively involved and promotes sound land use planning and flood loss reduction activities. The long-term plan and identified projects will help alleviate flooding in the County and Cities within County. The County Master Plan has identified areas of concern and the "Regional Storm Water Management Plan" has addressed those areas with a detailed list of projects.
	OBJECTIVE: Evaluate canals in the county that may cause flooding.	**PROBLEM IDENTIFICATION:** Weber County has an extensive canal system and canal breach or overtopping has and will continue to create a significant flood threat.						

WEBER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Identify canals in the county that have the potential to cause damage due to flooding.	LOW	Two years	County Emergency Management, State Mitigation Program Grant	Countywide	Depends on scope of study	County Stormwater, County Engineer, County Emergency Services, State Hazard Mitigation Planner	City of Riverdale experienced a significant flood event from a canal breach. Other private canals may also be of concerns.
Severe Weather	**OBJECTIVE:** Reduce impact to life and property from severe weather related incidents	**PROBLEM IDENTIFICATION:** Most disaster declarations are generated from weather related incidents. Weber County continues to be impacted by snowstorms, hail, thunderstorms/lightning, tornados, heavy rain, and avalanche.						
	ACTION: Establish and support countywide National Weather Service Storm Ready program.	MED	Two years	County Emergency Management	Countywide	Minimal, some cost for weather radios	County Emergency Management, SLC NWS	This is a proactive public information program that allows communities to be recognized for many weather related activities they are already doing.
	ACTION 2: Identify areas of avalanche risk and develop and post signs for avalanche danger	LOW	Ongoing	County Emergency Management, County and City Planners, County and City Engineers, Road Dept/Public Works	Countywide	Minimal, for signs and placement of signs.	County/City Engineers and Road Dept./Public Works	Avalanche danger in areas of North Ogden Divide and in the Ogden Valley will continue to threaten lives and property as people move and travel into areas of risk.
Wildfire	**OBJECTIVE:** Reduce impact to life and property from urban interface wildland areas	**PROBLEM IDENTIFICATION:** Urban interface wildland fire continues to be of concern in areas of Uintah Highlands, Wolf Creek, North Ogden, and other areas of the Ogden Valley.						

WEBER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	ACTION: Develop and implement a strong land use ordinance that addresses fuel reduction in areas at risk from fire.	HIGH	Ongoing	County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials	Countywide	Minimal - Time and involvement.	County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
	ACTION: Have communities participate in the Fire Wise Community programs.	HIGH	Ongoing	Forestry Fire and State Lands, US Forest Service	Countywide	Minimal - Time and involvement.	Contractors, County and City Fire, Local participation	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
Dam Failure	**OBJECTIVE:** Reduce the impact of catastrophic flooding due to dam failure	**PROBLEM IDENTIFICATION:** Dam failure from federal, state and private dams can impact Weber County. Debris basin type dams are of concern at Birch Creek, Glassman Way, and on Harrison Blvd.						
	ACTION: Re-evaluate current high hazard dams and evaluate use of early warning sirens to warn public.	MED	Ongoing	Local and State	Countywide	Unknown	County Emergency management	A catastrophic dam failure can impact a significant population in the County. Evaluating the risk and vulnerability will allow for a more efficient emergency response.
	ACTION 2: Identify and then fund dams needing armored concrete chutes.	MED	Unknown and based on funding	Local and State	Countywide	Unknown	Stormwater Management, County Engineer, State Engineer	A catastrophic dam failure can impact a significant population in the County. Armored concrete chutes are an approved structural mitigation measure.
Landslides	**OBJECTIVE:** Re-evaluate current landslide map	**PROBLEM IDENTIFICATION:** Weber County has significant areas of landslides.						
	ACTION: Update current landslide map and supporting data	LOW	Unknown and based on funding	Local and State	Countywide	Unknown	County and City Engineering	Current landslide maps include data that does not necessarily reflect areas at risk.

WEBER COUNTY NATURAL HAZARD MITIGATION PROJECTS								
Hazard	**Objective/Project**	**Priority**	**Time Frame**	**Possible Funding Sources**	**Jurisdiction Affected**	**Estimated Project Cost**	**Responsible Agency**	**Background**
	OBJECTIVE: Monitor landslide movement in areas that impact infrastructure and population.							
	ACTION: Evaluate landslide areas where parameters can be used	LOW	Unknown and based on funding	Local and State	Countywide	Unknown	County and City Engineering, UGS	Area of Bear Hollow and the mouth of Weber Canyon have active landslides and can impact roads and population.

Menu of Mitigation Strategies

Flood

Prevention

- ♦Planning and zoning
- ♦Floodplain open space preservation
- ♦Building construction regulations
- ♦Regulation of other facilities (critical)
- ♦Stormwater management

Property Protection

- ♦Relocation
- ♦Acquistion
- ♦Building elevation
- ♦Floodproofing
- ♦Lifeline protection
- ♦Flood insurance

Natural Resource Protection

- ♦Wetlands protection
- ♦Erosion and sediment control

Emergency Services

- ♦Flood threat recognition
- ♦Warning dissemination
- ♦Flood response
- ♦Critical facilities protection
- ♦Health and safety maintenance

Post-disaster recovery and mitigation

Structural Projects

- ♦Reserviors/impoundments
- ♦Levees
- ♦Diversions
- ♦Channel and drainage modifications
- ♦Channel and basin maintenance

Earthquake

Prevention

- ♦Planning and zoning
- ♦Building construction regulations
- ♦Regulation of other facilities (critical)

Property protection

- ♦Non-structural methods
- ♦Retrofit upgrades
- ♦Earthquake insurance

Natural Resource Protection

- ♦Identified fault rupture zones
- ♦Identified secondary impact

Emergency Services

- ♦Earthquake threat recognition
- ♦Emergency planning for secondary impact
- ♦Emergency response (mutual aid, CERT)
- ♦Critical facilities protection
- ♦Health and safety maintenance
- ♦Post-disaster recovery and mitigation

Structural Projects

- ♦Rebuild or retrofit critical facilities higher seismic code
- ♦Rebuild or retrofit infrastructure higher seismic code

Flood (continued)

Public Information

- ♦Flood hazard maps
- ♦Map information
- ♦Outreach projects
- ♦Real estate disclosure
- ♦Library
- ♦Technical Assistance
- ♦Environmental education

Dam Failure

Prevention

- ♦Dam failure inundation maps
- ♦Planning, zoning, open space preservation in risk area
- ♦Building codes with elevation based on dam failure
- ♦Dam safety inspections
- ♦Rigorous dam maintenance schedule
- ♦Draining dam when conditions are unsafe

Property Protection

- ♦Acquisition of structures in inundation path
- ♦Flood Insurance

Earthquake (continued)

Public Information

- ♦Seismic maps; liquefaction, faults, zones
- ♦Map information
- ♦Outreach projects
- ♦Real estate disclosure
- ♦Library
- ♦Technical Assistance
- ♦Education

Wildfire

Prevention

- ♦Zoning ordinances to reflect fire risk zones
- ♦Restrict development areas near fire protection and water resources
- ♦Planning to include: spacing of buildings, firebreaks, on-site water storage, wide roads, multiple accesses
- ♦Code standards for roof materials and fire protection systems
- ♦Maintenance programs to clear dead and dry bush
- ♦Regulations on open fires
- ♦Open space around structures

Property Protection

- ♦Retrofitting roofs, add spark arrestors
- ♦Create and maintain defensible space
- ♦Insurance
- ♦Eliminate ladder fuels

Dam Failure (continued)

Natural Resource Protection

- ♦Prohibit development in high-risk areas

Emergency Services

- ♦Monitor condition dam
- ♦Warning and evacuation plans based on dam failure
- ♦Develop and conduct dam failure emergency exercise

Structural Projects

- ♦Dam improvements, spillway enlargements
- ♦Remove unsafe dams

Public Information

- ♦Develop outreach materials on dams, dam failure and community emergency plan for dam failure

Wildfire (continued)

Property Protection (continued)

- ♦Install sprinkling systems
- ♦Develop fire resistant plans
- ♦Have home addresses displayed
- ♦Clean out rain gutter

Natural Resource Protection

- ♦Prohibit development in high-risk areas
- ♦Understand impact of non-native vegetation
- ♦Promote tread soft ATV use
- ♦Develop watershed management plan
- ♦Maintain watershed
- ♦Establish and promote fuel reduction

Emergency Services

- ♦Mutual aid agreements for fire fighting
- ♦Participate in State Wildfire Suppression Fund
- ♦Develop and exercise local wildfire response plan and evacuation plans

Structural Projects

- ♦Construct wildfire fuel breaks
- ♦Install heliport water stations
- ♦Tree and underbrush thinning in critical areas
- ♦Increase number of fire hydrants
- ♦Install water tanks

Public Information

- ♦Develop maps for wildfire hazard areas
- ♦Wildfire information mailout to high risk residents
- ♦Develop urban wildfire “how to protect your home from wildfires” book
- ♦Newspaper article on wild fires

Dam Failure (continued)

Landslides

Prevention

- ♦Monitor and evaluate areas after wildfire
- ♦Install ground monitoring instruments on landslides for movement
- ♦Restrict development in landslide-prone areas
- ♦Establish codes (grading, construction, excavation), in landslide-prone areas

Property Protection

- ♦Control and monitor surface and groundwater drainage
- ♦Control building in areas of landslides
- ♦Evaluate property maintenance in areas of landslides (over watering)

Natural Resource Protection

- ♦Complete a watershed management plan
- ♦Limit us of ATVs in areas of landslides to manage erosion
- ♦Evaluate impact of wildfire in areas of landslides
- ♦Restrict development in landslide-prone areas
- ♦Maintain natural vegetation

Emergency Services

- ♦Monitor and warning systems
- ♦Evacuation plans and exercises

Wildfire (continued)

Public Information (continued)

- ♦Presentation on wildfires at community meetings
- ♦Develop wildfire displays for display in public building
- ♦Real estate disclosure of high hazard wild fire area

Severe Weather

Prevention

- ♦Early warning and notification systems
- ♦Building codes to address wind and snow load
- ♦Properly ground structures for lightning
- ♦Public education for severe weather conditions
- ♦Restrict development in areas of avalanche

Property Protection

- ♦Structural tie down of roofs for high winds
- ♦Restrict development in areas of avalanche
- ♦Monitor NWS weather warnings and watches

Natural Resource Protection

- ♦Evaluate impact of severe weather
- ♦Restrict development in areas of avalanche

Emergency Services

- ♦Monitor NWS weather warnings and watches
- ♦Develop plans and exercises for severe weather related incidents

Landslides (continued)

Structural Projects (continued

- Build buttress, retaining walls other engineered structures
- Install subsurface drainage materials
- Remove landslide materials

Public Information

- Updated maps of landslide areas
- Real estate disclosure
- Develop outreach material (newsletters, articles, displays)
- Notice to homeowners in landslide areas detailing hazard

Drought

Prevention

- Establish economic incentives for water conservation
- Encourage water conservation
- Develop early warning system, monitoring
- Implement water metering and leak detection programs
- Develop early warning system, monitoring program

Property Protection

- Evaluate potential for wildfire due to drought
- Identify secondary affects from drought

Natural Resource Protection

- Legislation to protect stream flows
- Protect water aquifers

Emergency Services

- Alert procedures for water quality issues
- Create inventory of pumps, filters, other equipment

Severe Weather (continued)

Structural Projects (continued)

- Install sheds over roads below avalanche terrain
- Install drift fences along snow drift areas
- Install avalanche fencing along ridgelines for
- Wind blown snow

Public Information

- Develop outreach document on avalanche safety
- Become and NWS Storm Ready Community
- Promote lightning safety week
- Develop cold weather safety materials

Problem Soils

Prevention

- Planning and zoning restrictions and regulations
- Open space
- Building codes
- Drain system maintenance

Property Protection

- Insurance
- Remove soil
- Ensure rain gutters extend away for structures

Natural Resource Protection

- Leave area as open space

Emergency Services

- Identify structures impacted by problem soils

Drought (continued)

Emergency Services (continued)

- ♦Establish water hauling program
- ♦List livestock watering locations
- ♦Establish hay hotline
- ♦Fund water system improvements (wells, systems)
- ♦Lower well intakes
- ♦Develop drought contingency plan
- ♦Issue emergency permits for water use

Structural Projects

- ♦Redesign or create new reservoir storage
- ♦Provide pumps and piping for distribution

Public Information

- ♦Develop drought education material
- ♦Water conservation outreach material
- ♦Other outreach for awareness

Problem Soils (continued)

Emergency Services (continued)

Structural Projects

- ♦Presoak and/or compact soils
- ♦Install drain fields
- ♦Bring in fill
- ♦Remove soils
- ♦Bring in fill

Public Information

- ♦Develop information on problem soils
- ♦Outreach materials on problem soil mitigation

A STRATEGIC PLAN FOR EARTHQUAKE SAFETY IN UTAH

UTAH SEISMIC SAFETY COMMISSION

January 1995

PREFACE

This document is the result of many stages of planning and review, first by the Utah Earthquake Advisory Board and its four standing committees, and then by the Utah Seismic Safety Commission (USSC). The USSC was created in July 1994 by Utah House Bill 358 and was mandated to produce this document for the 1995 Utah Legislature. A draft of the document was completed in August 1994 and sent out for public comment during September 1994. Comments were solicited from state and federal government agencies, professional societies, the Utah League of Cities and Towns, the Utah Association of Counties, interested private individuals, and all groups listed as "responsible agencies" in the document. Written comments were received, carefully considered, and incorporated as feasible into this final report.

A Strategic Plan for Earthquake Safety in Utah emphatically is only a beginning, both in detail and in action. Implementing the strategic plan will be an evolutionary process that will adjust to changing priorities, new information, and broader community involvement. Utah has already made many significant steps toward earthquake safety and preparedness, but there is a long way to go. This document identifies needs and creates a framework to coordinate efforts and monitor progress. Hopefully we can use what was learned in the January 1994 Northridge, California, earthquake and other recent seismic disasters to prepare Utah before a large earthquake strikes here.

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EXECUTIVE SUMMARY

♦ *Introduction*

The mission of the Utah Seismic Safety Commission (USSC), building on work of its predecessor, the Utah Earthquake Advisory Board (UEAB), is to develop a strategic plan for earthquake safety in order to save lives, prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes. This document was developed through a review and planning process undertaken by the UEAB and contains a list of recommended "strategies" to reduce losses from earthquakes. The document has been completed and adopted by the Utah Seismic Safety Commission as a strategic plan for presentation to the 1995 Utah Legislature.

The main points this document attempts to make are the following:

1. There is a real and serious danger of both life-threatening and damaging earthquakes in Utah in our lifetimes.

2. We as individuals and collectively can take significant actions now to reduce the loss of life, property damage, and long-term economic impact in the future.

3. Implementing an earthquake-safety plan for Utah is a long-term process.

4. Strategies to safeguard lives and property from earthquakes must be sensitive to financial and regulatory burdens. Many actions can be taken now without great expense that will make Utah safer tomorrow.

We believe government has a fundamental responsibility to protect the health, safety, and welfare of its citizens. With respect to earthquake safety, this involves five basic actions: (1) improving our geotechnical understanding of earthquakes and earthquake hazards, (2) improving development and construction practices, (3) educating the public, (4) disaster-response planning, and (5) post-earthquake recovery planning. These actions and the recommended strategies in this document are consistent with Governor Leavitt's Key Objectives and with the Utah Legislature's strategic plan, *Utah Tomorrow*. The individual strategies have been placed in a format consistent with state planning guidelines.

Efforts to promote public policy for earthquake safety in Utah began nearly two decades ago with the Utah Seismic Safety Advisory Council (1977-1981), followed by the Earthquake Task Force of the Utah Advisory Council on Intergovernmental Affairs (1989-1991) and later the UEAB (1991-1994). Responsibility has now passed to the USSC.

♦ *The Earthquake Threat in Utah*

Utah has experienced damaging earthquakes in the past, and geologic evidence indicates that earthquakes larger than any experienced locally in historical time are likely in the future. Large earthquakes are possible anywhere in Utah, but they are most likely in a "seismic belt" about 100 miles wide extending north-south along the Wasatch Front and through Richfield to Cedar City and St. George.

Earthquakes produce a variety of geologic hazards that threaten life and property. These hazards include ground shaking, surface fault rupture, regional subsidence, liquefaction and related ground failure, landslides, rock falls, and various types of flooding. Earthquake hazards are greatest in the Wasatch Front area because of the greater earthquake probability and because of extensive areas where geologic conditions pose the potential for damaging, earthquake-induced effects. The probability of large earthquakes appears to be slightly lower in southwestern Utah, and geologic conditions there are not as prone to aggravate earthquake effects. In general, earthquake probabilities and hazards are lower in eastern and western Utah outside the main seismic belt.

We must prepare for earthquakes because: (1) Utah is a seismically active region, (2) our population is concentrated in the areas of greatest hazard, and (3) many of our older buildings and lifelines have low earthquake resistance. We have been lucky so far to experience only moderate-sized earthquakes, of which the majority have originated in areas of low population; we cannot expect this luck to last.

♦ *Strategies for Earthquake Safety*

The following pages list the main objectives and strategies for earthquake safety. The list of strategies, which is not in order of priority, is not intended to be exhaustive. Work will continue to develop consensus and to set priorities for action. Also listed in the following pages are the planned outputs (for example, products, plans, and assessments) and desired outcomes, in terms of increased earthquake safety, for each strategy.

Summary of Strategies

Objective 1: Increase earthquake awareness and education.		
Strategy	**Output**	**Outcome**
1.1 Inform citizens about earthquake hazards and risks.	Information and training targeted to meet individual or collective needs.	All citizens are better able to prepare for and respond to an earthquake.
1.2 Incorporate earthquake education in school curricula.	A multi-level curriculum for earthquake education in all public schools.	All students are provided with earthquake science and safety training as a part of their regular education.
1.3 Disclose geologic hazards in real-estate transactions.	Homebuyers are made aware of geologic hazards at a property prior to purchase.	Homebuyers are more informed in their decisions.

Objective 2: Improve emergency response and recovery.		
Strategy	**Output**	**Outcome**
2.1 Establish community emergency response teams (CERTs) statewide.	Trained volunteer community emergency response teams exist statewide.	Reduce life, property, and environmental loss by providing more immediate response in a disaster.
2.2 Develop effective exercise and training programs for hospitals.	All hospital staff are trained for earthquake emergency response including implementing a standardized triage system.	Hospitals are prepared for earthquake response.
2.3 Enhance communication capabilities for emergency responders.	Develop a communication system that will allow for the use of new technologies and provide the capability of expansion during peak disaster use.	Emergency response capability will be enhanced because the new communication system will allow for the interoperability of agencies to meet the requirements of multi-agency response.
2.4 Enhance the integrated emergency management system statewide.	An intergrated emergency management system at all levels of government and the private sector to protect life, health, property, and the environment.	All jurisdictions and agencies can more fully utilize their resources to respond to any type of a disaster, including earthquakes.

Objective 3: Improve the seismic safety of buildings and infrastrucure.		
Strategy	**Output**	**Outcome**
3.1 Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.	Competent plan reviews are completed for new construction.	Help ensure that new buildings are being designed safely by competent professionals to withstand seismic forces.

3.2 Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.	Copies of the amendment are distributed to building officials, architects, and engineers through the media and professional societies, and education programs are conducted.	A gradual decrease in the seismic hazard posed by existing unreinforced masonry buildings.
3.3 Improve the post-earthquake operational status of essential service buildings.	All essential government services buildings are identified. Buildings constructed before 1976 are retrofitted or relocated as needed, to meet standards that will allow them to remain operational after an earthquake.	The ability to provide unimpeded disaster relief services.
3.4 Reduce structural hazards of government-owned buildings.	Government-owned buildings structurally modified to better withstand earthquakes.	A safer environment to conduct government business.
3.5 Mitigate nonstructural hazards in government-owned and -leased buildings.	Assess hazards in government-owned buildings and upgrade as necessary.	A safer and operational working environment for government agencies following an earthquake.
3.6 Improve safety of older public school buildings.	Identify and reduce structural and non-structural seismic hazards in all pre-1976 public school facilities.	Safer facilities for students and teachers, as well as buildings usable in an emergency.
3.7 Improve safety and operational ability of older hospital buildings.	Assess earthquake vulnerability of all hospitals and upgrade the structures to better survive an earthquake.	Safe structures that will provide a more secure environment for patients and staff and improved ability to survive an earthquake and provide disaster relief.
3.8 Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent to withstand moderate to large earthquakes.	Assess seismic vulnerability of all older high-occupancy structures and retrofit or disclose building condition upon resale.	Prevent collapse in the event of an earthquake, thus reducing life loss, property loss, potential secondary effects, and reconstruction costs.
3.9 Improve the seismic safety of older homes.	Create and distribute maps of seismic-hazard areas and upgrade information packets, procedural manuals, standards, and requirements to all affected home owners, all real-estate agents, building contractors, and lending institutions. Establish funding sources and incentives to encourage seismic-safety retrofitting.	Improved safety and lower repair costs in the event of an earthquake.
3.10 Improve safety of mobile homes.	Seismically brace all new mobile homes; retrofit inadequately braced existing mobile homes at time of resale. Create and implement incentive packages to encourage mobile home owners to retrofit existing installations.	Increased safety for occupants, reduced amounts of utility rupture and associated hazards and repair costs.

3.11 Prevent loss of historic buildings.	Vulnerability assessments and mitigation completed on buildings on the National Historic Register.	The preservation of historic buildings and their associated heritage in the event of an earthquake.
3.12 Improve lifeline survivability in the event of an earthquake.	Assess and mitigate earthquake hazards on all lifelines.	Functional or easily/rapidly repairable lifelines after a earthquake.
3.13 Improve earthquake performance of water and waste-water systems.	Establish appropriate and practical uniform safety and emergency-response plans for all water and waste-water systems.	Improved safety, performance, and reliability of water and waste-water systems.

Objective 4: Improve essential geoscience information.

Strategy	Output	Outcome
4.1 Reduce earthquake losses by mapping and identifying geologic hazards.	Hazard maps for all earthquake-prone urban areas.	Development and management are safer, more reasoned, and more cost-effective.
4.2 Perform geologic-hazards investigations for critical public facilities.	Geologic-hazards investigations are performed for all new critical public facilities.	Critical facilities will not be sited in hazardous areas and, in the event of a natural disaster, facilities that are needed for emergency response will remain intact.
4.3 Make land use compatible, through local government ordinances, with known hazards.	Local governments are encouraged or required to adopt geologic-hazards ordinances as needed.	Land use is safer and consistent with identified geologic hazards.
4.4 Ensure design professionals and building officials are kept current on relevant geoscience information.	Periodic meetings of geoscientists and engineers to discuss implications of geoscience information to building safety.	Up-to-date, reliable geoscience information is used to guide the safe and economical earthquake-resistant design of new buildings.
4.5 Determine appropriate seismic criteria and procedures for evaluating performance of existing dams.	Guidelines for seismic safety assessments of existing dams.	Uniform, state-of-the-art assessments of seismic safety of dams.
4.6 Reduce earthquake-induced liquefaction risk to highway structures.	Identify all hazardous bridges; generate a plan to reduce hazards.	Highway bridges are safer in the event of earthquake-induced liquefaction.
4.7 Determine appropriate seismic design coefficients for highway bridges.	Calculate and incorporate new seismic design coefficients in design work for new bridges associated with the widening of I-15.	(1) Ensure that the best available information is used for the safe and economical design of the new bridges. (2) Prevent the need for retrofit of the bridges in the near future. (3) Reduce bridge damage in an earthquake.

4.8 Develop incrementally a strong-motion program.	Deploy at least 108 accelerographs in the seismic regions of the state to record strong ground shaking.	The hazard of strong ground shaking from local earthquakes is better quantified so it can be correctly incorporated into safe, cost-effective design of buildings and other structures. Key information can also be rapidly available for crisis management.
4.9 Develop a statewide, real-time earthquake monitoring system.	(1) Increased number of seismically vulnerable counties and cities in Utah for which continuous and accurate instrumental earthquake data are available. (2) Rapid emergency alert, within minutes after the occurrence of an earthquake in the Utah region, to state-agency officials, emergency managers, and the general public.	Collect and distribute data needed: (1) for more cost-effective earthquake engineering, (2) for more rapid and effective emergency response, (3) to reliably quantify earthquake dangers, and (4) to improve scientific understanding of local earthquake behavior, in order to better mitigate effects.
4.10 Monitor faults using Global Positioning System (GPS) measurements.	Regular monitoring of a network of GPS benchmarks.	Strain buildup and ground deformation associated with faults are understood on a very detailed level, allowing more accurate estimation of the likelihood of large earthquakes and accompanying hazards.

Objective 5: Assess earthquake risk.

Strategy	Output	Outcome
5.1 Update estimates of direct losses expectable from earthquakes.	Comprehensive studies to estimate the potential loss of life, number of injuries, and damage to structures and lifelines from earthquakes of various magnitudes and locations.	Earthquakes are placed in a proper policy perspective based on credible projections of losses and societal impacts; emergency planning is improved; and long-term hazard-reduction activities are prioritized.
5.2 Evaluate the indirect losses associated with earthquakes.	A study assessing the indirect economic losses from earthquakes including: wage and job loss, rebuilding cost, impacts on insurance and financial institutions, and costs of business interruption and failure.	Identification of indirect economic impacts, resulting in increased preparedness, more rapid recovery, and wise resource allocation.
5.3 Conduct lifeline collocation vulnerability studies.	All lifeline collocation sites in UBC seismic zone 3 are identified; a plan is developed for each one.	During an earthquake emergency, damaged lifelines in one area will not cripple each other.

INTRODUCTION

♦ *Mission*

The impacts of earthquakes are well known. This knowledge has come at great cost in lives and property. We must take advantage of this knowledge to adopt policies and take actions to save lives and prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes in Utah. With the ultimate goal of making Utah a safer place to live, the mission of the Utah Seismic Safety Commission (USSC), as for its predecessor, the Utah Earthquake Advisory Board (UEAB), is to function as a medium for state and local governments, the private sector, and the public to advance earthquake-related issues by developing, researching, and recommending seismic policies and approaches aimed at reducing Utah's earthquake hazards and managing Utah's earthquake risk. The USSC was given the charge to:

- ❑ Review earthquake-related hazards and risks in Utah.
- ❑ Prepare recommendations to identify and mitigate these hazards and risks.
- ❑ Prioritize recommendations for adoption as policy or loss-reduction strategies.
- ❑ Act as a source of information for earthquake safety and promote earthquake loss-reduction measures.
- ❑ Prepare a strategic seismic safety planning document for the 1995 General Legislative session.
- ❑ Update the strategic planning document and other supporting studies or reports.

To achieve part of its mission, the USSC has completed this document prepared in draft form by the UEAB. The main points that the USSC and this document are attempting to make are the following:

1. There is a real and serious danger of both life-threatening and damaging earthquakes in Utah in our lifetimes.
2. We as individuals and collectively can take significant actions to reduce the loss of life, property damage, and long-term economic impact in the future.
3. Implementing an earthquake-safety plan for Utah is a long-term process.
4. Strategies to safeguard lives and property from earthquakes must be sensitive to financial and regulatory burdens. Many actions can be taken now, without great expense that will make Utah safer tomorrow.

♦ *Government Responsibility*

We believe government has a fundamental responsibility to protect the health, safety, and welfare of its citizens. The government's role in improving earthquake safety is to foster, encourage, and, where necessary, require individual and collective action to deal responsibly with the earthquake threat. Reducing our vulnerability to earthquakes requires five types of actions: (1) improving our geotechnical understanding of earthquakes and earthquake hazards, (2) improving development and construction practices, (3) educating the public concerning earthquake hazards and how to respond during a hazardous event, (4) disaster-response planning, and (5) post-earthquake recovery planning. These actions necessarily involve an understanding of what will be effective in reducing risk and an appreciation of the willingness and ability of the people involved to take action.

Government, academic, and private-sector scientists and engineers must work together to understand the earthquake threat to help determine which loss-reduction strategies are appropriate and cost-effective. Improvement of development and construction practices is primarily the responsibility of state, county, and municipal government agencies through adoption and enforcement of building codes, subdivision zoning, and retrofit ordinances. Public education is an ongoing process requiring coordination and cooperation among local school districts, state agencies, and universities to reach all citizens. Government agencies must develop disaster-response plans to identify: (1) the types of decisions that are likely to be needed when the expected earthquake event occurs, (2) who will make the

decisions, and (3) how the decisions will be transmitted to the public and emergency-response personnel for implementation. Recovery plans are also needed to anticipate and meet the needs of communities as the post-earthquake recovery period unfolds over a period that may be as long as 5 to 20 years. These plans will help ensure a quick return to cultural and economic viability following an earthquake.

♦ *Governor's Objectives*

For effective strategic planning, within the realm of state government, plans should be developed in harmony with a statewide vision. The cornerstone of Governor Leavitt's planning agenda is a set of overall policy goals known as the "**Five Key Objectives**." These objectives address issues critical to elevating Utah State Government to a new level of performance. They are:

1. Providing a world-class education.
2. Creating quality jobs and business climate.
3. Improving government.
4. Enhancing the quality of life for all Utahns.
5. Fostering self-reliance.

The strategies proposed in this document are consistent with Governor Leavitt's Key Objectives. They are also consistent with—and indeed many are already part of—the Utah State Legislature's strategic plan, *Utah Tomorrow.*

First, dealing with Utah's earthquake threat relies on earthquake science and engineering, much of it within Utah's system of higher education, involving the development and application of modern technologies in a world-class way.

Second, a healthy business climate in Utah depends on essential infrastructure—including the means to deal with a real and serious earthquake threat. As emphasized by a 1989 blue-ribbon panel (convened to review earthquake instrumentation in Utah), "Potential earnings will come...from increased willingness on the part of risk-conscious investors to fund large projects in Utah once the earthquake threat and the means to cope with it are better understood." A decision by state policy-makers to implement a strategic plan for dealing with Utah's earthquake dangers will favorably impress sophisticated risk managers, who increasingly will be involved, for example, in the siting of new industries or in decisions to fund private economic development.

Third, this plan provides a means to improve government by increasing awareness of the earthquake threat and promoting responsible actions to reduce risks. The threat is far-reaching, requiring a coordinated effort by all levels of government - federal, state, and local.

Fourth, the strategies proposed in this plan are fundamental for ensuring quality of life in the form of safety for all Utahns in their homes, schools, workplaces, and neighborhoods.

Fifth, self-reliance involves education, which inherently involves information and public instruction, to deal with the complexities of modern life. One complexity is that earthquakes pose the greatest natural threat to life and property in Utah. These strategies are intended to help Utahns become progressively self-reliant in avoiding major loss of life and property in earthquakes.

♦ *History of Seismic Advisory Committees in Utah*

In 1976, the United States Geological Survey (USGS) published a study of the likelihood of and projected losses from major earthquakes in Utah. This study reported that a moderate to large earthquake was likely to strike the Salt Lake City area within the next 100 years with serious repercussions. The USGS considered "seismicity, geological history, population density, and distribution and physical status of structural and lifeline installations throughout the region." The USGS report appeared in the aftermath of a magnitude 6.0 earthquake in March 1975 in Pocatello Valley on the Idaho-Utah border. This earthquake was felt throughout the Salt Lake Valley and the northern part of Utah and damaged several buildings in Salt Lake County. The combined effect of the 1975 earthquake and the 1976 USGS report was to awaken political support for earthquake action among public officials representing Utah's urban areas.

Utah Seismic Safety Advisory Council, 1977-1981

State Representative Genevieve Atwood sponsored a bill in the 1977 Utah Legislature to create an earthquake advisory council to attend to seismic safety issues. The Utah Seismic Safety Advisory Council (USSAC) (see appendix) was created and became the first successful effort to shape public policy for reducing earthquake risk in Utah. The USSAC mission was to "provide recommendations for a consistent policy framework for seismic safety in Utah, to recommend programs to reduce earthquake hazards, and suggest goals and priorities..." Their charge was to recommend a consistent and comprehensive public policy plan for earthquake risk reduction in Utah. Even though USSAC products were highly commended, no agency or group was given responsibility to follow through on the recommendations. Very few of the recommendations were implemented and none of the suggested legislation became law.

The USSAC, nonetheless, made a significant difference in earthquake risk reduction in Utah by:

- Linking several of the isolated scientists and earthquake-safety activists into a network.
- Focusing attention on earthquake hazards.
- Writing a series of reports that documented the status quo of earthquake preparedness and provided a framework for action.
- Bringing together local leaders with national experts.
- Providing visibility for all individuals and agencies who wanted to contribute to earthquake-hazard reduction.
- Providing an umbrella of political legitimacy to engineering, political, scientific, and other professional groups who lobbied their membership for increased acceptance of state-of-the-art techniques.
- Providing a supportive network that lasted beyond the lifetime of the organizations.

The USSAC conducted or commissioned numerous studies, sponsored meetings, issued reports, and in other similar ways dealt with the earthquake threat in Utah.

1981-1991

After the USSAC was dissolved in 1981 under the "sunset" provision of its enacting law, the role of coordinating a state earthquake program effectively passed to informal cooperative efforts among the Utah Geological Survey (UGS), the Utah Division of Comprehensive Emergency Management (CEM), and the University of Utah Seismograph Stations (UUSS). Federal attention to Utah's earthquake threat greatly increased from 1983 to 1988 as part of a special five-year focus on earthquake hazards and risk in the Wasatch Front region by the U.S. Geological Survey under the National Earthquake Hazards Reduction Program. As a result of the five-year program, earth scientists and engineers amassed a large body of technical information and reached fundamental agreement about the seriousness, extent, and nature of Utah's earthquake dangers. Despite a greatly-heightened public awareness of Utah's earthquake threat, numerous attempts to motivate state governmental action on earthquake issues were mostly unsuccessful. From 1989-1991, most of these efforts were coordinated through the Earthquake Task Force of the Utah Advisory Council on Intergovernmental Relations (UACIR) (see appendix). The UACIR's activities culminated in late 1990 when the Earthquake Task Force presented a list of critical needs for 1991 legislation to improve earthquake safety. As a result, six bills and one resolution which in some way dealt with earthquake safety were introduced into the 1991 Legislature. All failed (through inaction rather than defeat), but the debate over the bills further increased awareness and gained support from many key legislators.

Utah Earthquake Advisory Board (UEAB), 1991-1994

In 1991, the Utah Earthquake Advisory Board (UEAB) was formed at the instigation of state officials and was funded through CEM by a

supplemental grant from the Federal Emergency Management Agency (FEMA). Approval was gained to create the Board as an advisory group within the executive branch of state government, placing it under the Governor's Disaster Emergency Advisory Council. Under the terms of the Board's charter, Board members were chosen from leaders in their fields of expertise such as seismology, geology, structural engineering, geotechnical engineering, architecture, public policy, and emergency management. The makeup of the Board included members representing state agencies, local government, professional organizations, and the private sector (see appendix).

The mission of the UEAB was to advance earthquake-related issues by developing, researching, and recommending seismic policies and providing a long-term strategic planning document to reduce Utah's earthquake hazards through managing the state's earthquake risk. With completion of the draft of this document, the UEAB achieved a major part of its mission and turned its responsibilities over to the Utah Seismic Safety Commission, effective July 1, 1994.

Utah Seismic Safety Commission, 1994 to present

State Representative Kim Burningham introduced legislation in the 1994 Utah Legislature to establish a commission to study and advance earthquake safety in Utah. HB 358 passed, establishing the Utah Seismic Safety Commission (USSC) and designating the Utah Division of Comprehensive Emergency Management and the Utah Geological Survey to provide staff support. The make-up of the USSC is similar to the UEAB but includes representatives from the Utah Senate and House of Representatives (see appendix). The USSC was charged with preparing a strategic planning document for the 1995 Utah Legislature. With completion of this document, the duties of the USSC shift to facilitating implementation of the strategic plan and keeping it up-to-date.

♦ *Acknowlegements*

The USSC gratefully acknowledges the help of the UEAB and its standing committees, identified in the appendix, and UEAB staff support by: Bob Carey, Jim Tingey, Caryn Johnson, Nancy Barr, John Rokich, Jeanne Andersen, and Judy Watanabe of CEM; Gary Christenson, Noah Snyder, and Janine Jarva of the UGS; and Sue Nava of the UUSS. These staff, along with UGS staff Barry Solomon and Don Adams, helped prepare this report.

THE EARTHQUAKE THREAT IN UTAH

Earthquakes can cause injury and death, major economic loss, and social disruption. They occur with no warning. A recent, disturbing example was the magnitude 6.7 Northridge, California, earthquake of January 17, 1994, in the densely populated Los Angeles metropolitan area. The earthquake killed 61 people, injured 7,300, made 21,000 homes and apartments uninhabitable, and caused an estimated $20 billion in damage.

Utah has also experienced damaging earthquakes and has the potential for earthquakes larger than the recent Northridge shock. Although no large earthquake has occurred in Utah since settlement in 1847, geologic studies indicate that earthquakes of magnitude 7.0 to 7.5 have occurred repeatedly in Utah in prehistoric time. Along the populous Wasatch Front such earthquakes occur on the Wasatch fault, on average, once every 400 years. Some experts believe that the last occurred about 400 years ago.

♦ *What Is An Earthquake?*

An earthquake is the abrupt rapid shaking of the earth caused by sudden slippage of rocks deep beneath the earth's surface. The rocks slip when they can no longer withstand accumulated forces. The zone of weakness along which the rocks slip is called a fault. Shaking is caused by seismic waves travelling outward from the fault break (figure 1).

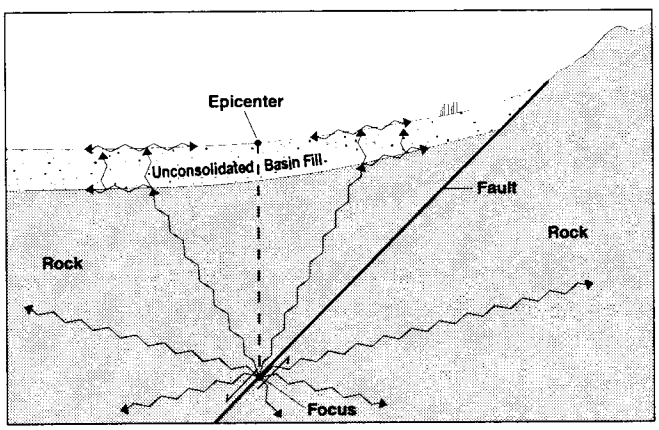

Figure 1. Generation of seismic waves by fault rupture in an earthquake as shown in this cut-away cross section. The focus is the place on the fault where the rupture begins. The point on the surface directly above the focus in the epicenter.

The most commonly used way to measure earthquake size has been the Richter scale, which measures the magnitude of earthquakes based on the amount of ground shaking recorded on a seismograph. The scale has no upper or lower bounds. Each 1-unit increase of the scale represents a 10-fold increase in the amplitude of ground displacement at any site. For example, a magnitude 6 earthquake causes 10 times greater ground displacement at the same distance than does a magnitude 5 earthquake. More importantly, each 1-unit increase represents a 30-fold increase in energy release. Thus a magnitude 6 earthquake is 30 times more powerful than a magnitude 5 earthquake. A magnitude 7 earthquake is nearly 1000 times more powerful than a magnitude 5 earthquake. An earthquake must generally be at least magnitude 2 to be felt by people, and about magnitude 5.5 before significant damage occurs. Seismologists are now using "moment magnitudes" to measure earthquakes, which extends the original Richter magnitudes to greater distances and to larger earthquakes.

♦ *Where Will Earthquakes Occur?*

Earthquakes can occur anywhere in Utah...

Hundreds of small earthquakes are recorded each year in the Utah region (figure 2.) Moderate, potentially damaging earthquakes (magnitude 5.5 to 6.5) occur every several years on average. An earthquake of magnitude 5.8 occurred near St. George on September 2, 1992. The most damaging effect of that shock was a destructive landslide in the town of Springdale, about 28 miles from the earthquake epicenter (figure 3.) Larger earthquakes occur less frequently than smaller earthquakes, but the potential for large earthquakes (magnitude 6.5 to 7.5) exists over much of Utah. Such an earthquake in the Salt Lake City area could cause up to $8.5 billion in damage to private buildings and homes alone, not including damage to other kinds of structures and facilities, and other indirect financial losses. Estimates of potential life-loss and injury made in 1976, now out of date and probably low, indicate that under the worst conditions (but assuming no dam failures), 2,300 people could die and 9,000 suffer injuries requiring medical treatment. As many as 30,000 people could be homeless and require temporary shelter.

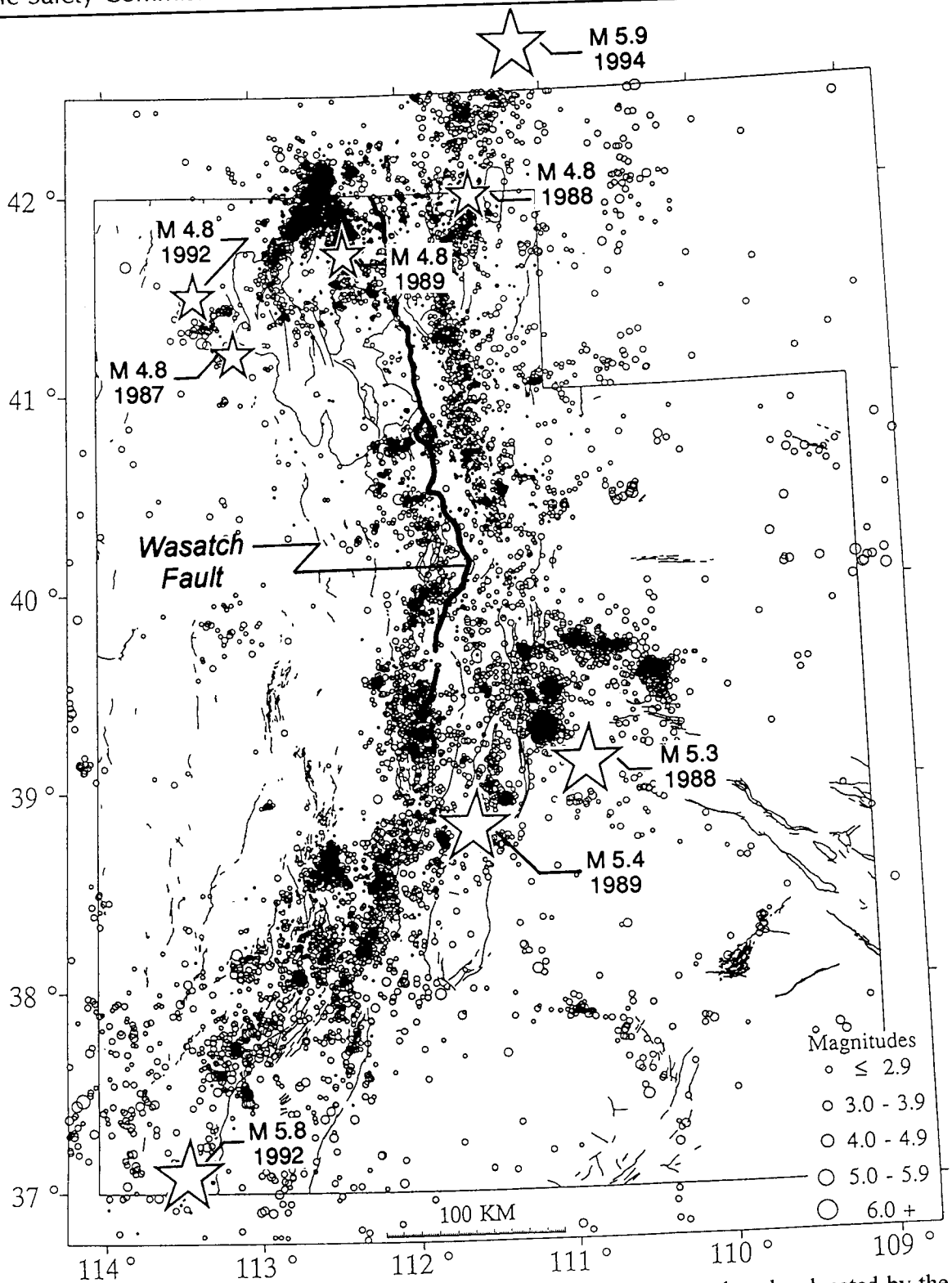

Figure 2. Map of Utah region showing the epicenters of more than 16,000 earthquakes located by the University of Utah Seismograph Stations from 1962 though 1993. Earthquakes of magnitude 4.8 and larger since 1987 shown as stars. The base map showing geologically young faults was compiled by the Utah Geological Survey.

Figure 3. House destroyed by landsliding in Springdale triggered by the magnitude 5.8 St. George earthquake of September 2, 1992. Photo by Bill D. Black, Utah Geological Survey.

...but there is a greater potential in certain areas.

The Intermountain Seismic Belt, which passes through Utah, is a broad zone more than a hundred miles wide where the frequency of earthquakes and the potential for moderate to large earthquakes is greatest. In Utah, the seismic belt passes through the north-central part of the state along the Wasatch Front and then turns southwestward through Richfield and Cedar City (figure 4.) Utah's part of the seismic belt has historically been characterized by small to moderate earthquakes, but there is clear geologic evidence of large prehistoric earthquakes in the magnitude 7 range. The earthquake probability is lower both east and west of the main seismic belt. These areas are characterized by less frequent earthquakes of all magnitudes, but they are not earthquake free.

♦ *Geologic Hazards Caused By Earthquakes*

Earthquakes cause a wide variety of life-threatening and potentially damaging geologic hazards in Utah. The principal earthquake hazards are ground shaking, surface fault rupture, regional subsidence, liquefaction and related ground failure, slope failure, and various types of flooding (table 1). Ground shaking affects large areas and, for a given earthquake, is generally strongest near the epicenter. In the 1994 Northridge, California, earthquake ground shaking was responsible for 98 percent of the estimated $5.9 billion in direct damages. Surface fault rupture usually occurs only in earthquakes of about magnitude 6.5 and larger. This ground rupture may

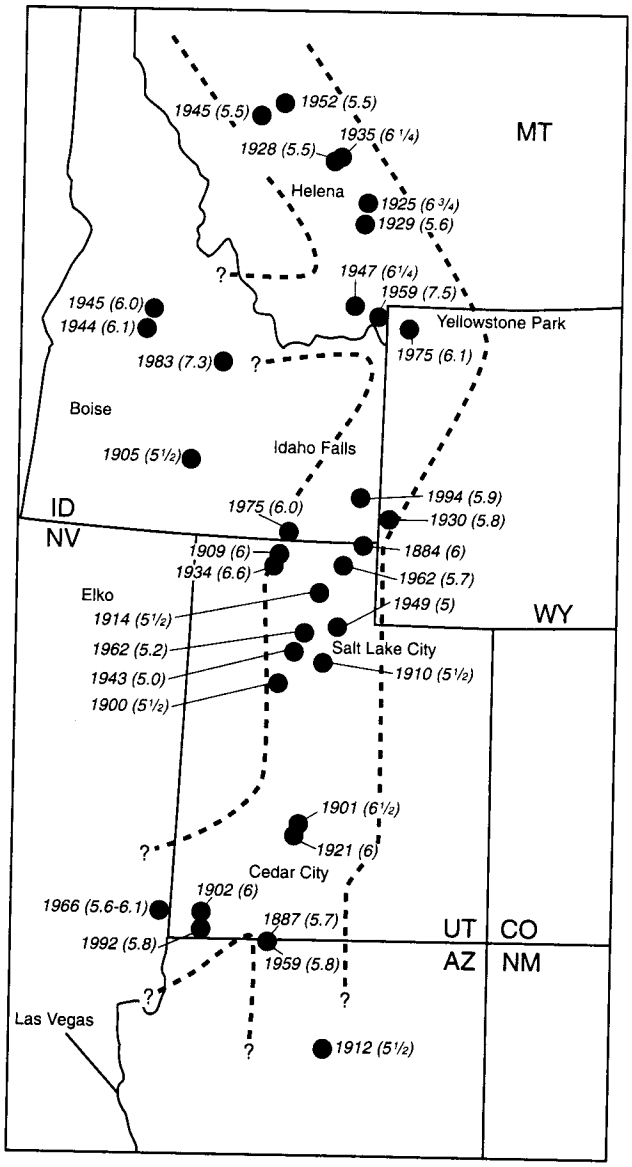

Figure 4. The Intermountain Seismic Belt (area between dashed lines) and the epicenters of historical earthquakes of magnitude 5 and greater (large dots). Year and magnitude are labeled for each earthquake. Modified from Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch Front area, *in* Gori, P.L., and Hays, W.W., editors, Assessment of regional earthquake hazards and risk along the Wastch Front, Utah: U.S. Geological Survey Professional Paper 1500-D, p. D6.

Table 1. Principal earthquake hazards, expected effects and hazard-reduction techniques.

Hazard	Effects	Hazard-Reduction Techniques
Ground Shaking	Damage or collapse of structures	Make structures seismically resistant, secure heavy objects
Surface Fault Rupture	Tilting and ground displacement	Set structures back from fault
Regional Subsidence	Ground tilting; flooding and loss of head in gravity-flow structures	Create buffer zones, build dikes, restrict basements, design tolerance for tilting
Liquefaction	Differential settlement, ground cracking, subsidence, downslope movement of earth material	Treat soil, design structural solutions
Rock Fall	Damage due to impact	Avoid hazard, remove or stabilize rock, protect structures
Landslides	Damage to structures, loss of foundation support	Avoid hazard, remove material, stabilize slopes
Seiches	Inundation, drowning, erosion	Avoid hazard, flood-proof and/or strengthen structures, elevate buildings

affect a zone many hundreds of feet wide along the surface trace of the fault that caused the earthquake. Regional subsidence and tilting of the downdropped block during a large surface-faulting earthquake extends miles from the fault, affecting a much larger area than surface faulting. Liquefaction (the temporary transformation of a cohesionless soil into a fluid mass accompanying earthquake ground shaking) is expected in areas of shallow ground water and sandy soils such as in the centers of basins and along streams. Liquefaction can result in various types of ground failure. Rock falls are the most common type of slope failure during earthquakes, but failures of many types may be expected in any hilly or mountainous area where earthquakes occur. Earthquakes may cause changes in water levels in wells and other permanent changes in hydrologic conditions. Flooding may result from water-line or canal breaks, stream diversions, increased ground-water discharge, seiches (waves on the surface of water in a lake, commonly initiated by an earthquake), and failures of dikes and dams. Ground subsidence on the valley side of the Wasatch fault could shift the shoreline of Great Salt Lake or Utah Lake eastward, resulting in inundation of neighboring areas.

♦ *In the Wasatch Front region*

Along the main seismic belt in Utah, earthquake hazards are greatest along the Wasatch Front because: (1) the Wasatch fault, which bounds the west edge of the Wasatch Range, has been the most frequent source of large earthquakes in Utah, (2) deep valley-basins filled with soft soils amplify ground shaking, (3) extensive areas are underlain by shallow ground water and liquefiable soils, and (4) Great Salt Lake, Utah Lake, and many reservoirs increase flood hazards associated with earthquakes. The largest historical earthquake in Utah was a magnitude 6.6 shock in 1934 that originated in Hansel

Valley, north of Great Salt Lake. The most damaging earthquake in Utah's history also occurred in the general Wasatch Front region -- a magnitude 5.7 shock near Richmond, Cache Valley, in 1962 (figure 5.)

♦ *In southern Utah*

Historical earthquake activity has been relatively high along the Intermountain Seismic Belt in southern Utah. But geologic evidence for recurrent, large surface-faulting earthquakes in southwestern Utah during the past 30,000 years is not as strong as in north-central Utah, where the Wasatch fault and other faults appear to be more active than faults to the south. The second largest historical earthquake in Utah was along the main seismic belt in southern Utah -- the 1901 earthquake near Richfield of estimated magnitude 6.5. One of the most prominent faults in southern Utah, the Hurricane fault, was the probable source of the 1992 St. George earthquake.

Shallow ground water is present in valley bottoms in southern Utah, but much less extensively than in northern Utah and thus the liquefaction hazard is lower. Areas of thick basin fill and soft soils are also less common in southern Utah, and therefore hazards due to amplified ground shaking are less. Because southern Utah has fewer large surface-water impoundments and natural lakes, the danger of earthquake-induced flooding is lower.

Figure 5. House damaged in Richmond during the 1962 earthquake, magnitude 5.7, the most damaging earthquake in Utah's history. Photo by Ariel D. Benson, Richmond, Utah.

♦ *In eastern Utah*

In eastern Utah, east of the main seismic belt, the earthquake probability and hazard is relatively low, but moderate-sized, potentially damaging earthquakes can occur. The largest historical earthquake in this region was the 1988 San Rafael Swell earthquake of magnitude 5.3. In Carbon and Emery Counties, extensive mining-induced seismicity results from stress redistribution caused by underground coal mining, posing a danger chiefly to mine operations. Shallow ground water is uncommon in eastern Utah, found chiefly in stream bottoms, so liquefaction is a minor hazard. Bedrock is exposed or shallow over much of the area so amplified ground shaking is unlikely, although seismic waves will travel farther and dissipate less quickly than in western Utah. Rock falls may be the most significant hazard in eastern Utah because they can be locally generated by earthquakes as small as magnitude 4, and many potentially unstable cliffs are present in the area.

♦ *In western Utah*

Earthquake hazards are also relatively low in western Utah west of the main seismic belt. However, amplified ground shaking is a hazard in valleys with deep sediments, liquefaction hazards are present in the northern valleys, and surface-faulting hazards are present along range-front faults. Slope-failure hazards are present but not extensive in the various mountain ranges, but these hazards increase to the east along the western fringe of the main seismic belt.

♦ *Why We Should Prepare For A Major Earthquake*

- ❑ Utah is a seismically active region.
- ❑ Utah's population is concentrated in the area of greatest earthquake hazard.
- ❑ Utah's older buildings and lifelines have low earthquake resistance.

There is a critical need for hazard-reduction measures, including risk identification and proper seismic-structural design and construction of buildings. Education, awareness, and preparedness are all necessary and important for Utah's residents.

STRATEGIES FOR EARTHQUAKE SAFETY

The following section lists the individual actions (strategies) that the USSC considers important to improve earthquake safety in Utah. It is not a comprehensive list and is not in order of priority. The strategies are divided into five categories to address the USSC's five key objectives:

1. Increase earthquake awareness and education.

2. Improve emergency response and recovery.

3. Improve the seismic safety of buildings and infrastructure.

4. Improve essential geoscience information.

5. Assess earthquake risk.

The first four categories correspond to topics assigned to the UEAB standing committees, and the corresponding strategies chiefly represent the work of those committees. Strategies in the fifth category (risk assessment) represent work that necessarily involves interdisciplinary input.

For each strategy, specific outputs are listed which can be measured to evaluate performance of the responsible parties in implementing the strategy. Also, the projected outcome is listed so that the ultimate goal of the strategy is known and success can be measured in light of this desired outcome. Background material explaining the need for the strategy is included, together with a brief discussion of ways to implement the strategy, a list of those responsible agencies (meaning those entities either having statutory responsibility or likely to take a leading role), and an estimate of resources needed. The latter are rough estimates which will be refined once the strategy is being considered for implementation. The list of strategies is meant to be a "living" list which can either be expanded as new actions are identified, or reduced as strategies are implemented and outcomes are achieved.

Objective 1:

Increase earthquake awareness and education.

STRATEGY: Inform citizens about earthquake hazards and risks.

OUTPUT: Information and training targeted to meet individual or collective needs.

OUTCOME: All citizens are better able to prepare for and respond to an earthquake.

Background

Different elements of Utah society have different needs for information and training to deal with mitigating and responding to the earthquake threat. There exists significant demand for earthquake education materials and services which should be appropriate, readily available, and user-friendly.

Implementation

Programs would be targeted to each of the following population segments with the corresponding products:

1. General public – A free Earthquake Awareness Guide of earthquake services and materials widely distributed.
2. School teachers – Science and safety instructional materials.
3. Businesses – Guides and training for earthquake preparedness in the workplace for managers and employees, techniques to reduce losses and resume operations quickly after a disaster.
4. Architects, engineers, contractors – coordination of materials and training through professional associations and licensing agencies.
5. Local government – awareness program of materials, services, and information on laws, procedures, rules, and standards.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
American Red Cross
University of Utah Seismograph Stations
Utah Geological Survey
Utah Office of Education
Utah Division of Occupational/Professional Licensing
Utah League of Cities and Towns
Utah Association of Counties
Uniform Building Code Commission
Structural Engineers Association of Utah
American Institute of Architects, Utah Chapter
American Society of Civil Engineers, Utah Chapter
Association of Engineering Geologists, Utah Chapter

Resources Needed

First year: two person years: $80,000; materials: $75,000.
On-going: training: (1-3 FTEs) $40,000 to $120,000; materials: $15,000.

STRATEGY: Incorporate earthquake education in school curricula.

OUTPUT: A multi-level curriculum for earthquake education in all public schools.

OUTCOME: All students are provided with earthquake science and safety training as a part of their regular education.

Background

More than 468,000 students (approximately 26% of Utahns) are in grades K-12 in Utah schools. Incorporation of earthquake science and safety in the school curriculum will better ensure student safety now and help produce educated citizens who will be able to make responsible decisions in the future.

Implementation

It would be most appropriate to focus efforts for lesson plans at grade levels 3, 5, and 9 in conjunction with earthquake science or related topics in the State Science Core Curriculum. The objective can be accomplished by doing the following: (1) educating the curriculum providers – district level school boards, school administrators, and teachers' unions – about the value of earthquake education in schools and the ease with which that can be implemented, (2) developing Utah-relevant earthquake education materials and a variety of options for implementation, (3) establishing certification standards for earthquake education programs, and (4) providing teacher in-service workshops. Resources to carry out this program must be provided or made available as opposed to redirecting existing resources.

Responsible Agencies

Earthquake Education Resource Group (includes Utah Geological Survey, University of Utah Seismograph Stations, and Utah Division of Comprehensive Emergency Management)
Utah Office of Education

Resources Needed

A task force composed of earthquake scientists and educators and members of the target audience (teachers and administrators) could develop and implement the entire project. Salaries would be needed for 1.5 FTE for three years as well as additional funds for office supplies and curriculum materials. The estimated total expenditure is $80,000 to $100,000 per year for three years.

STRATEGY: Disclose geologic hazards in real-estate transactions.

OUTPUT: Homebuyers are made aware of geologic hazards at a property prior to making a purchase.

OUTCOME: Homebuyers are more informed in their decisions.

Background

Buying a home is probably the greatest investment most families make in a lifetime. In making a decision on purchasing a home, they need accurate information. A commonly overlooked concern is geologic hazards because most homebuyers are unaware of geologic hazards and falsely assume that government would not allow homes to be built in hazardous areas. Homebuyers need to know the risks they are incurring. There is presently no easy way for homebuyers or real-estate agents to know if a property is vulnerable to geologic hazards.

A seller's disclosure form available to potential buyers would provide the necessary information. The Utah Association of Realtors has a voluntary disclosure form which includes geologic hazards that they recommend be used by all realtors. The Utah Division of Real Estate is presently developing a "property condition" disclosure form including geologic hazards which will be required in all transactions involving a real-estate broker, but it will not be required in non-brokered transactions.

Implementation

Disclosure can be implemented at either the state or local government level. Uniformity statewide is desirable, and would require legislation. Accurate maps showing geologic hazards are useful to inform sellers, real-estate agents, and local governments of potential hazards, but aren't necessary to implement disclosure if only known hazards or damage from hazards are to be disclosed.

Responsible Agencies

- Utah Division of Real Estate
- Local governments
- Utah Geological Survey (to provide hazards information)

Resources Needed

If responsibility for disclosure is placed with sellers or real-estate agents, no government funding is necessary. Minimal costs may be incurred in handling paperwork. If the state places responsibility with local governments, state or local funds to handle additional paperwork may be required.

Objective 2:

Improve emergency response and recovery.

STRATEGY: Establish community emergency response teams (CERTs) statewide.

OUTPUT: Trained volunteer community emergency response teams exist statewide.

OUTCOME: Reduce life, property, and environmental loss by providing more immediate response in a disaster.

Background

In the immediate aftermath (first 72 hours) of an earthquake, standard emergency services will not be available. Research has shown that most rescues and emergency services are provided by untrained volunteers spontaneously functioning in damaged neighborhoods. This initiative would provide very basic training for interested people in fire safety, light rescue, disaster medical operations, hazard inspection, and other services. Grouped together within each community, as a part of neighborhood groups, church groups, or professional organizations, these volunteers would be in place to act independently and spontaneously in the event of a disaster, known and trusted by the people they are helping. These volunteers will respond to their neighborhoods first, then go to staging areas to assist their local government's disaster efforts.

Implementation

Four steps are required: (1) orient elected officials, policy makers, police, and fire and emergency management personnel in the use of volunteers in disaster response; (2) identify citizen groups and volunteer organizations; (3) distribute information and hold workshops through local public safety organizations and community service groups; and (4) continue to provide technical assistance and recertification to CERTs wishing to provide community-based relief. The steps would be accomplished under the direction of local Emergency Program Managers, with assistance of fire and rescue agencies to train volunteer community emergency response teams and team leaders.

Responsible Agencies

- Utah Division of Comprehensive Emergency Management (CEM)
- Local Emergency Program Managers
- Fire and medical agencies
- Community groups of all types

Resources Needed

Funding needed to provide CERT instructors to train local volunteers groups, to provide CERT safety equipment and basic supplies, and to manage and track statewide CERT teams and resources: approximately $100 per volunteer. Local governments within Salt Lake County began pilot training programs in 1994. Trainers currently volunteer their time free-of-charge. CEM would like to provide CERT training to 30 Utah communities with populations of 100,000 or less, annually. It would take about 15 years to offer training to most communities statewide. If training for two classes of 25 volunteers each are run in each of 30 communities, annual cost would be approximately $150,000.

STRATEGY: Develop effective exercise and training programs for hospitals.

OUTPUT: All hospital staff are trained for earthquake emergency response including implementing a standardized triage system.

OUTCOME: Hospitals are prepared for earthquake response.

Background

Past exercises have revealed inadequacies in response-related operations. Hospitals need to ensure their facilities are operational after an earthquake. This would require training and exercising hospital response plans, as well as interaction between hospitals and coordination with local emergency management officials. Hospitals need to routinely schedule exercises individually and in conjunction with other hospitals and local officials. All hospitals should exercise using a standardized triage system with universal triage tags. This system would save time, lessen confusion, and, most importantly, save lives. A universal triage system would be critical in mutual medical aid situations where emergency room staff are working in hospitals other than their own.

Implementation

There are six elements to preparing Utah hospitals for an earthquake emergency: (1) accurately identify each hospital's capabilities and seismic vulnerability; (2) enhance communication for air traffic at each hospital; (3) train hospital staff on ARES/RACES (amateur radio operators emergency systems) capabilities; (4) provide training as part of the hospital's policies; (5) establish continuing education goals; and (6) standardize hospital triage systems and encourage comprehensive seismic safety education programs for hospital personnel. Exercises to test hospital emergency response plans should be held periodically.

Responsible Agencies

- Utah Division of Comprehensive Emergency Management (CEM)
- Utah Hospital Association
- Utah Department of Health
- Local emergency management officials
- Local governments
- Local fire and police departments

Resources Needed

CEM's Exercise Program specializes in writing and conducting exercises. Developing and conducting a hospital-specific earthquake-scenario exercise centered around a standardized triage system would cost approximately $50,000.

STRATEGY: Enhance communication capabilities for emergency responders.

OUTPUT: Develop a communication system that will allow for the use of new technologies and provide the capability of expansion during peak disaster use.

OUTCOME: Emergency response capability will be enhanced because the new communication system will allow for the interoperability of agencies to meet the requirements of multi-agency response.

Background

Public safety and local governmental agencies in Utah currently operate radio systems in the VHF 150 and UHF 450 frequency band. The availability of additional frequencies in these two bands for system expansion is very limited. With the advancement of technology comes the responsibility to develop a system that will allow for the use of this new technology. We must ensure that the system allows for the interoperability of agencies to meet the requirements of multi-agency response. Most agree that radio coverage, combined with inadequate channel allocations, are the biggest problems in meeting the objectives of protection of life and property. During emergency situations, history continues to repeat itself with the inability of agencies to communicate with each other in an effective manner.

Implementation

A new communication network that will support both voice and data applications and accommodate current and future requirements needs to be developed. The system should support city, county, state, and federal agencies. All government agencies that are users or will have future communication needs will be requested to evaluate their present capabilities and their future communication requirements.

Responsible Agencies

- Utah Division of Information Technology Services
- Utah Department of Public Safety
- ARES/RACES (amateur radio operators organizations)
- Local governments
- State agencies

Resources Needed

An 800 MHz system is currently being evaluated for future communication needs for the state, including emergency response. Preliminary estimates indicate the initial phase of conversion from the present system will cost up to $10 million.

STRATEGY: Enhance the integrated emergency management system statewide.

OUTPUT: An integrated emergency management system at all levels of government and the private sector to protect life, health, property, and the environment.

OUTCOME: All jurisdictions and agencies can more fully utilize their resources to respond to any type of a disaster, including earthquakes.

Background

As Utah's population, infrastructure, and economy continue to grow, it becomes an increasing challenge for all agencies to inventory and utilize their resources. City, county, and state governments have designated Emergency Coordinators to prepare and conduct mitigation, preparedness, response, and recovery operations. These Coordinators are also responsible for exercising and evaluating their plans. Emergency planning and operation evaluation is an ongoing process. This should lead to a higher level of response proficiency.

Implementation

Encourage a full-time Emergency Coordinator for each state agency. Increase training in Integrated Emergency Management concepts. Continue to exercise emergency plans.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
State Emergency Response Teams (SERT)
County emergency management offices

Resources Needed

Funding for 1 FTE Emergency Coordinator in each of the 25 largest state agencies would cost approximately $48,500 per coordinator, or an approximate annual cost of $1,212,500.

Objective 3:

Improve the seismic safety of buildings and infrastructure.

STRATEGY: Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.

OUTPUT: Competent plan reviews are completed for new construction.

OUTCOME: Help ensure that new buildings are being designed safely by competent professionals to withstand seismic forces.

Background

Many municipalities have some form of plan review to ensure that buildings are being designed in accordance with the Uniform Building Code (UBC). However, a lot of buildings are built which do not meet current seismic code requirements, particularly in rural portions of Utah where plan checking is not performed.

Implementation

Mandate that important structures, such as schools, hospitals, or emergency response facilities, particularly those located in seismic zone 3, have a plan review by a competent professional before a building permit is issued. Require plan reviews on all construction over a certain height and/or size in cities and towns located in nonrural counties, particularly Davis, Utah and Salt Lake.

Responsible Agencies

Structural Engineers Association of Utah
International Conference of Building Officials, Utah Chapter
Local governments

Resources Needed

Salary of competent in-house reviewer: $35,000 to $60,000 per year; or outside consultants: $500 to $2,000 per structure.

STRATEGY: Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.

OUTPUT: Copies of the amendment are distributed to building officials, architects, and engineers through the media and professional societies, and education programs are conducted.

OUTCOME: A gradual decrease in the seismic hazard posed by existing unreinforced masonry buildings.

Background

Unreinforced masonry structures built prior to 1976 pose a great risk to life safety during even moderate earthquakes. The weakest structural link is frequently the connection between the roof structure and supporting walls. A failure at this location can lead to collapse of the roof. Also, unreinforced parapets and appendages are particularly vulnerable to collapse if not properly anchored.

The logical time to perform this work at least expense is during reroofing when the roof structure is exposed, and new ties and braces can be easily installed. Ordinances similar to the amendment have worked successfully in Ogden and California cities.

The Uniform Building Code (UBC) Amendment was passed by the Utah UBC Commission in 1993, but has not been enforced, partially due to lack of knowledge of the amendment by building officials, or by building owners contracting reroofing without first obtaining a building permit, thereby bypassing the amendment requirement.

Implementation

Educate building officials, engineers, and architects of the amendment through the media, professional organizations, and the State Division of Occupational/Professional Licensing. Enforce the requirement to obtain a building permit before allowing people to reroof their buildings.

Responsible Agencies
- Structural Engineers Association of Utah
- American Institute of Architects, Utah Chapter
- International Conference of Building Officials, Utah Chapter
- Division of Occupational/Professional Licensing
- Uniform Building Code Commission

Resources Needed
- Minimal.

STRATEGY: Improve the post-earthquake operational status of essential service buildings.

OUTPUT: All essential government services buildings are identified. Buildings constructed before 1976 are retrofitted or relocated as needed, to meet standards that will allow them to remain operational after earthquakes.

OUTCOME: The ability to provide uninhibited disaster relief services.

Background

Lessons learned in recent damaging earthquakes demonstrate the need to continue essential government services during and after an earthquake. Many facilities constructed during periods when codes were not as comprehensive as current codes have sustained damages that restrict their use after an earthquake. Precautions must be taken to determine acceptable levels of facility performance to ensure post-earthquake availability of functions. Older essential services buildings that house emergency operations centers, law enforcement offices, and fire stations may not be able to remain functional after earthquakes. The potential loss of these functions poses an unacceptable risk because it would slow emergency response and result in unnecessary casualties and property damage.

Implementation

Using a uniform assessment procedure, the cataloging of location, hazard type, and structure vulnerability should be undertaken. Retrofit or relocation possibilities are then analyzed. Cost/benefit information is compiled and analyzed. Mitigation is then undertaken on a priority basis.

Responsible Agencies:
- Local governments
- Utah Division of Facilities Construction and Management

Resources Needed

A rapid visual screening assessment costs approximately $1,500 per building.

Funding to rehabilitate the facilities on a priority basis depends on results of assessment.

STRATEGY: Reduce structural hazards of government-owned buildings.

OUTPUT: Government-owned buildings structurally modified to better withstand earthquakes.

OUTCOME: A safer environment to conduct government business.

Background

State and local governments own a great number of buildings. Some have unreinforced masonry walls or are made of nonductile concrete or other materials likely to collapse during an earthquake. In past earthquakes, these facilities have suffered higher losses than other construction-type facilities. The public, government employees, and government functions—including many emergency services—are at risk because of these buildings. The state owns approximately 4,500 buildings of which approximately 2,300 would be considered essential in the event of a catastrophic event.

Implementation

Complete a program to ensure that major state government buildings can withstand an earthquake to the extent that collapse is precluded, occupants can exit safely, and functions can be resumed or relocated promptly consistent with the need for these services after earthquakes. Essential buildings would need to be identified and prioritized in terms of the necessity for their use to supply essential services after a catastrophic event. ATC-21, the rapid visual screening of buildings for potential seismic hazards could then be used to identify buildings by design and vulnerability parameters. Based on these parameters, buildings should then be prioritized by order of essential need and vulnerability to a seismic event. Detailed evaluations and cost estimates should then be generated for the retrofitting or replacement of each of the facilities, including a timetable for completion of the work.

Responsible Agencies

Utah Division of Facilities Construction and Management
Local governments

Resources Needed

Rapid visual screening to identify and catalogue government buildings structurally at risk in a seismic event averages $1,500 per building. Funding to conduct geologic investigation of the building site averages $2,000 per site. The total cost to evaluate 2300 essential state-owned buidings would be $3,450,000 for the buildings themselves and $4,600,000 for the geologic site evaluations, or approximately $8,050,000.

Cost for detailed evaluation of at-risk government buildings averages $5,000 per building when done on individual buildings. Evaluations conducted on groups of buildings can be considerably less costly.

Costs to upgrade government-owned buildings ranges from $8.75 to $18.00 per ft^2. Cost to carry out needed seismic upgrade of buildings will depend on results of assessment.

STRATEGY: Mitigate nonstructural hazards in government-owned and leased buildings.

OUTPUT: Assess hazards in government-owned buildings and upgrade as necessary.

OUTCOME: A safer and operational working environment for government agencies following an earthquake.

Background

Falling hazards to occupants and visitors can be posed by nonstructural building elements such as parapets, cornices, ceiling and lighting systems, window and building cladding systems, air conditioning, and plumbing and electrical equipment. These hazards are significant to the continuity of building functions following earthquakes.

The seismic safety of nonstructural elements in all new construction is largely regulated by building codes. Before 1976, however, most building codes failed to explicitly regulate the seismic safety of nonstructural elements. As a result, nonstructural elements in older buildings are often unbraced or unattached to the structure and can fall or move excessively during earthquakes.

Implementation

Perform an evaluation of government-owned and leased buildings with regard to falling hazards in existing nonstructural building elements. The evaluation would identify and prioritize these elements with regard to level of danger presented. A cost estimate for correcting each hazard would be part of the evaluation. Upon completion of the evaluation, appropriate action can be undertaken.

Responsible Agencies

Utah Division of Facilities Construction and Management
Agencies and institutions that are responsible for facilities
Local governments

Resources Needed

If evaluation of nonstructural hazards is performed during investigation of structural hazards (see Strategy 3.4) in the same building, additional cost would be approximately $100 per building.

Cost to carry out seismic upgrade will depend on results of evaluation.

STRATEGY: Improve safety of older public school buildings.

OUTPUT: Identify and reduce structural and non-structural seismic hazards in all pre-1976 public school facilities.

OUTCOME: Safer facilities for students and teachers, as well as buildings useable in an emergency.

Background

A large number of public school buildings were designed prior to the 1976 Uniform Building Code seismic requirements. Additionally, some recent portable classrooms may not be adequately anchored to their foundation. Many schools have free-standing bookshelves, file cabinets, and other heavy shelved items that are not secured and may cause harm. A major earthquake may cause significant property damage and injury to students and teachers. Additionally, these damaged structures will not be available for disaster relief efforts.

Implementation

Identify all schools and their associated hazard, structural, and non-structural problems. Initiate plan to mitigate, rebuild, or relocate the public school structures, and create a priority list to determine which buildings are the most hazardous. Study minimal cost methods of partially retrofitting schools, such as providing connections between wall and roof structures.

Responsible Agencies

Utah Office of Education
Individual school districts

Resources Needed

Funding for seismic studies provided in school district taxing policies. Studies by Salt Lake School District averaged $1,000 per building. These studies were done on a group basis. A projected range would be from $500 to $5,000 per building, and would depend on the complexity of the structure and the degree of detail required in the study. Over one-third of these assessments have already been done. Total cost for assessments of all school buildings would be on the order of $720,000.

Funding and technical expertise for seismic upgrades also funded by school district taxing. Costs for upgrades in Salt Lake averaged $833,333 per school, but costs will vary as indicated in the assessments. If the statewide average upgrade costs $500,000 per school, the total cost would be about $300 million.

STRATEGY: Improve safety and operational ability of older hospital buildings.

OUTPUT: Assess earthquake vulnerability of all hospitals and upgrade the structures to better survive an earthquake.

OUTCOME: Safe structures that will provide a more secure environment for patients and staff and improved ability to survive an earthquake and provide disaster relief.

Background

Many Utah hospitals were designed prior to the 1976 Uniform Building Code seismic requirements. A major earthquake may cause significant property damage and injury to patients and health-care providers. Of equal concern, these damaged structures will not be available for disaster relief efforts after an earthquake.

Implementation

Hospitals should remain operational after an earthquake. A risk and vulnerability analysis of the structures should be performed. Upgrade the structural and non-structural components as required.

Responsible Agencies

Uniform Building Code Commission
Utah Division of Comprehensive Emergency Management
Privately owned and county hospital organizations

Resources Needed

Cost of seismic studies could range anywhere from $1,000 to $10,000 per structure depending on building size, complexity, and degree of detail desired in the study. Many Wasatch Front hospitals have already been evaluated.

Cost for seismic upgrades depend upon vulnerability but can be generalized between $8.75 to $25.00 or more per ft^2.

STRATEGY: Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent enough to withstand moderate to large earthquakes.

OUTPUT: Assess seismic vulnerability of all older high-occupancy structures and retrofit or disclose building condition upon resale.

OUTCOME: Prevent collapse in the event of an earthquake, thus reducing life loss, property loss, potential secondary effects, and reconstruction costs.

Background

High-occupancy buildings designed prior to the 1976 Uniform Building Code seismic requirements are of special concern because of the potentially significant loss of life and injury. Efforts should be made to insure against structural collapse and non-structural failure.

Implementation

Identify all high-occupancy buildings in the state. Assess each structure to determine vulnerability and propose mitigation techniques and costs. Require disclosure of hazards and building condition upon resale. Find funding sources and incentives to help building owners mitigate the hazards. A publication by the Applied Technology Council (ATC-33) provides seismic rehabilitation guidelines for existing buildings.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
Uniform Building Code Commission
Local governments

Resources Needed

Cost of vulnerability studies are approximately $1,000 to $4,000 per building.

Cost for seismic upgrades for public facilities is $5 to $25 or more per ft^2.

Technical expertise and guidelines for seismic upgrades.

Local government agencies enact and enforce new regulations.

STRATEGY: Improve the seismic safety of older homes.

OUTPUT: Create and distribute maps of seismic-hazard areas and upgrade information packets, procedural manuals, standards, and requirements to all affected home owners, all real-estate agents, building contractors, and lending institutions. Establish funding sources and incentives to encourage seismic-safety retrofitting.

OUTCOME: Improved safety and lower repair costs in the event of an earthquake.

Background

There are many unreinforced masonry houses along the Wasatch Front which are susceptible to seismic damage. Many older frame houses were built without adequate anchorage to their foundations. Water heaters and other non-structural elements are usually not anchored to resist earthquakes.

Implementation

The first step is to create and distribute an information packet describing hazards, general procedures, standards, funding sources, and incentives to the homeowners. Technical and procedural documents are to be made and dispensed upon request. Funding and incentive packages should be created by public and private industries such as insurance and mortgage companies. One publication, available through the Utah Division of Comprehensive Emergency Management, describes methods for seismically upgrading older, unreinforced masonry homes.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
Utah Division of State History
Uniform Building Code Commission
Real-estate, insurance, and mortgage groups

Resources Needed

Cost to develop a household earthquake upgrade information packet and technical and procedural documentation (booklets available through State agencies and from the Federal Emergency Management Agency) approximately $40,000.

Financial incentives to encourage homeowners to make seismic retrofits.

STRATEGY: Improve safety of mobile homes.

OUTPUT: Seismically brace all new mobile homes; retrofit inadequately braced existing mobile homes at time of resale. Create and implement incentive packages to encourage mobile home owners to retrofit existing installations.

OUTCOME: Increased safety for occupants, reduced amounts of utility rupture and associated hazards and repair costs.

Background

Mobile homes are extremely vulnerable to earthquake damage. Since mobile homes are virtually never connected to a foundation, they tend to fall off their supports during an earthquake, often severing their typically rigid gas and water connections. This can lead to fire and rupture of water lines.

Implementation

Identify locations where bracing and retrofitting is appropriate. Legislation is needed to require new mobile homes to be seismically braced and existing mobile homes be retrofitted at time of resale. Provide tax or insurance incentives to those who mitigate.

Responsible Agencies

Utah Division of Motor Vehicles
Local government

Resources Needed

Cost of seismic bracing on new installations will be part of the installation price paid by homeowners but is unknown at this time.

Provide financial incentives to retrofit existing installations. California requirements and industry standards for wind anchorage can accomplish retrofit requirements if enforced.

Local governmental agencies enact and enforce new regulations.

STRATEGY: Prevent loss of historic buildings.

OUTPUT: Vulnerability assessments and mitigation completed on buildings on the National Historic Register.

OUTCOME: The preservation of historic buildings and their associated heritage in the event of an earthquake.

Background

Utah's designated historic buildings are an irreplaceable cultural resource. Many of these structures are likely to be damaged beyond repair by an earthquake. The problem is compounded by the lack of funding to reinforce these buildings in a way that preserves their historic and architectural qualities. After an earthquake, damaged historic buildings should not be demolished without thorough review.

Implementation

Identify and then reduce seismic hazards in all "National Register" historic buildings. Provide mitigation solutions and aid in the creation and acquisition of funds needed to make the necessary upgrades.

Responsible Agencies

Utah State Historical Society for privately owned buildings
Utah Division of Facilities Construction and Management for state buildings

Resources Needed

Funds needed for assessments on approximately 1,000 sites. Assessment and retrofit costs for historic structures are much higher than for other buildings.

Money and technical expertise for seismic upgrades depends on results of assessments.

STRATEGY: Improve lifeline survivability in the event of an earthquake.

OUTPUT: Assess and mitigate earthquake hazards on all lifelines.

OUTCOME: Functional or easily/rapidly repairable lifelines after a earthquake.

Background

Critical elements of the infrastructure of many utilities and other lifelines are vulnerable to damage during earthquakes. Within the electric power network, porcelain insulators and certain pole-mounted transformers may have a high probability of failure. Telecommunications switching equipment, as well as transceiver towers and conduits may be displaced or moved out of alignment. Liquid and gaseous fuel pipelines and petrochemical tanks may be displaced or ruptured.

Implementation

State, county, and local public works departments in conjunction with utilities should survey, inventory, and assess the condition of their respective lifelines. Upon completion of the assessment, plans for mitigation and or replacement should be developed and implemented. Emergency response plans should be developed, and seismic considerations incorporated into the design of new lifelines.

Responsible Agencies

Utah Public Service Commission
Uniform Building Code Commission
Federal Energy Regulatory Commission
Municipal and private utilities and pipeline operators

Resources Needed

Regulatory rate consideration from Utah Public Service Commission, Federal Energy Regulatory Commission or local government.

Cost for assessing lifeline vulnerability not available at this time.

Cost for lifeline upgrades depends upon results of assessments.

STRATEGY: Improve earthquake performance of water and waste-water systems.

OUTPUT: Establish appropriate and practical uniform safety and emergency response plans for all water and waste-water systems.

OUTCOME: Improved safety, performance, and reliability of water and waste-water systems.

Background

Culinary and waste-water systems include aqueducts, pumping stations, transmission pipelines, water and waste-water treatment facilities, distribution and collection pipe networks, and distribution storage tanks and reservoirs, all of which are vulnerable to earthquakes. Water and waste-water systems can be rendered inoperable because of damage to tanks, reservoirs, treatment facilities; broken transmission mains; failures at pipe joints; and failed equipment. Damages from water sloshing in tanks and clarifiers is unavoidable during earthquakes, but economical, preventive measures can be taken to reduce the amount of damage and recovery time after earthquakes. Many of the state's water systems' transmission mains and aqueducts cross active faults and dormant landslide zones, and are vulnerable to fault rupture or earthquake-caused slope failure. Because most of the transmission systems are underground, localized damage to such systems is unavoidable. Water and waste-water systems should stockpile replacement components needed after earthquakes.

Implementation

All water and waste-water systems should be inventoried to assess their earthquake performance. All water and waste-water systems would identify and report their emergency-response plans and procedures for the timely repair or replacement of earthquake-damaged water and waste-water systems. Establish appropriate and practical, uniform seismic-safety criteria and procedures and adopt a comprehensive policy on acceptable levels of earthquake risk in water systems. A report should be made to the state legislature that will make recommendations for any additional authority needed to develop and enforce an effective policy on acceptable earthquake risk, including uniform seismic-safety standards, and emergency-response and recovery plans if required.

Responsible Agencies

Utah Department of Environmental Quality
Water system owners (local governments, sanitation districts, etc.)
Waste-water system owners (local governments, sanitation districts, etc.)

Resources Needed

Cost to assess systems not available at this time.

Cost to the state to establish safety criteria and policies on acceptable risk unknown at this time.

Cost to upgrade systems depends upon results of assessments.

Objective 4:

Improve essential geoscience information.

STRATEGY: Reduce earthquake losses by mapping and identifying geologic hazards.

OUTPUT: Hazard maps for all earthquake-prone urban areas.

OUTCOME: Development and management are safer, more reasoned, and more cost-effective.

Background

Strong ground shaking, liquefaction, slope failure, surface fault rupture, and other forms of ground failure are responsible for most losses caused by earthquakes. Changes in ground water conditions caused by earthquakes can also have major, sometimes permanent, consequences. Areas subject to these hazards need to be identified and mapped by qualified professionals so that information can by used by local governments in land-use ordinances and by others in adequately considering geologic hazards in development and management. Geologic-hazard maps for certain hazards are complete for much of the Wasatch Front from Ogden to Provo, but remain to be done in other urban areas subject to earthquake hazards. The Utah Geological Survey (UGS) has a long-term goal to complete these maps statewide, but the process will take decades. To accelerate the program, 1-2 additional UGS staff would be needed. To help ensure that local governments use the maps, UGS presently requires contributions from local governments. Experts in the private/academic sector may also complete some the hazard mapping. Certain hazards such as strong ground shaking require additional research and data collection to develop suitable databases and techniques to produce maps.

Implementation

Geological hazards mapping is ongoing at the UGS and will continue. Maps for some hazards could be completed by university or private-sector specialists.

Responsible Agencies
- Utah Geological Survey
- Local governments
- University geology departments, private geologists

Resources Needed

UGS staff (1-2 FTE's): $40,000 to $80,000 per year.

Local government cost sharing: $5,000 to $10,000 per city.

Private/academic mapping: $50,000 to $100,000 per project.

STRATEGY: Perform geologic-hazards investigations for critical public facilities.

OUTPUT: Geologic-hazard investigations are performed for all new critical public facilities.

OUTCOME: Critical facilities will not be sited in hazardous areas and, in the event of a natural disaster, facilities that are needed for emergency response will remain intact.

Background

Critical public facilities (schools, water tanks, public-safety buildings, etc.) are still being sited in hazardous areas, sometimes with no knowledge of hazards and sometimes with knowledge coming too late to abandon sites or alter designs without incurring great additional expense. Many governments require private developers to consider geologic hazards, but do not themselves consider hazards in locating their own buildings.

Certain public buildings are critical for public safety during and after a disaster. These buildings must not be vulnerable to geologic hazards that could endanger occupants or reduce functionality following a disaster such as an earthquake when they are needed most. The consequences will be reduced capacity to house and feed those needing shelter after a disaster, reduced response capability, possible loss of life in public buildings with accompanying liability, and government losses due to property damage.

Implementation

Legislation could be passed requiring such investigations, performed either by the private sector or by the Utah Geological Survey (UGS).

Responsible Agencies

- Local governments
- Utah Geological Survey
- Utah Division of Facilities Construction and Management (DFCM)

Resources Needed

DFCM already requires such investigations by the private sector for buildings they administer as a part of their building costs. Local governments would similarly need to fund such costs if done by the private sector. Under the Utah Code, the UGS is charged to perform geologic-hazards investigations for schools and local government critical facilities, but because of declining budgets the UGS cannot take on an increased workload without additional funding. The UGS may need 1-2 additional staff ($40,000 to $80,000 per year) to perform these studies, depending on workload.

STRATEGY: Make land use compatible, through local government ordinances, with known hazards.

OUTPUT: Local governments are encouraged or required to adopt geologic-hazards ordinances as needed.

OUTCOME: Land use is safer and consistent with identified geologic hazards.

Background

In Utah, local governments regulate land use. One critical life-safety and property-loss element that should be considered in land use is geologic hazards. Land uses must be compatible with hazards present, and often hazards must be reduced prior to use.

Damages from unwise land use in Utah have principally been from landslides, debris flows, flooding, and soil-foundation problems. However, earthquakes present the potential to cause damage and life-loss far exceeding that from other hazards. This potential loss can be reduced by prudent land use. Governments may be incurring liability by allowing development in hazardous areas.

Implementation

Legislation or state policy requiring (or encouraging) local governments to adopt geologic-hazards ordinances is needed. Many local governments already have such ordinances but do not adequately enforce them. Once implemented, geologic assistance from the Utah Geological Survey (UGS) to review reports will be required. Sample ordinances and guidelines for developing and enforcing ordinances are already available.

Responsible Agencies
- Local governments
- Utah Geological Survey

Resources Needed

No legislative appropriation is necessary; costs principally to be born by private developers, typically $1,000, perhaps up to $3,000 per project. Some staff costs to enact ordinances will be incurred by local governments, and costs to provide technical assistance to enforce ordinances will be incurred by the UGS. Costs for report reviews can be passed on to developers. Total costs to developers statewide would be on the order of $300,000 per year (based on 250 studies per year).

STRATEGY: Ensure design professionals and building officials are kept current on relevant geoscience information.

OUTPUT: Periodic meetings of geoscientists, engineers, and building officials to discuss implications of geoscience information to building safety.

OUTCOME: Up-to-date, reliable geoscience information is used to guide the safe and economical earthquake-resistant design of new buildings.

Background

Seismic requirements for construction in Utah are contained in the Uniform Building Code (UBC), adopted statewide in 1987. UBC requirements are based on two geoscience factors: (1) the seismic zone rating taken from the UBC Seismic Zone Map (derived from a map of peak horizontal ground accelerations with a 10 percent probability of being exceeded in 50 years) and (2) the site coefficient, taken from site soil information. Information with relevance to seismic zone factors and site coefficients is constantly evolving through scientific research and experience in recent earthquakes.

Geologists, seismologists, and geotechnical engineers must look at new information and lessons learned in recent earthquakes with regard to their implications for building safety in Utah, and keep structural engineers, building officials, and policy-makers aware of pertinent findings and their implications to building codes.

Implementation

New geologic, geotechnical, and seismologic (particularly strong-motion) data must be analyzed and applied to building safety. Various disciplines must coordinate activities and perform evaluations and reviews of pertinent information.

Responsible agencies

- Utah Geological Survey
- University earth-science and engineering departments
- American Society of Civil Engineers, Utah Chapter
- Association of Engineering Geologists, Utah Chapter
- Structural Engineers Association of Utah
- International Conference of Building Officials, Utah Chapter
- American Institute of Architects, Utah Chapter
- Uniform Building Code Commission

Resources Needed

Resources are needed for participation in post-earthquake investigations and key conferences and to convene local workshops; approximately $10,000 per year.

STRATEGY: Determine appropriate seismic criteria and procedures for evaluating performance of existing dams.

OUTPUT: Guidelines for seismic safety assessments of existing dams.

OUTCOME: Uniform, state-of-the-art assessments of seismic safety of dams.

Background

The State of Utah has a program for protecting public health and welfare by regulating the safety of several hundred existing dams. Among the issues considered in this program is the performance of dams under seismic loading. Current regulations require estimation of the maximum acceleration and an "operating-basis" acceleration at each dam determined to have questionable future performance. These regulations require embankments to have "acceptable" deformations under maximum acceleration loading and essentially no deformations under the operating-basis acceleration. The reliability of deformation predictions is of concern with respect to public safety. Are procedures for predicting earthquake ground motions and embankment deformations sufficiently reliable that relatively little post-deformation freeboard should be required? Or are these procedures sufficiently uncertain that the predicted deformations could result in dangerous overtopping? Should the operating basis acceleration be defined as the largest likely to be experienced during the useful life of the dam or a period of economic depreciation?

Costs of rehabilitation of existing dams can be extremely high, and many dams are owned by rural water districts that depend on the water but do not have spare financial resources. The State is charged with protecting public health, safety, and welfare; the dam owners are charged with maintaining their facilities and providing water for the welfare of people in their service areas. Accurate acceleration values and reliable procedures for evaluations of dam seismic response are important for state agency personnel and dam owners to maintain safe and economical dams.

Implementation

This strategy requires two parts: (1) a detailed evaluation of maximum earthquakes together with attenuation of ground motion with distance, and (2) a detailed evaluation of the reliability of alternative procedures for predicting the seismic response of dams.

Responsible Agencies
Utah Department of Natural Resources, Division of Water Rights

Resources Needed
Research for this initiative is estimated at $200,000 over a two-year period.

STRATEGY: Reduce earthquake-induced liquefaction risk to highway structures.

OUTPUT: Identify all hazardous bridges; generate a plan for mitigation of each structure.

OUTCOME: Highway bridges are safer in the event of earthquake-induced liquefaction.

Background

Earthquake-induced liquefaction is a major cause of earthquake damage to bridges. Areas prone to liquefaction include floodplains and other lowland areas where water tables are shallow and sediments are of recent deposition. For example, 266 highway and railway bridges were damaged or destroyed during the great 1964 Alaska earthquake due to ground displacements generated by liquefaction. Similar, but less extensive bridge damage occurred during earthquakes near Charleston, South Carolina, in 1886; San Francisco, California, in 1906 and 1989; and in the Imperial Valley of California in 1979.

Several areas of Utah have been identified as susceptible to liquefaction during moderate to large earthquakes. Some segments of major roadways, including Interstate highways and primary arteries, and many segments of secondary routes cross these potentially hazardous areas. A survey of bridges and bridge sites is needed to assess which bridges may be vulnerable to liquefaction-induced damage. This assessment could then be used to develop a mitigative plan to prevent or minimize damage and disruption to the highway system during future earthquakes.

Implementation

An assessment should be made of highway bridges in the state to determine their vulnerability to liquefaction-induced damage. Plans should then be made to reduce hazards through retrofit or replacement.

Responsible Agencies

Utah Department of Transportation
Help from specialists from universities and other state agencies in Utah

Resources Needed

Funding needed for assessment: $300,000.

Cost of mitigation depends on results of assessments.

STRATEGY: Determine appropriate seismic design coefficients for highway bridges.

OUTPUT: Calculate and incorporate new seismic design coefficients in design work for new bridges associated with the widening of I-15.

OUTCOME: (1) Ensure that the best available information is used for the safe and economical design of the new bridges. (2) Prevent the need for retrofit of the bridges in the near future. (3) Reduce bridge damage in an earthquake.

Background

The design of new bridge structures for the I-15 corridor requires scientists and engineers to determine the seismic forces which will act on the bridge. Recent experiences in California indicate that soft deep and stiff shallow soil profiles can significantly affect ground motions at a site. While studies and evaluations of various soil types have been prepared in California, the results of these evaluations are not directly transferrable to the existing conditions in Utah.

There is considerable uncertainty regarding appropriate design accelerations for bridges in Utah. Examining the similarities in soil conditions and the potential for large earthquakes, current design requirements in Utah appear to be unsafe based on California's experience. However, direct application of design accelerations used in California may be overly conservative because of differences in the rates of earthquake occurrence in Utah and in California. Because bridge structure (superstructure and foundation) costs and earthquake resistance can vary significantly depending of the correct design acceleration coefficient, it is important to accurately estimate this value for safe and economical design.

Implementation

This strategy would require detailed subsurface investigations (to 200 ft) at several bridge sites with soil profiles typical of that along the I-15 alignment. Based on the soil information which is collected, computer models will be used to predict the ground motions which would develop for a number of potential earthquakes.

Responsible Agencies
- Utah Department of Transportation
- Help from specialists from universities within Utah

Resources Needed
- It is estimated that costs for necessary geotechnical studies will total approximately $300,000.

STRATEGY: Develop incrementally a strong-motion program.

OUTPUT: Deploy at least 108 accelerographs in the seismic regions of the state to record strong ground shaking.

OUTCOME: The hazard of strong ground shaking from local earthquakes is better quantified so it can be correctly incorporated into safe, cost-effective design of buildings and other structures. Key information can also be rapidly available for crisis management.

Background

Measurements of actual ground-shaking are essential to ensure that buildings and structures in Utah are neither under-designed, posing a life-safety threat, nor over-designed, wasting precious resources. Engineers need, but lack, recordings of strong ground shaking from Utah earthquakes to design and construct earthquake-resistant structures (including buildings, highways, and dams) that are cost-effective. A 1989 blue-ribbon panel of national earthquake experts recommended that to obtain the necessary data, a minimum of 108 new strong-motion recording instruments (accelerographs) be installed in Utah. In 1992 the Utah Legislature appropriated $75,000 to the Utah Geological Survey (UGS) to begin a strong-motion instrumentation program, and an advisory committee of engineers and scientists was formed to guide the program. But funding was discontinued after one year. The need for strong-motion data for earthquake engineering persists--to be able to predict reliably what strong ground shaking must be anticipated and to know what forces damaged structures have experienced. Recent California earthquakes also emphasize that crisis managers quickly need reliable information on the severity and geographic extent of strong ground shaking for emergency response.

Implementation

The UGS and its strong-motion advisory committee believe that a viable strong-motion program can be established and maintained through an incremental approach. With creative planning, instruments can progressively be spread throughout the seismically dangerous areas of the state to optimize the chance of recording strong ground shaking wherever it occurs. To the extent feasible, innovative instruments will be purchased to allow at least some capability for rapidly assessing strong-motion information within minutes of a sizable earthquake along the Wasatch Front urban corridor in order to direct appropriate levels of response.

Responsible Agencies

Utah Geological Survey
University of Utah Seismograph Stations

Resources Needed

To purchase, deploy, and maintain 108 instruments over 20 years would have an annual ongoing cost of $150,000.

STRATEGY: Develop a statewide, real-time earthquake monitoring system.

OUTPUT: (1) Increased number of seismically vulnerable counties and cities in Utah for which continuous and accurate instrumental earthquake data are available. (2) Rapid emergency alert, within minutes after the occurrence of an earthquake in the Utah region, to state-agency officials, emergency managers, and the general public.

OUTCOME: Collect and distribute data needed (1) for more cost-effective earthquake engineering, (2) for more rapid and effective emergency response, (3) to reliably quantify earthquake dangers, and (4) to improve scientific understanding of local earthquake behavior, in order to better mitigate effects.

Background

Instrumental earthquake recording provides essential information needed by many state agencies and local governments for rapid emergency response, for the reliable assessment of earthquake hazards and risk, and for safe cost-effective earthquake engineering. Utah's existing seismographic network, operated by the University of Utah Seismograph Stations (UUSS), does not provide adequate instrumental coverage of many seismically dangerous parts of the state—especially outside the Wasatch Front area. Strong-motion instrumentation in Utah is greatly inadequate. Available technology, which is becoming commonplace elsewhere, needs to be incorporated to ensure automated, rapid communication of vital information—including the extent and severity of strong ground shaking—to emergency managers within minutes after any significant earthquake.

Implementation

The UUSS needs to transform Utah's existing seismographic network into a statewide, real-time earthquake monitoring system. This can be progressively accomplished in 5 years, providing coverage of all high-risk areas of Utah. Capabilities for real-time data processing and automated post-earthquake alert can be added to Utah's existing seismic network, but without effective coverage of rural Utah.

Responsible Agencies

University of Utah Seismograph Stations
Utah Geological Survey
Utah Division of Comprehensive Emergency Management
Utah Division of Information Technology Services

Resources Needed

The costs for a modest, but effective, state seismic system will require a one-time capital investment of approximately $1 million and additional ongoing costs of approximately $150,000 per year.

STRATEGY: Monitor faults using Global Positioning System (GPS) measurements.

OUTPUT: Regular monitoring of a network of GPS benchmarks.

OUTCOME: Strain buildup and ground deformation associated with faults are understood on a very detailed level, allowing more accurate estimation of the likelihood of large earthquakes and accompanying hazards.

Background

Precise surveys of ground deformation across active faults using GPS technology are a fundamental technique in modern earthquake monitoring. GPS has become the principal tool used in the National Earthquake Hazards Reduction Program for measuring the cycle of ground deformation before, during, and between large earthquakes. The value of GPS surveying was recently demonstrated in the Los Angeles basin where ground deformation was observed prior to the 1994 Northridge earthquake, indicating that rupture was likely on hidden faults such as the one that produced the magnitude 6.7 quake.

GPS measurements are particularly important in Utah for: (1) understanding how fast Utah's normal faults accumulate strain energy prior to large earthquakes, (2) assessing the likely locations and timing of future earthquakes, especially along the Wasatch fault, (3) identifying hidden faults that may underlie Utah's densely populated valleys, and (4) evaluating how the broad warping of the earth's surface during future large earthquakes may cause Great Salt Lake or Utah Lake to inundate neighboring areas.

Implementation

Utah needs a statewide network of GPS survey benchmarks that are systematically observed with a pool of at least five GPS receivers. This effort requires (1) a plan for periodic and prioritized surveys of Utah's major active faults, and (2) integration of GPS data collection with other earthquake monitoring and with high-precision surveying for state, county, and local engineering. A stable long-term funding base is essential.

Responsible Agencies

University of Utah Seismograph Stations
Utah Geological Survey
County Surveyors: Salt Lake, Davis, Weber, Box Elder, Utah, among others

Resources Needed

Approximately $150,000 would be required for one-time acquisition of five dual-frequency GPS receivers, together with ancillary equipment. Recurring costs for field operations, data processing, data archiving, equipment upgrades, and coordination with cooperating agencies would require about $70,000 per year.

Objective 5:

Assess earthquake risk.

STRATEGY: Update estimates of direct losses expectable from earthquakes.

OUTPUT: Comprehensive studies to estimate the potential losses of life, number of injuries, and damages to structures and lifelines from earthquakes of various magnitudes and locations.

OUTCOME: Earthquakes are placed in a proper policy perspective based on credible projections of losses and societal impacts; emergency planning is improved; and long-term hazard-reduction activities are prioritized.

Background

Utah's last comprehensive forecast of earthquake losses was published in 1976 and is out of date. Subsequent studies have restrictively analyzed losses, say, to buildings only, or apply to restricted areas, such as Salt Lake County. In 1991, the Federal Emergency Management Agency (FEMA) funded the non-profit, California-based Applied Technology Council (ATC) to develop methods to estimate losses, including casualties, and apply these methods to estimate losses associated with a magnitude 7.5 earthquake in Salt Lake County. This and a study by the University of Utah Geography Department considered only losses in Salt Lake County. FEMA and the National Institute of Building Sciences (NIBS) have also developed a draft methodology (planned for release in 1996) to estimate earthquake losses at various levels of detail, depending on available data bases and technical experience of those performing the analysis.

Implementation

In order to establish credible forecasts of earthquake losses in Utah, various methodologies, together with available information, must be carefully evaluated. This will require close coordination among technically diverse experts and the use of both scenario-based and probabilistic risk methods for damage and casualty estimates. Available methodologies include those developed by the ATC, FEMA/NIBS, and the University of Utah Department of Geography. The Utah Seismic Safety Commission can provide a suitable forum for coordinating the interdisciplinary teams and studies required to produce well-founded estimates of direct losses expectable from earthquakes in Utah. These estimates must account for significant differences due to time of day and season. Also, loss estimates are needed for specific classes of buildings, such as schools, and for different levels of ground shaking accompanying moderate to large earthquakes, so that the cost-effectiveness of retrofit options and other loss-reduction measures can be realistically evaluated.

Responsible Agencies

- Utah Seismic Safety Commission
- Utah Division of Comprehensive Emergency Management/Utah Geological Survey/other data providers
- Utah Division of Risk Management/other users of loss estimates
- Structural Engineers Association of Utah

Resources Needed

- Cost to review methods and determine needs: $30,000.
- Cost to apply University of Utah methods: not available at this time.
- Cost to apply ATC-36 methods: not available at this time.
- Cost to apply FEMA/NIBS methods to first earthquake scenario: $250,000.

STRATEGY: Evaluate the indirect losses associated with earthquakes.

OUTPUT: A study assessing the indirect economic losses from earthquakes including: wage and job loss, rebuilding cost, impacts on insurance and financial institutions, and costs of business interruption and failure.

OUTCOME: Identification of indirect economic impacts, resulting in increased preparedness, more rapid recovery, and wise resource allocation.

Background

An earthquake may only last for thirty seconds, but the indirect effects and recovery can last for months or years. The rate of small business failures following an earthquake is high. Also, financial and insurance institutions will incur costs, including disruption of electronic communications and loan/premium payments. Once the costs are known, institutions and businesses can act accordingly in pre-disaster recovery planning.

Implementation

This strategy would be best implemented using the results of a study to estimate the direct losses from an earthquake (see Strategy 5.1). Economists will then be able to estimate indirect losses from direct losses from various scenario earthquakes in various areas. A team of economists will need to be assembled and funding sought to perform the study.

Responsible Agencies
- Utah Seismic Safety Council
- Utah Division of Comprehensive Emergency Management
- Utah Department of Commerce
- Utah Division of Risk Management

Resources Needed
- Cost for study unknown at this time.

STRATEGY: Conduct lifeline collocation vulnerability studies.

OUTPUT: All lifeline collocation sites in UBC seismic zone 3 are identified; a plan is developed for each one.

OUTCOME: During an earthquake emergency, damaged lifelines in one area will not cripple each other.

Background

In many locations, various lifelines, including pipeline, rail, highway, electric, and communications are located within close proximity of each other, either in defined corridors or at crossings. Seismic damage to one lifeline may easily impact adjacent lifelines. The Federal Emergency Management Agency (FEMA) has funded the study of earthquake-induced failure of the concentrated lifelines at the Beck Street overpass area in Salt Lake City; numerous other similar locations exist along the Wasatch Front.

Implementation

Undertake studies to identify all critical collocation sites within UBC seismic zone 3. Establish a task force of public and private sector lifeline operators to evaluate the potential impacts of their facilities from damage to adjacent lifelines.

Responsible Agencies

Utah Division of Comprehensive Emergency Management
Utah Department of Transportation
Municipal and private utilities, railroads, and pipeline operators

Resources Needed

Cost to identify UBC seismic zone 3 collocation sites and perform screening studies to identify potential risks, using existing methods and data: $100,000.

Cost to perform detailed studies depends on number and complexity of sites and quality of existing data.

GLOSSARY OF TERMS

Aftershock—an earthquake that follows a larger earthquake in the same general area. The number and sizes of aftershocks normally decrease over time, but many are capable of causing injury and damage.

Debris Flow—a muddy slurry of water, soil, rock, and organic material much like wet concrete that flows downslope.

Earthquake—the shaking or vibrating of the ground caused by the sudden release of energy stored in rock beneath the earth's surface.

Epicenter—the point on the surface of the earth directly above the focus or hypocenter (origin) of an earthquake. Point directly above where an earthquake originates.

Fault—a fracture in the earth along which the two sides have been displaced relative to one another.

Focus (hypocenter)—the initial point of rupture of an earthquake below the surface; the point within the earth that is the origin of an earthquake.

GPS—"Global Positioning System" technology, based on satellite signals, that allows the horizontal and vertical position of a point on the earth to be measured with a precision as fine as a centimeter or less using portable receivers.

Hazard—any physical phenomenon that has the potential to produce harm or other undesirable consequences to some person or thing.

Landslide—a general term for any type of downslope movement of rock and soil under the influence of gravity.

Lifelines—utility lines used for the distribution and transmission of oil, gas, water, sewer, and telephone and electrical service.

Liquefaction—loss of strength caused when water-saturated, sandy soils react to vibrations and temporarily act like a liquid.

Magnitude—a quantity characteristic of the total energy released by an earthquake. The Richter Scale is commonly used for Utah earthquakes. It is a logarithmic scale based on the motion that would be measured by a standard (Wood-Anderson) type of seismograph, 100 kilometers (60 miles) from the epicenter.

Non Structural—curtain walls, non-bearing partitions, suspended ceilings, water heaters, filing cabinets, etc.

Normal Fault—dipping fault where the upper block drops down relative to the lower block on the other side. Most Utah faults are normal faults.

Real-Time Monitoring—the recording and processing of seismic data in such a way that immediate post-earthquake information is available within minutes to emergency managers. (Standard earthquake-monitoring schemes typically involve a delay of a half-hour to an hour before seismologists can report the location, size, and extent of an earthquake.)

Retrofit—repair, brace, and strengthen buildings and structures to resist seismic forces.

Risk—the probability that the potential harm or undesirable consequences of a hazard will be realized; the combination of the hazard and the vulnerability.

Seismic—pertaining to an earthquake or earth vibration.

Seismograph—an instrument that records waves generated by an earthquake.

Seismogram—a recording of earthquake waves by a seismograph.

Soil-foundation problems—excessive settlement or heave of soil beneath a building, causing damage to the foundation.

Strong-Motion Instrument—a rugged, low-magnification seismograph designed to record the amplitude, frequency, and duration of strong ground shaking that is potentially damaging to structures.

Unreinforced Masonry—buildings or structures built of brick, concrete, and glass block, hollow clay tiles, or stone that are not reinforced with steel mesh or reinforcing bars.

Zone of Deformation—distortion, slumping and cracking of the ground surface (mainly on the valley side) at or very near the line where a fault breaks or intersects the surface.

Vulnerability—susceptibility to physical injury, harm, or damage.

APPENDIX

The Utah Seismic Safety Advisory Council (USSAC) Members, 1977-1981:

Harvey L. Hutchinson	Chairman; Civil Engineer, Utah Water Conservancy District (Utilities)
Stanley W. Crawley	Vice-Chairman; Professor, Graduate School of Architecture, University of Utah (Architecture)
Genevieve Atwood	Representative, Utah Legislature (Public-at-Large)
Jerold H. Barnes	Director, Salt Lake County Planning Department (Planning)
Winfred O. Carter	Professor, Department of Civil Engineering, Utah State University (Engineering)
William J. Gordon	Geotechnical Engineer, Dames & Moore (Geotechnical Engineering)
Bruce N. Kaliser	Engineering Geologist, Utah Geological Survey (Geology)
Harvey W. Merrell	Utah Association of Counties
Joyce U. Miller	Utah League of Cities and Towns
Donald J. Peck	Public-at-Large
Robert B. Smith	Professor, Department of Geology and Geophysics, University of Utah (Seismology)
Delbert B. Ward	Executive Director; Adjunct Associate Professor, Graduate School of Architecture, University of Utah

The Utah Advisory Council for Intergovernmental Relations, Earthquake Task Force Members, 1989-1991:

Ken Alkema	Director, Utah Division of Environmental Health
M. Lee Allison	Director, Utah Geological Survey
Walter J. Arabasz	Director, University of Utah Seismograph Stations
Kenneth Bullock	Executive Director, Utah League of Cities and Towns
Michael Christensen	Deputy Director, Governor's Office of Planning and Budget
Carl Eriksson	Inspection Services Manager, Salt Lake County
Lorayne M. Frank	Director, Utah Division of Comprehensive Emergency Management

Brent Gardner	Executive Director, Utah Association of Counties
Pat Iannone	Utah Association of Realtors
David L. Johnson	Deputy Director, Utah Department of Administrative Services
Kenneth W. Karren	Structural Engineer, Karren and Associates
Jerrianna Kolby	American Red Cross
Dennis Lifferth	Church of Jesus Christ of Latter-Day Saints
Peter W. McDonough	Senior Operations Engineer, Mountain Fuel Supply Company
Kenneth J. Naylor	American Institute of Architects, Utah Chapter
Ray Nielsen	Representative, Utah Legislature
Craig A. Peterson	Senator, Utah Legislature
Lawrence D. Reaveley	Chairman, Utah Geological Survey Board
Carole Scott	Mayor, Town of Manila
Wilford H. Sommerkorn	Assistant Director, Davis County Planning Department
Neal P. Stowe	Director, Utah Division of Facilities Construction and Management
Richard Thorn	Associated General Contractors
T. Leslie Youd	Professor, Department of Civil Engineering, Brigham Young University

The Utah Earthquake Advisory Board (UEAB) Members, 1991-1994:

Lorayne M. Frank	Chairperson; Director, Utah Division of Comprehensive Emergency Management
M. Lee Allison	Director, Utah Geological Survey
Walter J. Arabasz	Director, University of Utah Seismograph Stations
Kenneth Bullock	Executive Director, Utah League of Cities and Towns
David Curtis	Engineer, Curtis Engineering; Structural Engineers Association of Utah
Frank M. Fuller	Project Coordinator, Utah Division of Facilities Construction & Management

James W. Golden	Assistant Chief Structural Engineer, Utah Department of Transportation
Steven M. Klass	Governor's Office of Planning and Budget, 1991-1993 (Assistant State Planning Coordinator)
John A. Harja	Governor's Office of Planning and Budget, 1993-1994 (Senior Research Analyst)
Suzanne Winters	Governor's Office of Planning and Budget, 1994 (State Science Advisor)
Michael Stransky	American Institute of Architects, Utah Chapter, 1991-1993 (Architect, Stransky and Associates)
Barry Smith	American Institute of Architects, Utah Chapter, 1993-1994 (Architect, Astle-Ericson & Associates)
T. Leslie Youd	Civil Engineer, Brigham Young University; American Society of Civil Engineers, Utah Chapter

The Standing Committees of the UEAB, 1993-1994:

Awareness and Education Standing Committee—M. Lee Allison, Chairperson

Kathy Bledsoe	Parent Teacher Association
Rex Curtis	Retired School Teacher
Steve Lutz	Director, State Fire Academy
Gary Madsen	Associate Professor, Department of Sociology, Utah State University
Hollie Muir	Disaster Education Coordinator, American Red Cross
DeeDee O'Brien	Outreach Coordinator, College of Mines and Earth Sciences, University of Utah
Patrick Reese	Emergency Response, Church of Jesus Christ of Latter-Day Saints
Kay Sadler	MIS Director, West Valley City
Kimm Williams	Public Information Officer, Utah Division of Comprehensive Emergency Management

Engineering and Architecture Standing Committee—David Curtis, Chairperson

Carl Carpenter	Principal Engineer, Provo City Water Resources Department
Scott Ellis	Structural Engineer, Ellis and Associates
Frank M. Fuller	Project Coordinator, Utah Division of Facilities Construction & Management
James W. Golden	Assistant Chief Structural Engineer, Utah Department of Transportation

Peter W. McDonough	Senior Operations Engineer, Mountain Fuel Supply Company
Barry Smith	Architect, Astle-Erickson & Associates
Michael Stransky	Architect, Stransky and Associates

Geoscience Standing Committee—Walter J. Arabasz, Chairperson

M. Lee Allison	Director, Utah Geological Survey
Jeffrey R. Keaton	Senior Engineering Geologist and Vice President, AGRA E and E, Inc.
William R. Lund	Deputy Director, Utah Geological Survey
James C. Pechmann	Research Associate Professor, Department of Geology and Geophysics, University of Utah
Kyle M. Rollins	Assistant Professor, Department of Civil Engineering, Brigham Young University
T. Leslie Youd	Professor, Department of Civil Engineering, Brigham Young University

Response and Recovery Standing Committee—Lorayne M. Frank, Chairperson

Roger Anderson	Assistant Director, Davis County Emergency Services
Roger Forsberg	Manager of Performance Management, Thiokol Corporation
LeGrand Jones	Loss Control Administrator, Utah Department of Transportation
Deborah H. Kim	Emergency Services & Trauma Coordinator, University of Utah Medical Center
Jeff Rylee	Director, Salt Lake City Emergency Services

The Utah Seismic Safety Commission (USSC) Members, 1994:

T. Leslie Youd	Chairperson; Department of Civil Engineering, Brigham Young University; American Society of Civil Engineers, Utah Chapter
Craig A. Peterson	Senator, Utah Legislature
Clark Reber	Representative, Utah Legislature
D. Douglas Bodrero	Commissioner, Utah Department of Public Safety
M. Lee Allison	Director, Utah Geological Survey

Walter J. Arabasz	Director, University of Utah Seismograph Stations
James Bailey	Structural Engineer, Allen & Bailey Engineers; Structural Engineers Association of Utah
Kenneth Bullock	Executive Director, Utah League of Cities and Towns
Lorayne M. Frank	Director, Utah Division of Comprehensive Emergency Management
James W. Golden	Assistant Chief Structural Engineer, Utah Department of Transportation
William E. Juszcak	Project Coordinator, Utah Division of Facilities Construction & Management
Barry Smith	Architect, Astle-Ericson & Associates; American Institute of Architects, Utah Chapter
Suzanne Winters	State Science Advisor, Governor's Office of Planning & Budget

For More Information Contact the Following:

For questions about earthquake preparedness—

The Utah Division of Comprehensive Emergency Management
1110 State Office Building
Salt Lake City, Utah 84114
(801) 538-3400

For questions about geology, faulting, and natural hazards in Utah—

Utah Geological Survey
2363 South Foothill Drive
Salt Lake City, Utah 84109-1497
(801) 467-7970

For questions about earthquake monitoring and research—

University of Utah Seismograph Stations
705 William C. Browning Building
Salt Lake City, Utah 84112-1183
(801) 581-6274

For general geologic information—

U.S. Geological Survey
Earth Science Information Center
2222 W. 2300 South
Salt Lake City, Utah 84119
(801) 975-3742

For emergency services information—

American Red Cross
1391 South Park Street
P.O. Box 6279
Salt Lake City, Utah 84152-6279
(801) 467-7339

Earthquake Safety in Utah

USSC

DECEMBER 2000

A Progress Report on the Activities and Accomplishments of the

UTAH SEISMIC SAFETY COMMISSION

for the Period July 1, 1996 to June 30, 2000

EARTHQUAKE SAFETY IN UTAH

USSC

DECEMBER 2000

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UTAH SEISMIC SAFETY COMMISSION

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Utah Seismic Safety Commission, December 2000

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Suzanne Winters
Representing the State Planning Coordinator

Former Commission Members During July 1996-June 2000

M. Lee Allison, 1994-1999
Utah Geological Survey

James S. Bailey, 1994-2000
Structural Engineers Association of Utah

Dan Bauer, 1998-2000
Representing the State Planning Coordinator

Commissioner D. Douglas Bodrero, 1994-1997
Department of Public Safety

Kenneth H. Bullock, 1994-1999
Utah League of Cities and Towns

Commisioner Craig L. Dearden, 1997-2000
Department of Public Safety

Lorayne M. Frank, 1994-1998
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James W. Golden, 1994-1999
Utah Department of Transportation

Kimm Harty, 1999-2000
Utah Geological Survey

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Utah Division of Facilities Construction Management

Senator Craig A. Peterson, 1994-1998
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Representing the State Planning Coordinator

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Commission Chair, 1994-1997
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Commission Staff, December 2000

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Utah Division of Comprehensive Emergency Management

Amisha Lester
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Francis X. Ashland
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Former Commission Staff During July 1996-June 2000

Utah Division of Comprehensive Emergency Management

Brenda Edwards, 1995-1997
Sylvia Haro, 1997-1998

Utah Geological Survey

Gary E. Christenson, 1994-1997
Janine Jarva, 1994-1998
Tim Madden, 1998-2000
Barry Solomon, 1997-2000

Acknowledgments

The Commission is greatly indebted to its staff and to the many members of its various committees, identified in Appendix A, for both past and ongoing efforts in helping to advance earthquake safety in Utah. We give special thanks to Tim Madden for his assistance in compiling and editing an earlier draft version of this report, which included many of the descriptions of the activities and accomplishments of the Commission and most of the survey of seismic safety initiatives summarized in Appendices E, F, and G. We also thank the many respondents to surveys described in this report relating to: (1) earthquake preparedness in schools, (2) earthquake safety awareness in businesses and communities, and (3) lifeline inventories.

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FOREWORD

We know for certain that Utah's people, built environment, and economy are all exposed to a real and constant earthquake threat. Most Utahns view earthquake dangers as more unlikely than they truly are, and risk—the likelihood of loss—is increasing because of dramatic population and urban growth in earthquake-prone areas like the Wasatch Front.

A report issued in September 2000 by FEMA, the Federal Emergency Management Agency, called *HAZUS99 Estimated Annualized Earthquake Losses for the United States,* helps to place Utah's earthquake risk in perspective. According to the report, projections of direct economic losses in Utah to the building stock alone (damage repair, rebuilding, loss of contents and use)—factoring in both infrequent large earthquakes and more frequent moderate-size shocks—add up to **$51.5 million per year** on an annualized basis. Like an actuarial statistic, this is the loss that is expected, averaged over time.

The FEMA report ranks Utah **seventh** in the Nation in absolute risk and **sixth** in relative risk when one takes the ratio of the average annualized earthquake loss to the replacement value of the building inventory. The report emphasizes that the loss estimates are extremely conservative because they do not cover damage and losses to critical facilities, transportation systems, and utility lifelines—nor indirect economic losses (ripple effects on economic sectors that do not sustain direct damage).

What about losses in a single big quake? A study reported in 1997 by the Applied Technology Council in California estimates that the expected direct economic losses to buildings and lifelines for a magnitude 7.5 earthquake in Salt Lake County would be approximately **$12 (±3) billion**. If one adds indirect economic and social losses (casualties, displaced households, and short-term shelter needs), total losses could be 20 percent higher, putting the total in the range of $11 billion to $18 billion.

Will such a "big one" happen in our lifetime? Geologists debate whether the chance of a big quake on the Wasatch fault in the Salt Lake Valley in the next 50 years is closer to 5 percent or 25 percent. In either case, it's clear that we're playing Russian roulette with stored-up earthquake energy on the Wasatch fault—and other active faults—in Utah.

During the past 5600 years, large earthquakes have occurred on the Wasatch fault's Salt Lake City segment about once every 1400 years, and the last one was almost that long ago. The Wasatch fault has unleashed a magnitude-7-size shock along one or another of its five segments between Brigham City and Nephi every 350 years on average in the past 5600 years. The last one happened about 600 years ago near Provo.

Utah is not as prepared as it needs to be to withstand, respond to, and recover from future earthquakes—including damaging, moderate-size shocks in the magnitude 5 and 6 range. Since the 1950s, shocks of this size have occurred in the Utah region one to three times every decade, and growth is increasing the odds that populated areas will be hit.

The mission of the Utah Seismic Safety Commission is to improve earthquake safety in Utah—to save lives, prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes. Individuals and communities don't have to be at the complete mercy of earthquake forces. We **can** have some control, and we **can** reduce earthquake losses.

Lessons learned from earthquake disasters around the world point the way to improving earthquake safety in Utah:

- heightened public awareness and consumer demand for earthquake safety
- better building codes and enforcement
- strengthening of vulnerable buildings
- prudent urban planning and development
- improved design and protection of critical infrastructure
- better tools and readiness for emergency response and recovery
- better information on geological hazards and their effects, especially in urban areas
- and the joint commitment and leveraging of public and private funding to achieve the above

This progress report on the activities and accomplishments of the Utah Seismic Safety Commission during 1996-2000 includes many successes. What has worked best for the Commission has been an ongoing response to its statutory charge to "act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures."

We've taken most of the easy steps towards earthquake preparedness that require only modest resources. There remains the challenge of taking key long-term defensive actions that will require larger funding in the range of hundreds of thousands to millions of dollars. The willingness of the public and private sectors in Utah to make such investments ought to be guided by sensible principles of risk management—as was the praiseworthy decision to use high seismic design standards in rebuilding I-15.

Faced with the projection of annualized earthquake losses of $51.5 million per year, or with the prospect of losses of $11 billion to $18 billion from a single large earthquake on the Wasatch fault, decision-makers in Utah must deal with this risk in informed realistic ways.

For our part, we on the Utah Seismic Safety Commission are keenly aware of the dangerous mix in the Wasatch Front area of (1) dramatically increasing population,
(2) complex and costly urban infrastructure, and (3) pent-up earthquake energy. And we are equally aware that earthquakes in Utah are not just a Wasatch Front problem.

We pledge to continue our efforts to advance earthquake safety in Utah—and we look forward to a continuing partnership with public and private leaders to reduce the impact of future earthquakes on people, homes, businesses, and communities in Utah.

Walter J. Arabasz
Chair, Utah Seismic Safety Commission

EXECUTIVE SUMMARY

Since 1995 when the Commission created *A Strategic Plan for Earthquake Safety in Utah*, 27 (or three-fourths) of its 35 strategic objectives have either been successfully met or are being addressed in an ongoing way. This report describes varied activities and accomplishments of the Commission—either initiated, planned and executed, influenced, or engaged in—during the four-year period from July 1996 through June 2000. An earlier progress report for the period from July 1994, when the Commission was formed, through June 1996 was issued in November 1996.

This report also details the results of a survey on earthquake awareness issues. The survey, which supplements an earlier survey summarized in the 1996 progress report, was sent to counties, cities, and major employers throughout the state. The latest survey was intended to gather information on earthquake-related regulations, enforcement activities, reviews, educational practices, and mitigation efforts in Utah by private and governmental entities, and to evaluate the level of commitment those entities place on earthquake safety. Generally speaking, the survey shows that the larger the entity, public or private, the higher the priority given to earthquake safety.

The USSC maintains five Standing Committees, greatly enlarging the number of individuals actively involved in carrying out the work of the Commission. These committees respectively focus on (1) Awareness and Education (incorporating an earlier separate committee on Emergency Management), (2) Engineering and Architecture, (3) Geoscience, (4) Lifelines and Infrastructure, and (5) Intergovernmental Relations. The Commission also depends heavily upon the Utah Division of Comprehensive Emergency Management, the Utah Geological Survey, and the University of Utah Seismograph Stations—three key partners in Utah's state earthquake program—to pursue the Commission's goals.

Some of the notable activities and accomplishments of the Commission during the report period, organized under nineteen topical issues and actions, include the following:

- **Seismic safety in school construction:** Beginning in 1997, advocacy by the Engineering and Architecture Committee—and consensus-building with school districts—resulted in the adoption of regulations by the State Board of Education in 1999 that require all new school construction (and major additions to existing facilities) in regions of moderate to high seismic risk to undergo seismic quality control reviews by a licensed structural engineer.

- **Prepared schools:** The Schools Subcommittee of the Awareness and Education Committee gained the cooperation of school administrators, teachers, and parents in helping prepare K-12 schools for earthquakes and other disasters. A 1998 survey of emergency preparedness sent to 731 public schools (50 percent response) and 102 private schools (25 percent response) has formed the basis of an ongoing "Prepared Schools Project" under which schools can qualify for reduced insurance premiums. The Schools Subcommittee received a national award in excellence for educational outreach to schools

for its project, "Prepared Schools for Effective Drills and Safe Surroundings."

- **Involving businesses and institutions in seismic safety planning:** The Awareness and Education Committee planned and convened three conferences—in 1996, 1997, and 1998—to motivate businesses and institutions to include earthquake safety in their contingency planning and to help businesses survive and recover from earthquakes. The conferences successfully attracted more than 500 participants, received prominent newspaper and TV media coverage, distributed volumes of reference material and self-help guides, and raised public awareness of practical steps that can increase earthquake safety and economic survival.

- **Recognizing efforts of businesses, governments, schools, and individuals to improve seismic safety in Utah:** In 1996 and 1997 the Commission publicly recognized and made awards for excellence and outstanding contributions to earthquake safety in Utah. In 1996 the Award for Outstanding Contributions to Earthquake Saftey in Utah went to the *Salt Lake Tribune* and its science writer, Lee Siegel (for informative reporting on many earthquake-related issues in Utah); in 1997, to Mountain Fuel Supply Company (for seismic strengthening of its facilities and varied efforts in earthquake awareness). Certificates of Excellence were awarded in 1996 to Brigham Young University (for campus- and community-wide safety efforts), the Salt Lake City School District (for pioneering efforts in seismically strengthening local schools), and Hyde Park City (for diverse community actions in earthquake preparedness); in 1997, to the Utah Department of Transportation (for state-of-the-art seismic design in the Interstate 15 reconstruction project).

- **Recognition of efforts by Commission staff to advance earthquake education and awareness:** Three public-education projects undertaken in coordination with the Commission received awards in excellence in 1997 from the Western States Seismic Policy Council. These involved (1) providing earthquake-related curriculum material and training to teachers in Utah schools together with developing and circulating a traveling exhibit on *Earthquakes in the Intermountain West*, (2) publishing *The Utah Guide for the Seismic Improvement of Unreinforced Masonry Buildings*, and (3) producing a series of maps and brochures that describe earthquake hazards and risk in Utah.

- **Building code enforcement and plan review:** In 1996 the Engineering and Architecture Committee prepared a White Paper on building-code enforcement and plan review recommending amendments to state law that would ensure code enforcement and provide for licensing or certification of building officials and plans examiners throughout the state. Draft legislation based on these recommendation failed in the Utah legislature in 1997. There have been ongoing efforts to effect rules changes through the Utah Division of Professional Licensing.

- **Seismic strengthening of existing buildings:** Since April 1999 the Commission has

been (1) actively advocating seismic upgrading of unreinforced masonry buildings when their lives are extended through major remodeling and (2) enforcement of an existing statewide ordinance that requires building owners to install roof anchors and parapet bracing when reroofing their buildings. These efforts involve partnering with the Structural Engineers Association of Utah and the Uniform Building Code Commission.

- **Seismic vulnerability of state buildings:** In 1996 the Commission attempted unsuccessfully to advocate dedicated state funding for progressively remediating the seismic vulnerability of older state-owned buildings. In October 1999, Commissioner Matthias Mueller of the Division of Facilities Contruction and Management outlined results of a survey of 193 older state buildings indicating that 111 of the 193 buildings surveyed by that date needed structural upgrading. Progress is being incrementally made in seismically strengthening selected state-owned buildings as part of major remodeling projects.

- **The safety of construction in downtown Salt Lake City:** In 1998 and 1999 the Commission served as a sounding board and forum for concerns about fault-displacement hazards associated with active faults in the Salt Lake City metropolitan area. The public discussions related to (1) active-fault maps and geotechnical reports required for building permits and (2) whether an active fault is under the site of an expansion to the Salt Palace. Some issues for earthquake-hazard ordinances in Salt Lake County remain unresolved. For the Salt Palace construction, both Salt Lake County and Salt Lake City accepted a finding that geological features uncovered in the Salt Palace excavation were liquefaction-induced and not directly associated with an active fault.

- **Vulnerability of the state's lifelines, infrastructure, and water and wastewater systems:** Since 1998 the Lifelines and Infrastructure Committee has been involved in an ongoing project to create a GIS-based inventory of all the important lifelines in Utah, including transportation routes and utility corridors, with a primary focus on the Wasatch Front area. The Commission sponsored educational presentations to operators of water and wastewater systems in Utah to help them evaluate the seismic vulnerability of their own systems. The Commission is also partnering with other state groups to make Utah's critical infrastructure disaster-resistant.

- **Interstates 15 and 80 bridge reconstruction:** In 1996, four members of the Commission's Geoscience Committee served on an I-15 Corridor Seismic Advisory Committee to assist the Utah Department of Transportation (UDOT) in establishing seismic design criteria and in reviewing and making recommendations on the acceptability of earthquake-related studies and design recommendations made by I-15 consultants. The committee persuaded UDOT to use design standards for I-15 that were higher than those it conventionally uses so that freeway bridges would not collapse but at most sustain reparable damage during a large earthquake on the Wasatch fault. UDOT is

also attending to reinforcement of aging highway bridges on I-80 between State Street and Parley's Canyon in the Salt Lake Valley.

- **Local government needs for geoscience information and training to reduce risks from earthquakes and other geologic hazards:** In 1999 the Geoscience Committee and the Utah Geological Survey jointly established a Guidelines Advisory Committee to work with local governments to determine what information products and services relating to geologic hazards were needed, who should provide them, and what resources were needed. A final report was completed in late 1999. The committee addressed the possible roles of local government insurers—Utah Risk Management Mutual Agency and Utah Local Governments Trust (UGLT)—in encouraging risk reduction.

- **Recognizing earthquake hazards, assessing risks for communities, and preparing communities for emergency response:** Since 1997 the Utah Division of Comprehensive Emergency Management, together with the Commission's Emergency Management Committee, has been involved in (1) implementing Hazards United States (HAZUS), a geographic information system-based software package that identifies earthquake hazards and assesses the loss-vulnerability of communities and (2) providing Community Emergency Response Team (CERT) training. Both projects are greatly advancing earthquake preparedness in Utah.

- **Real-time earthquake information system and strong-motion recording:** Initiatives aimed at strong-motion instrumentation and real-time earthquake information capabilities have long involved scientists and engineers from the University of Utah Seismograph Stations (UUSS), the Utah Geological Survey, and the Commission**.** Efforts finally bore fruit in 1999 with the announcement that UUSS would receive federal funding during fiscal year 2000 under a cooperative project with the U.S. Geological Survey to begin building a real-time urban strong-motion network in the Ogden-Salt Lake City-Provo urban corridor before the 2002 Winter Olympics. The system will rapidly provide automatically-generated earthquake alerts and computer maps of the intensity and extent of strong ground shaking within minutes of a sizable local earthquake.

- **A Unified Utah Earthquake Master Model:** In 1997 the Commission and its Geoscience Committee deliberated on new information and an action proposal for "A Unified Utah Earthquake Master Model" from Professor Robert Smith, University of Utah, relating to deformation measurements across the Wasatch fault from Global Positioning System (GPS) monitoring. While the Commission has adopted a cautious approach to interpreting higher-than-expected rates of deformation reported from the GPS monitoring, Professor Smith continues to provide a valuable service in developing and operating arrays of GPS instruments for continued monitoring of earth deformation in Utah.

- **National Science Foundation request for proposals to fund earthquake engineering centers:** In 1996 the Commission voted unanimously to support a competitive proposal to the NSF from a consortium—including Brigham Young University, Utah State University, the University of Utah, Portland State University, the Oregon Department of Mineral Industries, and the Utah Geological Survey—to develop an earthquake-engineering research center in Utah. In April 1997, after the proposal had been submitted, NSF revised the program announcement and ultimately funded centers in California, New York, and Illinois.

- **The relevance of Seismic Safety Commissions:** In 1999 an invited presentation by the chair of the Nevada Earthquake Safety Council inspired the Commission (1) to seek an amendment to the Utah Seismic Safety Commission Act of 1994 that would allow the USSC to solicit and receive external funding and (2) to pursue more aggressively better building codes and their enforcement for earthquake safety. The Utah Seismic Safety Commission Act was successfully amended in the 2000 general session of the Legislature, and the Engineering and Architecture Committee—jointly with the Structural Engineers Association of Utah—began to champion the seismic strengthening of existing buildings.

- **Disaster-resistant communities:** The dramatic growth and development in Utah's Greater Wasatch Area increases the urgency of taking actions that will make Utah's communities more disaster resistant. Funding from the Federal Emergency Management Agency under *Project Impact* to selected cities (Centerville, Salt Lake City, Logan, Moab, Provo) is advancing this goal.

- **Commission Meetings Outside the Salt Lake City Area:** Quarterly meetings of the Commission outside the Salt Lake City metropolitan area have become a valuable out-reach tactic to promote earthquake awareness and planning. In April 1998 the Commission met in Brigham City with the public and with officials from Box Elder, Cache, and Weber Counties. In April 2000 the Commission similarly traveled to the campus of Brigham Young University in Provo to meet with local and county officials in Utah County. [In April 2001 the Commission will meet in Ogden.]

The Commission's priorities for the future include: expanding its "Prepared Schools" program; advocating requirements for strengthening older existing buildings; improving the survivability and post-earthquake usability of essential service buildings; evaluating the seismic vulnerability of Utah's lifelines; ensuring that geologic-hazards investigations are performed for the safe siting of all new schools and critical public facilities; assisting local governments to reduce risks from earthquakes and other geologic hazards; supporting continued development of urban strong-motion monitoring and a real-time earthquake information system in the Wasatch Front area; ensuring that design professionals and building officials are kept current on relevant geoscience information; and advocating the disclosure of known geologic hazards in real-estate transactions so that homebuyers are appropriately informed of the risk they are assuming.

INTRODUCTION

In 1994 the Utah State Legislature created the Utah Seismic Safety Commission (USSC) with the explicit charge (see Appendix B) to do the following:

(a) review earthquake-related hazards and risks to the state of Utah and its inhabitants;
(b) prepare recommendations to identify and mitigate these hazards and risks;
(c) prioritize recommendations and present them to state and local governments or other appropriate entities for adoption as policy or loss reduction strategies;
(d) act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures;
(e) prepare a strategic seismic planning document to be presented to the State and Local Interim Committee before the 1995 general session of the legislature; and
(f) periodically update the planning document and monitor progress towards achieving the goal of loss reduction.

The mission of the Utah Seismic Safety Commission is to improve earthquake safety in Utah—to save lives, prevent injuries, protect property and the environment, and reduce social and economic disruption from earthquakes. The Commission's 1995 *A Strategic Plan for Earthquake Safety in Utah*, which has provided an effective "road map" for action (see Appendix C), set out the following guiding principles:

1. There is a real and serious danger of both life-threatening and damaging earthquakes in Utah in our lifetimes.

2. We as individuals and collectively can take significant actions now to reduce the loss of life, property damage, and long-term economic impact in the future.

3. Implementing an earthquake-safety plan for Utah is a long-term process.

4. Strategies to safeguard lives and property from earthquakes must be sensitive to financial and regulatory burdens. Many actions can be taken now without great expense that will make Utah safer tomorrow.

Earthquakes can't be prevented, but human behavior and the built environment can be modified to mitigate the impact of such events. As recent victims in earthquake-ravaged regions of Turkey, China, Taiwan, Japan, and the United States can attest, preparedness is important and can pay dividends.

One of the significant accomplishments of the Commission has been to provide leadership and coherence to Utah's state earthquake program. Besides the Commission's 15 members, Commission activities actively involve, on an ongoing basis, more than 35 interested individuals

on five standing committees (Appendix A): Awareness and Education, Engineering and Architecture, Geoscience, Lifelines and Infrastructure, and Intergovernmental Relations.

The Commission has been particularly successful in meeting its charge to "act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures." Successes in promoting earthquake awareness and loss-reduction actions have notably come from media attention to issues raised at quarterly meetings (including meetings at sites outside of Salt Lake City), focused activities of the standing committees, and Commission sponsorship or co-sponsorship of special-topic conferences.

In the main body of this report, we describe specific activities and accomplishments of the Commission during the four-year period, July 1996 through June 2000. Instead of a chronological recital, they are organized under key issues and actions.

Separately, in Appendix E, we describe and discuss a survey sent to (a) 52 of the state's largest employers, (b) all 29 counties, and (c) 112 first-, second-, and third-class cities. The survey examines how counties, communities, and businesses in Utah view their level of awareness of earthquake safety and the priority they place on earthquake safety, given the relative seismic risk where they are located.

Finally, taking into account the results of the survey described in Appendix E, we outline our plans for future initiatives, priorities, and activities for the Commission.

KEY ISSUES AND ACTIONS

SEISMIC SAFETY IN SCHOOL CONSTRUCTION

STRATEGIES ADDRESSED

3.1 — Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.

ACTION

At its second quarterly meeting of 1997, the Commission heard from the Engineering and Architecture Standing Committee (EASC) on proposed legislation that would have required state licensing of building-plans examiners. As an illustration of the problems inherent in the existing system, the EASC said no more than 10 percent of the 40 school districts in the state use licensed building inspectors, whose primary responsibility is to make sure the construction is being done according to the plans, not if the structure complies with building codes generally or seismic-safety requirements specifically.

When the report was published in a daily newspaper, the reaction from school districts was immediate. A contingent from the four largest districts in Utah asked to be allowed to respond at the next quarterly meeting of the Commission, on July 2, 1997. A spirited discussion ensued, with the school officials maintaining that their process adequately addressed the concerns of seismic safety. The Commission proposed that the EASC specifically and the Commission in general participate in a continuing dialogue with school districts to find out whether current practices of design, plan-checking, and inspection of new school construction in Utah posed an earthquake-safety issue. The intended outcome of this voluntary discussion would be to determine whether there is a process in place to ensure safe schools in Utah and, on a larger scale, whether there is concern for the structural safety of all buildings in Utah.

At the fourth quarterly meeting of the year, the EASC reported back that (1) the larger issue of building safety throughout Utah was an ongoing concern and (2) there was a need to review school construction designs later in the design process than is currently being done. The latter issue was to be directed to the State Office of Education to resolve through administrative rulemaking rather than attempt to accomplish any sort of legislative mandate.

At the second quarterly meeting of 1998, the EASC reported on a meeting with the State Superintendent of Public Education regarding the issue of "improved plan review" for school construction within the State of Utah. The Superintendent encouraged the EASC to submit written recommendations for consideration by his office.

By October 1998, a proposal which had been reviewed by representatives from the Granite, Davis, and Salt Lake school districts was submitted by the EASC to the State Office of Education. The proposal called for additional structural review by a licensed structural engineer at the 90-percent completion phase of design for new school construction. As a means of reducing the costs and the time involvement for this second review, it was proposed that it be performed by the same structural engineer who took part in an early-stage "value engineering session."

OUTCOME

The State Board of Education (SBE) adopted Rule R277-471, "Oversight of School Inspections," in the summer of 1999. The rule became effective November 2, 1999, and has the same authority as statute. At the same time, the State Office of Education (SOE) published the "School Building Construction and Inspection Resource Manual," and the new Rule specifies that the SBE, local school boards, and school district personnel shall act consistent with the Manual.

The Manual stipulates that a licensed structural engineer shall perform a value-engineering review of school plans and specifications at the 90-percent completion stage in buildings where costs exceed $300,000. The review "will focus primarily on the lateral load resisting systems and details."

The SOE requires that all new school construction and major additions to existing facilities located in regions of moderate to high seismic risk (Zones 2B and 3) be subject to this procedure.

PREPARED SCHOOLS

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
1.2 — Incorporate earthquake education in school curricula.
3.3 — Improve the post-earthquake operational status of essential service buildings.
3.6 — Improve safety and operation ability of older public school buildings.
5.1 — Update estimates of direct losses to be expected from earthquakes.
5.2 — Evaluate the indirect losses associated with earthquakes.

ACTION

The Awareness and Education Standing Committee (AESC), through its Schools Subcommittee, undertook a survey of public and private schools in Utah. The survey was mailed in April 1998 to 731 public school and 102 private school principals. Of that total, 365 public schools (49.9 percent) and 25 private schools (24.5 percent) responded. The purpose of the survey was to learn what has already been done in schools to prepare for emergencies and in what areas help is needed to become better prepared. During the course of the survey, the AESC's School Subcommittee succeeded in gaining Governor Mike Leavitt's endorsement on a proclamation designating April as "Earthquake/Disaster Preparedness Month," which enhanced public awareness of earthquake safety issues.

The responses to the survey indicated that the majority of Utah school principals, both public and private, have an interest in being well prepared for emergencies. Most (94 percent public, 76 percent private) have written plans and all responding schools hold at least one fire drill annually; most (83 percent public, 76 percent private) hold earthquake drills at least once a year, and fewer (50 percent public, 38 percent private) hold drills for other emergencies at least once a year. Even fewer (48.2 percent public, 40 percent private) have ever evaluated their plans, although most (87.4 percent public, 72 percent private) review it at least once every one-to-three years.

When asked specifically about earthquake risk, the respondents produced fewer positive responses. While most schools identified some or all of the nonstructural hazards, such as furnishings that could fall (77 percent public, 92 percent private), far fewer have in place a plan to mitigate these same hazards (59 percent public, 64 percent private). Many of the responding principals did not know whether their buildings had been inspected by structural engineers for earthquake resistance (64 percent public, 48 percent private).

Public schools usually have Parent-Teacher Associations that are active in safety issues (76 percent), and about half of all responding schools recognized that they could use some help in becoming better prepared. Most wanted help with writing emergency plans (52.5 percent public, 50 percent private) and receiving grade-level specific activity packets (57.2 percent public, 75 percent private). Fewer than half wanted how-to workshops on writing plans, conducting drills and exercises, educating school communities, and identifying and mitigating non-structural

hazards (43.1 percent public, 41.6 percent private); or CERT training (45 percent public, 37.5 percent private).

A major concern of the survey was with the preparedness of schools that did not reply. Were they statistically similar to the respondents, or did they choose not to participate in the survey because they had very little — or no — interest in earthquake preparedness issues?

The AESC is now using the school surveys to develop a "Prepared Schools Project," a plan to encourage and aid all schools to become better prepared for emergencies in general and earthquake hazards in particular. The project takes schools incrementally through two levels of preparedness, helping them reach the highest standard of readiness.

To assist schools with the "Prepared Schools Project", the AESC developed a "Certificate for Effective Drills and Safe Surroundings," which requires schools to complete four simple tasks: (1) conduct a school-wide earthquake/disaster drill, (2) have the school safety committee evaluate the drill, (3) conduct a school-wide hazard hunt, and (4) conduct the required number of fire drills during the school year. To assist with these tasks, the AESC provided all schools with a binder of activities, curriculum materials, a disaster video, maps, and posters. Once they earn that certificate, schools will then need to demonstrate competency in five areas: (1) awareness and education, (2) reducing risks before the event, (3) emergency response, (4) longer-term emergency response, and (5) recovery.

Another step in preparing schools was the School Safety Plan Bill passed during the 2000 Legislative Session. The Bill, H.B.14, sponsored by Representative Patrice Arent, requires schools to have a comprehensive plan as it relates to school violence. However, most school administrators are taking this opportunity to develop all-hazards school safety plans.

One of the obstacles to the program, according to school administrators, is accomplishing those tasks without detracting from budgeted time for instruction and activities. An example of how schools can make earthquake safety part of the learning curriculum was demonstrated in 1999 by Pleasant Grove High School (PGHS) in Utah County. Administrators used the existing Schools-to-Careers Program at PGHS to stage an earthquake preparedness drill that involved the entire 1,500-person student body, which was able to work with professionals from the local hospital and fire department, police and sheriff's agencies, ambulance companies, local government, newspapers, and radio stations.

As an added bonus, students in the Health Education Academy Program gained experience in triage efforts and first aid, while students in the Drama Department used their make-up skills to make the "injured" students looked realistic. Everybody had a role, and the school even used the drill to have the school district evaluate the building itself, which was constructed in 1959.

PGHS has an evacuation plan in place, and the exercise tested it as well as showing school officials how their plan interfaced with plans of local hospitals, city and county governments, and

police agencies. The drill tested evacuation and transportation capabilities by using ambulance companies, school buses, and even Utah Army National Guard paramedic vehicles.

By using a concept known as "job shadowing," administrators were able to keep everybody interested. Students followed health-care providers, police officers, reporters, emergency medical technicians, and fire department personnel as they did their jobs in a stressful setting. The drill involved surrounding communities and, as a part of the curriculum, it can be refined and reused every year.

The School Subcommittee was recognized by the Western States Seismic Policy Council at the National Earthquake Risk Management Conference. The Subcommittee tied with the Washington Division of Emergency Management and the Nevada Seismological Laboratory for the National Award in Excellence for Educational Outreach to Schools.

OUTCOME

By emphasizing the need and demonstrating ways for schools to adapt their curricula to accommodate seismic safety, the Commission has made a real impact on parents, teachers, and school administrators by instilling awareness of an issue too easily overlooked. Tangible outcomes will begin to accrue when schools pass the requirements to become "Prepared Schools" and qualify for reductions in insurance premiums.

INVOLVING BUSINESSES AND INSTITUTIONS IN SEISMIC SAFETY PLANNING

STRATEGY ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.

ACTION

The Awareness and Education Standing Committee (AESC) planned and convened three conferences—in 1996, 1997, and 1998—as part of a strategic initiative to get businesses and institutions to more carefully consider seismic safety issues in their contingency planning efforts.

At the first conference, "Earthquakes in Utah: Will Your Business Survive?" the AESC made the Strategic Plan an integral part of the agenda. The conference attracted more than 200 participants to the State Office Building and presented Utah business people with the sobering realities of earthquake vulnerabilities.

The conference featured a scenario presentation and panel discussion on what would happen if a magnitude 6.7 earthquake struck Salt Lake City. Representatives from county government, emergency response agencies, insurance and financial institutions, engineering and construction industries, and public utilities discussed possible ways the earthquake would affect them the day of the event as well as one week, one month, and one year later. The conference-goers were left with an encouraging message: preparation saves lives, jobs, and businesses.

Breakout sessions focused on mitigation, emergency response, business recovery, and workplace and home preparedness. Attendees viewed video footage of earthquake damage resulting from the 1994 Northridge, California, event; heard detailed information on building construction for earthquake safety; received tips on how large and small companies address earthquake problems; and picked up tips on making their homes earthquake safe.

The conference concluded with a presentation of the USSC Strategic Plan and the reminder that motivation for improving earthquake safety usually comes from private groups and local governments.

The AESC followed up a year later with another successful conference, "Earthquakes: Mean Business." The emphasis for this conference was on business survivability issues, and the 1994 Northridge, California, earthquake served as a model for a team of researchers who interviewed business owners one and two years after the event. Business representatives discussed the components of a recovery plan, including the ability to:

- Respond to the new market dynamic by changing strategy and tactics, while being realistic in assessing capabilities and options. If a new location is needed, for example, do it without delay and get the word out; do not simply wait for customers to return.
- Maintain adequate cash reserves and insurance to cover potential damage.

- Know the terms of the lease and the responsibilities contained in it.
- Prepare for recovery delays; it takes time to restore infrastructure and community services.
- Take the extra steps needed to protect business records, both paper and electronic copy.

The message to businesses was clear: think about more than just bricks and mortar. For businesses to survive an earthquake, structural mitigation efforts must be met with management mitigation techniques.

The 1997 symposium also offered breakout sessions on the "employee lifeguard" program for remaining in business in spite of an earthquake, legal liability and insurance issues for employers, business and home preparedness measures, emergency response training, and workplace preparedness and survival techniques. More than 150 business leaders and government officials from the Wasatch Front attended.

In 1998, the AESC joined with the Utah Chapter of the Association of Contingency Planners (ACP) in sponsoring a symposium on preparing businesses and communities for surviving disasters. Presentations included breakout sessions on "How to Plan: The ABCs of Business Resumption Planning," "Plan Validation: Testing Your Plan in Small-Group Table-Top Demonstrations," and "All Hazards Preparation: A Broad-Scope Workshop on All Manner of Perils that can Affect Your Community." This conference attracted about 175 risk managers, contingency planners, and emergency preparedness officials from throughout the state.

Recognizing the value of an ongoing partnership with the Utah Chapter of the ACP, which has many active members from the business sector and major institutions, efforts were made by the Commission, beginning in late 1999, to add a representative from ACP as a formal member of the Commission.

OUTCOME

The three earthquake-awareness conferences attracted more than 500 representatives from communities, businesses, and institutions; received prominent coverage in Salt Lake City's major daily newspapers and television news stations; disseminated volumes of reference material and self-help guides; and helped raise the public's awareness of seismic safety concepts, concerns, and solutions.

Under an amendment to the Utah Seismic Safety Commission Act, passed in the 2000 General Session of the Legislature (see Appendix B), a representative from the Utah Chapter of the Association of Contingency Planners, biannually selected by its membership, was added to the Commission.

RECOGNIZING EFFORTS OF BUSINESSES, GOVERNMENTS, SCHOOLS, AND INDIVIDUALS TO IMPROVE SEISMIC SAFETY IN UTAH

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.

ACTION

During the earthquake awareness conferences that the Awareness and Education Standing Committee planned, coordinated, and carried out in 1996 and 1997, select businesses, institutions, and individuals were recognized for their efforts in promoting seismic safety in Utah.

At the 1996 conference, Lt. Gov. Olene Walker presented the first USSC Earthquake Safety in Utah Award to the *Salt Lake Tribune* and its Science Writer, Lee Siegel. The citation noted that the morning daily reported on earthquake-related activities in Utah and made an important contribution to increasing awareness and promoting earthquake safety among Utah's citizens, businesses, and decision-makers. Siegel spearheaded the reporting of earthquake issues, and his editors featured those reports and other earthquake-related articles prominently and supported earthquake safety.

The first Certificate of Excellence was awarded to Brigham Young University for its comprehensive campus-wide and community-wide earthquake safety efforts, including (1) providing earthquake awareness and preparedness information to all students and staff, (2) providing Community Emergency Response Teams (CERT) training for 118 employees, (3) developing an emergency communications system and comprehensive disaster-response plan, (4) maintaining 72-hour food and water supplies for all students, and (5) creating an on-going seismic upgrade plan for existing facilities.

The second Certificate went to the Salt Lake City School District for its pioneering efforts and initiative in upgrading older schools and improving earthquake safety. The district was the first in Utah to commission a district-wide evaluation of its buildings. Based on those findings, the district implemented a plan to retrofit and replace the schools that need upgrading.

The third Certificate went to Hyde Park City for involving its community in disaster planning, providing CERT instruction, holding mock disaster exercises, replacing or relocating city offices and water-system components to safer structures and locations, and including seismic hazards in its master plan and zoning ordinances.

At the 1997 conference, two organizations were recognized for their mitigation efforts. The USSC gave its Award for Outstanding Contributions to Earthquake Safety in Utah to Mountain Fuel Supply Company for its efforts to provide awareness and safety information to all its employees and customers. Mountain Fuel conducted company-wide earthquake response

exercises, was involved in a long-term program to upgrade its distribution lines and facilities to improve earthquake resistance, and exceeded building code requirements in its new facilities.

The Utah Department of Transportation received the Certificate of Excellence for implementing a state-of-the-art seismic design of the Interstate 15 reconstruction project. The criteria exceeded code requirements and were designed to help ensure the survival of this critical roadway even in the event of the strongest ground shaking expected.

OUTCOME

The Commission, together with its goals and objectives, was featured prominently in the two major daily newspapers in Salt Lake City and on the local television news channels, thus raising the awareness of state and regional residents to the issue of seismic safety.

RECOGNITION OF EFFORTS BY COMMISSION STAFF TO ADVANCE EARTHQUAKE EDUCATION AND AWARENESS

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
1.2 — Incorporate earthquake education in school curricula.

ACTION

The three organizations that are the foundation of the earthquake program in the state have received regional and national recognition of their programs in education and awareness.

The University of Utah Seismograph Stations' Earthquake Education Services (EES) outreach effort encouraged earthquake science and safety instruction in Utah schools by meeting teachers' needs for activities, materials and workshops. Its "Earthquakes in the Utah Core Curriculum" project received funding from FEMA. The project brought teachers and geologists together to develop grade-level-appropriate lessons and hands-on activities in grades 3, 5 and 9. The teacher/geologist teams traveled to individual school districts to instruct teachers and distribute activity packets and teaching materials. As the result of popularity of this program, CEM's Earthquake Preparedness Information Center (EPICenter) has provided three additional years of funding to continue the teacher workshops.

EES also compiled information on 48 damaging earthquakes that have occurred in the Intermountain West in the past 70 years, using that information to produce "Earthquakes in the Intermountain West," a traveling exhibit of photographs, text, and graphics. The exhibit was developed with funding from the National Earthquake Hazards Reduction Program (NEHRP) through the U.S. Geological Survey (USGS). The target audience is the general public and school communities. The 8-foot by 19-foot free-standing display has been placed in libraries, government buildings, small museums, and earth-sciences conventions.

The demand for the display was so great that a second one was purchased by the EPICenter. The Utah State PTA and the EPICenter have provided funding for travel and shipping costs for the displays which have traveled not only throughout Utah, but have been sent to Idaho, Montana and Wyoming. EPICenter also provides maintenance funding for the displays.

CEM's Earthquake Preparedness Information Center (EPICenter) published "The Utah Guide for the Seismic Improvement of Unreinforced Masonry Dwellings." The publication fills a need for information dealing with unreinforced masonry homes and the means by which to seismically retrofit them. It also provides homeowners, engineers, and general contractors with guidelines to assist in seismic retrofitting activities.

The UGS's Geologic Extension Service produced a series of maps and brochures that detail the earthquake hazards and risks in Utah. The series was written for the general public, real estate

agents, and public officials and was distributed at scientific conferences, teachers' workshops, and state and county fairs.

As mentioned previously in the Prepared Schools portion of this report, the USSC's School Subcommittee developed a certificate for "Effective Drills and Safe Surroundings" for schools. This program received national recognition recently at FEMA-sponsored conference in Seattle.

OUTCOME

The EES, EPICenter, and UGS were recognized by the Western States Seismic Policy Council (WSSPC) at their 1997 Annual Conference in Victoria, B.C. The EES effort was a co-winner with the California Seismic Safety Commission's Seismic Retrofit Practices Education Program, of the Award for Overall Excellence and won the Award of Excellence in Outreach to Schools. The CEM brochure won the Award for Excellence in Mitigation Efforts, and the UGS initiative won the Award for Excellence in Outreach to the General Public.

The USSC's School Subcommittee was a co-winner with the Washington Division of Emergency Management and the Nevada Seismological Laboratory for WSSPC's National Awards in Excellence 2000 for Educational Outreach to Schools.

BUILDING-CODE ENFORCEMENT AND PLAN REVIEW

STRATEGIES ADDRESSED

3.1 — Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
4.4 — Ensure design professionals and building officials are kept current on relevant geoscience information.

ACTION

In July 1996, the Engineering and Architecture Standing Committee (EASC) prepared a White Paper on building-code enforcement and plan review and presented it to the Utah Advisory Council on Intergovernmental Relations (UACIR). The proposal included suggested amendments to state law regulating the qualifications of building officials and plans examiners. The proposed changes also required all funds collected as a surcharge on building permits to be used solely for the purpose of code education and training.

The Commission noted in its White Paper that, although building code enforcement has improved in Utah over the past decade, serious deficiencies still exist. As a result, there are inequities for owners, builders, and citizens in general—including varying costs of construction from one jurisdiction to another, varying insurance rates from one city or county to another, under-regulation, and over-regulation. The solutions proposed by the Commission would include:

- Depositing all building permit revenues in a dedicated, non-lapsing fund.
- Establishing a regional or statewide agency that would provide assistance to local jurisdictions in meeting the objective of providing a full-service inspection program, to include quality control audits, special inspection coordination, code development, approved fabricator programs, support for absenteeism/overload circumstances, plan review for complex structures, engineering review, training, and maintenance of a technical library. The agency would be funded from the revenues derived from building permits.
- Appointing a state building codes administrator or building official to serve as technical support to the Uniform Building Code Commission (UBC) and to coordinate training needs.
- Creating minimum standards of competence for building officials and plans examiners.
- Ensuring that all state and school buildings would be accorded the same high level of examination and inspection as any other construction project, as provided for by the proposed legislation.

State Senator Craig Peterson, who represented the Senate on the Commission, sponsored the legislation as Senate Bill 135 in the 1997 General Session of the State Legislature. The measure received the support of the UACIR and the Inspector Licensing Board of the UBC Commission, but was opposed by the Utah League of Cities and Towns because of the funding issue.

OUTCOME

Senate Bill 135 passed the Senate by a comfortable margin but was narrowly defeated in the House during the 1997 General Session of the State Legislature. The EASC, with the support of the UBCC, then carried the issue to the Division of Professional Licensing (DOPL) in an attempt to get the rules changes incorporated into the State Inspector Licensing Law. That effort is ongoing.

SEISMIC STRENGTHENING OF EXISTING BUILDINGS

STRATEGIES ADDRESSED

3.1 — Enforce the state amendment to the Uniform Building Code which requires building building owners to install roof anchors and parapet bracing when reroofing their buildings.
3.8 — Improve the safety of older high-occupancy buildings (250 persons or more) to be structurally competent enough to withstand moderate to large earthquakes

ACTION

A fundamentally important way to promote earthquake safety in Utah is to reduce the number of seismically dangerous buildings within the state. It has long been recognized that unreinforced masonry buildings, referred to as URMs, are a major life-safety hazard in an earthquake, and this type of construction was common in Utah until about 1970.

At the Commission's April 1999 meeting, Commissioner James Bailey, a structural engineer, proposed that the Commission advocate a statewide ordinance, similar to ones successfully enacted in Seattle, Portland, and numerous jurisdictions in California, that would mandate when and how much retrofit was needed when an existing, non-residential URM building was remodeled. An ongoing process ensued informally termed the "existing building initiative."

In May 1999, the Commission asked the Structural Engineers Association of Utah (SEAU) for guidance as to the need for a statewide "existing building ordinance." Should regulation be advocated for the seismic retrofitting of certain classes of existing buildings in Utah—given the accelerating growth and development in seismically dangerous parts of the state? In response, the Seismic Committee of SEAU formulated a White Paper entitled, "Seismic Strengthening of Existing Buildings," dated July 8, 1999.

At a meeting of the Commission on July 9, 1999, Ken Willmore, chair of SEAU's Seismic Committee, presented the recommendations of his organization. A draft resolution approved by the SEAU board supported the need for regulations regarding the seismic retrofitting of existing buildings. The resolution suggested which actions should trigger the seismic upgrade of certain buildings, suggested existing documents to be used as guidelines for establishing a statewide code, recommended minimum seismic forces to be addressed by the code, and recommended the use of tax breaks and reduced insurance rates as incentives to make seismic upgrading attractive to building owners.

On July 14, 1999, the Commission wrote to the Uniform Building Code (UBC) Commission urging the adoption of the Uniform Code for Building Conservation (UCBC 2000) for the state of Utah and recommending that the UBC Commission take steps to ensure the enforcement of an existing statewide amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings. Adoption of the UCBC

2000 code would require and enforce at least a partial seismic upgrade when URM buildings in Seismic Zone 3 have their lives extended through major remodeling.

Representatives of the Commission appeared before the UBC Commission on August 20, 1999, and again on March 17, 2000, to advocate the requests described above. At the August 1999 meeting, the UBC Commission declined to take immediate action, citing potential costs and the need to build widespread political support. Instead, the UBC Commission members unanimously voted to announce their intent to consider adoption of the code and encouraged stakeholders to speak out on the issue. At the March 2000 meeting, faced with legal and other complications that confounded simple adoption of the UCBC Code, the UBC Commission referred the matter to its Structural Advisory Committee—encouraging a continuing partnership with USSC and SEAU in order to prepare further recommendations and to pursue educational outreach for promoting awareness of the existing "parapet" ordinance.

OUTCOME

In September 2000 the Uniform Building Code Commission passed a resolution recommending "that local jurisdictions within the State of Utah consider adoption of 'The Uniform Code for Abatement of Dangerous Buildings—1997,' 'The Uniform Code for Building Conservation—1997,' and 'The Guidelines for Seismic Retrofit of Existing Buildings—2000'." The process continues of attempting to enact formal statewide adoption of such codes—beyond simply recommending their local adoption.

Also in September 2000, a committee consisting of representatives from the Structural Advsisory Committee of the UBC Commission, SEAU, and USSC published a brochure, "Earthquakes and Roofing—What You Need to Know About Seismic Bracing When Reroofing an Existing Building." The brochure describes the "Utah Parapet Ordinance" and its implications and is being actively used in a statewide educational campaign.

SEISMIC VULNERABILITY OF STATE BUILDINGS

STRATEGIES ADDRESSED

3.3 — Improve the post-earthquake operational status of essential service buildings.
3.4 — Reduce structural hazards of government-owned buildings.

ACTION

In September 1996, the Commission presented a request to the Utah State Building Board (USSB)—similar to a high-priority request made by the Commission one year earlier to the Governor—that $10.5 million be added to the annual budget of the Division of Facilities Construction and Management (DFCM) in order to assess the seismic vulnerability of state buildings and to begin to retrofit those in most critical need.

The USSB subsequently gave the request a high priority and forwarded it to the Governor's office for inclusion in the fiscal year 1997-1998 budget. However, the requested funds were not included in the Governor's final budget recommendation for that year.

At the Commission's quarterly meeting in October 1999, Commissioner Matthias Mueller of DFCM summarized DFCM responsibilities for enforcing construction standards, including those for seismic safety, in state buildings. Code requirements, supplemented by DFCM design criteria, are implemented in the design of every new state facility, and a team of licensed inspectors from DFCM inspects state construction projects to ensure code compliance.

Mueller outlined results of a survey of 193 older state buildings indicating that 111 of the 193 buildings surveyed by that date needed structural upgrading. Buildings which had already undergone seismic and other upgrades included the Utah Industries for the Blind, Utah State University's Old Main building, Weber State University's Browning Performing Arts Center, the Governor's Mansion, the University of Utah's Kingsbury Hall, Snow College's Noyes Building, and Salt Lake Community College's Grand Theater.

According to Mueller, DFCM assumes that approximately 51 percent of state-owned buildings comply with the Uniform Building Code because they were constructed after the code was first implemented in 1974. Commissioner James Bailey noted that buildings constructed between 1974 and 1985 should not be presumed to comply with the code because quality control then was not as stringent as current practice.

OUTCOME

Despite the Commission's unsuccessful attempt in 1996 (and earlier in 1995) in advocating dedicated state funding for progressively remediating the seismic vulnerability of older state-owned buildings, progress is being incrementally made in seismically strengthening selected

buildings as part of major remodeling projects. Standards for seismic safety of new state facilities are routinely enforced by DFCM.

During the fiscal year 2000-2001, an amount of $36.7 million was appropriated to DFCM for improvement projects—separate from capital development projects—which will enable some seismic upgrades (e.g., seismic bracing when reroofing). Some of the capital development projects also include seismic upgrades.

THE SAFETY OF CONSTRUCTION IN DOWNTOWN SALT LAKE CITY

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
4.1 — Reduce earthquake losses by mapping and identifying geologic hazards.
4.3 — Make land use compatible, through local government ordinances, with known hazards.
4.4 — Ensure design professionals and building officials are kept current on relevant geoscience information.

ACTION

In 1998 and 1999 the Commission served as a sounding board and forum for concerns about fault-displacement hazards associated with active faults in the Salt Lake City metropolitan area. In 1997 Salt Lake County published a new version of its geologic hazards map, basing the depiction of active faults on a 1992 map produced by the U.S. Geological Survey. Unfortunately, Salt Lake County's 1997 map differed significantly from its earlier 1989 geologic hazards map, which showed that a branch of the Wasatch fault, known as the Warm Springs fault, may trend through downtown Salt Lake City approximately along West Temple.

As a consequence, several downtown projects were approved by Salt Lake City without the requirement to perform special studies for surface fault-rupture hazard.

Craig Nelson, Salt Lake County geologist at the time, brought the matter before the Commission in January 1998 after an investigative piece in a local newspaper revealed the discrepancy. He described efforts he had begun that would develop consistent standards for the County to follow in order to ensure a minimum acceptable scope-of-work and independent review of any geotechnical report prepared for developers. His plan would require all consultants to use the same map—the 1989 one—until a newer one could be prepared that showed the existence of the Warm Springs fault trend.

He also proposed to create a geologic review board to consider and approve all changes to the 1989 map and to hear any appeals of the county geologist's recommendations. The 1989 map would be made available through the Internet to improve the quality of information used for development and ensure a consistent set of standards with respect to seismic safety issues.

In early 1999 the issue of whether there was an active fault beneath the downtown area was raised again when contractors working on the Salt Palace Addition outlined for the Commission, at its January quarterly meeting, some evidence suggesting that a fault may indeed run directly through the site in a north-to-south trend consistent with the 1989 map projection.

Kenneth Ament, president of the construction company working on the addition, said his company addressed the potential for a fault on the site before beginning construction by drilling

12 boreholes into Lake Bonneville sediment, about 60 feet below the grade of 2nd South. The addition was designed to include an underground parking structure and an exhibit hall above.

The drilling revealed no evidence of a fault, but because of the difficulty in trenching posed by existing structures, the geotechnical report on the site recommended instead the inspection of cuts as excavation progressed. At 23 feet below the grade of 2nd South, the contractors uncovered geologic features that showed tectonic characteristics. They dug three trenches to provide a clearer view of the features and notified the state and county.

Initial indications were that the features were caused either by tectonic faulting or by liquefaction, which is not tectonic in nature. Work was suspended for 30 days to do more trenching closer to the existing Salt Palace structure to study the evidence more closely and to perform carbon dating on the deposits.

One consultant's conclusion was that the features uncovered were evidence of an extension of the Warm Springs fault, which manifests as a 30-foot downdrop just one mile north of the Salt Palace. Geologists have speculated that the Warm Springs fault could run as far as 4th South along the same line. Another consultant's conclusion was that the features resulted from liquefaction-induced lateral spreading.

Geologists examining the trenches said they showed sand dikes characteristic of liquefaction and displacement vertically, producing a graben—which represents pulling apart.

OUTCOME

Nelson resigned as Salt Lake County Geologist soon after his presentation to the Commission, and Darlene Batatian, the new Salt Lake County Geologist, continues to further his initiative. Salt Lake County submitted its contradictory consultants' reports on the Salt Palace to Salt Lake City. After obtaining a third-party review of the reports, Salt Lake City accepted the finding that the features were liquefaction-induced and permitted the project to continue. The contractor redesigned the foundation footings to accommodate the possibility of minor movement and resumed work on the structure, which is expected to be completed by the summer of 2001 in time for a major trade show. The facility will also serve as the main media center for the 2002 Winter Olympic Games. Factions within state and local government politicized the debate about whether the features represented an active fault or merely liquefaction. Consultants made equally compelling, but contradictory scientific presentations at the Association of Engineering Geologists annual meeting in Salt Lake City in October 1999.

VULNERABILITY OF THE STATE'S LIFELINES, INFRASTRUCTURE, AND WATER AND WASTEWATER SYSTEMS

STRATEGIES ADDRESSED

3.12 — Improve lifeline survivability in the event of an earthquake.
3.13 — Improve earthquake performance of water and waste-water systems.
4.6 — Reduce earthquake-induced liquefaction risk to highway structures.
4.7 — Determine appropriate seismic design coefficients for highway bridges.
5.3 — Conduct lifeline collocation vulnerability studies.

ACTION

The Lifelines and Infrastructure Standing Committee (LISC) began creating in 1998 a GIS-based inventory of all the important lifelines in Utah, including transportation routes and utility corridors, with a primary focus on the Wasatch Front area. The committee is also studying the issue of collocation of utilities, a situation that tends to magnify damage to lifelines during earthquakes.

The Lifelines Committee of the American Society of Civil Engineers (ASCE) conducted a survey in 1995 of Utah's approximately 300 water-system groups and 150 sewer-system groups regarding their knowledge of earthquake vulnerability. From that information, Mr. Carl Carpenter, a former member of ASCE's Water and Sewer Technical Committee, identified the need for basic education and developed a presentation to show those groups how to evaluate their own systems. In March 1998, Mr. Carpenter volunteered to make this presentation, under the auspices of the Commission, to operators of water and wastewater systems throughout Utah.

OUTCOME

The Commission agreed to fund further presentations by Mr. Carpenter and to help update the information with the latest data on water and wastewater systems in Utah.

The compilation of a GIS-based inventory of critical lifelines in Utah is continuing—in part, under combined efforts with the Utah Division of Comprehensive Emergency Management through the implementation of Hazards United States (HAZUS), a GIS-based software program for assessing vulnerabilities of the built environment to earthquakes and other hazards.

Members of the Commission are also actively involved on the Infrastructure Protection Subcommittee of the Utah Olympic Public Safety Command, whose efforts are aimed at making Utah's critical infrastructure disaster-resistant before, during, and after the 2002 Winter Olympics.

INTERSTATES 15 AND 80 BRIDGE RECONSTRUCTION

STRATEGIES ADDRESSED

3.12 — Improve lifeline survivability in the event of an earthquake.
4.6 — Reduce earthquake-induced liquefaction risk to highway structures.
4.7 — Determine appropriate seismic design coefficients for highway bridges.

ACTION

Attention to improved seismic safety for Utah's highway bridges and structures was a key part of the Commission's 1995 strategic plan, and individual members of the Geosciences Standing Committee (GSC) have been actively involved in advancing that safety. Prior to the $1.59 billion I-15 reconstruction project, the Utah Department of Transformation (UDOT) estimated that half of the Salt Lake Valley's deteriorating freeway bridges would collapse if a major earthquake hit the area.

In 1996, four members of the GSC served on an I-15 Corridor Seismic Advisory Committee to assist UDOT in establishing seismic design criteria and in reviewing and advising on the acceptability of earthquake-related studies and design recommendations made by I-15 consultants. The committee was instrumental in persuading UDOT to use design standards for the project that were higher than those it conventionally uses, so that freeway bridges would not collapse, but at most sustain repairable damage during a large earthquake on the Wasatch fault.

Following its attention to the seismic design of I-15 highway bridges and structures, UDOT co-sponsored a technical conference in January 1999 to address the problem of seismic retrofit of its highway bridges elsewhere in the state. Attention notably turned to aging highway bridges on I-80 between State Street and Parley's Canyon that posed potential losses of $170 million—and acute disruption of transportation—if hit by a magnitude 7 earthquake. Partial reinforcement of the 25 freeway bridges on that stretch of I-80 was scheduled to begin in the summer of 1999 to help keep those bridges operational for 15 years until they could be rebuilt completely.

Researchers at Utah State University and the University of Utah are conducting studies on old highway structures that were torn down during the I-15 reconstruction process. These old bridges and overpasses have become experimental devices that structural engineers use to determine if various shaking techniques can reveal structural damage in a bridge. The ability to use the condemned bridges gives the researchers information they can compare to results from national laboratories on the behavior of steel girders—information that cannot adequately be acquired in any other testing environment.

A research team from Brigham Young University is investigating the earthquake resistance of steel pilings used on the I-15 project, using a form of seismic testing known as static and

statnamic loading, to study how the pilings will hold up under the estimated stresses of an earthquake.

OUTCOME

Seismic design standards were used in the I-15 reconstruction project that significantly exceed minimum national highway standards, ensuring that the I-15 bridges will withstand the strongest earthquake shaking expectable without collapse. Damage that may be sustained will be repairable so that the bridges can be returned to service relatively quickly. In the case of reinforcing aging highway bridges on I-80 between State Street and Parley's Canyon, potential losses of as much as $170 million due to a magnitude 7 earthquake will be reduced to about $17 million, thanks to selective seismic retrofitting. Ongoing research by university scientists and engineers will allow engineers to ensure the earthquake safety of highway bridges in Utah in a cost effective way without over-building structures.

FUTURE NEED—AN EVALUATION OF UTAH'S TRANSPORTATION LIFELINES

While new facilities are designed and constructed to a higher level of seismic resistivity than in the past, much of Utah's transportation system was constructed prior to the development of modern seismic codes and engineering practices. It is important to identify the seismic vulnerability of the state's transportation lifelines. While the emphasis will be on State owned facilities, this exercise should also include city and county facilities as well.

The first step should be to determine the transportation lifelines that will become critical after a major seismic event. The effort should focus on routes adjacent to hospitals, fire stations, schools, the airport, etc., and requires local and regional planning input. Next, an evaluation of the bridges along the critical lifelines will need to be evaluated for seismic vulnerability. Bridges determined to be seismically vulnerable should be identified and prioritized. At a minimum, this information can be used by bridge owners when performing rehabilitation work on critical lifeline bridges. At a maximum, the information can be used to develop long range seismic retrofit strategies for Utah's bridges. UDOT has planned a research project to perform all or part of this evaluation including prioritizing, but as of now it is unfunded. The USSC will provide information regarding the limited work that has been accomplished in this endeavor, so the UDOT research effort can build on what has been accomplished to date. The USSC will also provide oversight and support as requested by UDOT.

LOCAL GOVERNMENT NEEDS FOR GEOSCIENCE INFORMATION AND TRAINING TO REDUCE RISKS FROM EARTHQUAKES AND OTHER GEOLOGIC HAZARDS

STRATEGIES ADDRESSED

4.1 — Reduce earthquake losses by mapping and identifying geologic hazards.
4.2 — Perform geologic hazards investigations for critical public facilities.
4.3 — Make land use compatible, through local government ordinances, with known hazards.
4.4 — Ensure design professionals and building officials are kept current on relevant geoscience information.

ACTION

In 1999, the Geoscience Standing Committee (GSC) and the Utah Geological Survey (UGS) established the Guidelines Advisory Committee (GAC) to determine what products and services would be needed, who should provide them, and what resources might be required by local governments. The GAC also addressed possible roles of local government insurers — Utah Risk Management Mutual Agency (URMMA) and Utah Local Governments Trust (ULGT) — in encouraging risk reduction.

The Commission relied on some investigational and educational priorities of the University of Utah Seismograph Stations (UUSS), the Division of Comprehensive Emergency Management (CEM), and the Applied Geology Section and Geologic Extension Service of the UGS in dealing with this issue. Other organizations involved in furthering the initiatives of the Commission include the Utah Department of Transportation (UDOT), Utah State University (USU), and Brigham Young University (BYU).

The GAC identified the following local government groups as having specific needs for geoscience information:

- planners, who work directly with developers, landowners, and geotechnical consultants in regulating land use;
- building officials, who perform field inspections of sites, and in some rural jurisdictions, perform all of the duties of city/county engineers and planners; and
- elected officials and administrators, who must be informed of the dangers to citizens in their jurisdictions posed by geologic hazards to help them implement appropriate risk-reduction measures.

The GAC identified the products and services needed by each of those groups, the likely preparers of the information, possible sources of funding, and steps needed for implementation.

Planners use geoscience information to prepare, adopt, and enforce ordinances and prepare master plans that reduce losses from geologic hazards. Planners should understand hazards and

be able to inform developers and landowners of studies required prior to approval of subdivisions or other land uses. The earth-science information products most valuable to planners, listed in order of priority, are:

- Special-study-area maps showing where geologic hazards may exist. These maps are chiefly for use in ordinances to indicate where special studies are required and possibly for disclosure in real-estate transactions. They would be prepared by the UGS, county geologists, or private consulting geologists. The UGS and local governments would share funding while consultants would be eligible for direct funding. In order to provide this product, the preparers would complete new maps and update existing maps, and conduct workshops in the use of geologic-hazards maps in ordinances and for disclosure.
- Non-technical brochure(s) explaining hazards and risk-reduction measures that planners can hand out to developers and homeowners; training for planners to better understand geologic hazards and risk reduction; compilations of individual packets of information specific to a city or county. The preparers would be the UGS, county geologists, and UUSS's Earthquake Education Services. No outside funding has been identified; possible contributions could come from cities and counties for specific information packets. The new brochures would cover all geologic hazards, and the preparers would more widely distribute those already available and provide workshops and training for planners to increase understanding of geologic hazards and risk-reduction measures.
- A brochure explaining the process of using geologic-hazards information and maps, ordinances, and disclosure to reduce risks and losses. Preparers would be the UGS and county geologists. There has been no outside funding identified. Preparers would produce the brochure and distribute and train users, perhaps through the American Planning Association (APA), Utah League of Cities and Towns (ULCT), Utah Association of Counties (UAC), and URMMA.

Building officials must be able to recognize evidence for hazards in the landscape and in excavations. They must be familiar with seismic and grading requirements in the UBC. The Utah Chapter of the International Conference of Building Officials (ICBO) could present workshops and field training at its annual meetings, and the URMMA could host workshops and hold field trips for building officials in UBC requirements and field hazard recognition with help from the UGS and county geologists. Funding could come from the UBC Commission (Division of Occupational and Professional Licensing) education fund.

Elected officials and administrators need succinct, straightforward information on geologic hazards and the role that local government can play in reducing risk and liability. Workshops are impractical because elected officials often change every two years; information products most valuable to this group, listed in order of priority, are:

- A brochure discussing geologic-hazards liabilities and Utah case law affecting cities and counties, and ways to promote safety and reduce liability. The preparers would be city/county attorneys, other legal council, or law-school students/faculty. Funding sources have not been identified, but the need could be met by encouraging and facilitating research by City/County attorneys or as a research project for law-school students/faculty.

- Analysis of costs and benefits of geologic-hazards risk reduction. The preparers would be the UGS, CEM, or the HAZUS Data Users Group. Funding sources have not been identified. HAZUS (see p.33) can produce loss estimates for earthquakes and other hazards. For all hazards, the need exists to compile historical losses, estimate costs of risk reduction, and compare actual and projected losses to risk-reduction costs to determine benefits.

URMMA and ULGT provide insurance coverage to their local government members. URMMA, in particular, promotes risk reduction by providing training and assigning ratings to local government members based on their risk-reduction efforts. URMMA could further help local governments manage risks from geologic hazards by including geologic hazards in their training workshops and risk ratings. The URMMA Executive Committee oversees risk ratings and would need to approve any proposed changes or additions to the rating system to include geologic hazards. Other groups highlighted by URMMA that need geoscience information to help encourage risk reduction include the ULCT, UAC, local Councils of Governments (county commissions and mayors in each county), URMMA itself, and ULGT. This information should include examples of risks taken and losses incurred by local governments from geologic hazards.

A need exists for geoscience information in a form designed for local government officials to use in promoting risk-reduction measures. Planners need maps depicting geologic-hazard special-study areas and information explaining hazards and the risk-reduction process. Building officials need training in UBC requirements and field hazard identification. Elected officials and administrators need information on local government liability and responsibility to protect public safety with respect to geologic hazards and the costs and benefits of risk reduction. Partnerships with various professional (APA, ICBO) and local government (ULCT, UAC, URMMA, ULGT) groups can greatly facilitate risk reduction.

Completion of these geoscience-information products and services becomes the responsibility of the designated preparers, as facilitated by the GSC and UGS. Because completion depends on factors outside the GAC's control, no time tables or schedules can be set for completing products or performing services.

In light of those needs, there have been several publications and technical studies produced by the UGS and others since July 1996, as well as new scientific and technical investigations involving the Applied Geology Section of the UGS and funded at least in part by the National Earthquake Hazards Reduction Program:

Non-Technical Publications

- *The Wasatch Fault* (PI-40), a brochure that explains the hazard the fault poses and gives examples of good and bad land uses in the fault zone, summarizes how often earthquakes occur on the fault, and discusses the potential for future activity. Several full-color photographs show what the fault is, where it is located, and how to recognize it.

- Earthquake hazard maps compiled by CEM of eastern Box Elder, Weber, Salt Lake, Davis, and Utah counties, showing critical facilities such as schools, hospitals, and dams, and locating liquefaction and surface-rupture hazards and landslides.
- *The Homebuyers Guide to Earthquake Hazards in Utah* (PI-38), a general-information pamphlet that discusses real estate concerns.
- *Earthquakes & Utah* (PI-48), a brief summary of seismic events that have affected Utah from Brigham City to St. George.

Technical Studies

- Surficial geologic map of the Nephi segment of the Wasatch Fault zone, eastern Juab County.
- Surficial geologic map of the West Cache fault zone and nearby faults, Box Elder and Cache counties.
- *Paleoseismology of Utah, Volume 6:* The Oquirrh fault zone, Tooele County, Utah: surficial geology and paleoseismicity.
- *Paleoseismology of Utah, Volume 7:* Paleoseismic investigation on the Salt Lake City segment of the Wasatch fault zone at the South Fork Dry Creek and Dry Gulch sites, Salt Lake County, Utah.
- *Paleoseismology of Utah, Volume 8:* Paleoseismic investigation at Rock Canyon, Provo segment, Wasatch fault zone, Utah County, Utah.
- *Proceedings Volume,* Basin and Range Province Seismic-Hazards Summit.

Scientific and Technical Activities

- A paleoseismic study of the West Cache fault zone (WCFZ), Cache Valley, Utah, which is between Logan and Brigham City, Utah's tenth and 16th largest cities, respectively. The UGS has excavated and logged four trenches to evaluate earthquake potential of the WCFZ and associated faults. The results provide a complete chronology of surface-rupturing earthquakes for western Cache Valley and the northern part of the populous Wasatch Front, and that information will permit accurate estimates of seismic hazard and risk.
- Seismic hazard mapping of Cache Valley using geographic information system (GIS) technology. The results help establish a customized protocol for mapping seismic hazards in the unique geologic environments of north-central Utah and provide seismic-hazard maps in a rapidly developing area near the northern Wasatch Front.
- A seismic hazard study of the Hurricane fault in southwestern Utah, which extends 250 kilometers from Cedar City, Utah, to Peach Springs, Arizona. The results of the investigation will be used to characterize the frequency of surface rupture and segmented behavior of the Hurricane fault, and will greatly improve understanding of seismic hazards in the region at a time when this information can be incorporated into design standards and building practices for on-going development.
- Development of a Quaternary fault database for Utah. Results of the study will provide a convenient reference for earthquake sources in Utah and add to the database for future National Seismic-Hazard Map updates.

- Geotechnical site-response mapping of the Salt Lake Valley, an area of high seismic risk characterized by deep, soft soils in the valley interior and shallow, stiff soils along the valley margins. This combination of geologic features tends to amplify earthquake ground motions relative to rock sites. The resulting maps produced by this effort are useful to earth-science consultants, geotechnical and structural engineers, local government officials, and researchers in the design of structures that do not require detailed site investigations, such as residential and small commercial and industrial buildings, where Uniform Building Code site coefficients are now commonly estimated or ignored. The maps are also being used to develop more accurate probabilistic ground-shaking estimates, regional ground-shaking models for loss-estimation studies, and earthquake scenarios for emergency response planning. The addition of this information to existing state GIS databases for fault zones and liquefaction-hazard zones will allow new data to be readily incorporated, and facilitate effective communication of earthquake hazards to Utah residents.
- A seismic hazard scenario for a magnitude 7 earthquake in Salt Lake City. An earthquake in Utah's metropolitan center would impact the lives of more than 1.3 million people, an area which includes all or part of eight Utah counties. Using ground-shaking maps of this area produced by an ongoing NEHRP-supported study by URS Corporation, UGS, UUSS, and Pacific Engineering & Analysis, the UGS will produce maps at a scale of 1:250,000 using GIS. The maps will be accessible to consulting engineers and geologists, planners, and state and local government agencies to ultimately serve as the scenario earthquake and be the focus for bringing together lifeline managers, engineers, contingency planners, and others to identify specific effects of the earthquake for emergency-response planning.
- Microzonation maps for earthquake ground shaking in the Salt Lake City metropolitan area. The UGS will publish a series of nine deterministic earthquake scenario and probabilistic ground shaking maps prepared by URS Corporation, UGS, UUSS, and Pacific Engineering and Analysis that ultimately will be used by the public, the engineering community, government agencies, and all interested parties involved in earthquake mitigation in Utah.
- Trenching efforts of the Wasatch fault zone. The UGS is assisting in a project to add detailed information of ancient earthquakes obtained by excavating large trenches on the Wasatch fault.
- Strong-motion recorders. Researchers from the USGS, UUSS, and UGS have installed and/or upgraded strong-motion accelerographs in the Salt Lake Valley that will record the next sizable earthquake in the valley. The goal of the study is to define how seismic shaking will affect the urban area during a major earthquake.

OUTCOME

The maps will add substantially to the information available to planners and public officials, who can use the maps to reduce the impact of seismic hazards on future development and manage post-earthquake response and recovery efforts. The trenching efforts will potentially aid scientists in earthquake forecasting worldwide and provide more accurate information on which to estimate damage in communities along the Wasatch Front. Data from the strong-motion sites will provide more statistically reliable data about the various soil types in the valley, and records from the array will be used by engineers and seismologists for investigations into structural responses, analyses of basin effects, ground-motion attenuation, and comparison of ground acceleration data with intensities.

RECOGNIZING EARTHQUAKE HAZARDS, ASSESSING RISKS FOR COMMUNITIES, AND PREPARING COMMUNITIES FOR EMERGENCY RESPONSE

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
2.1 — Establish Community Emergency Response Teams (CERT) statewide.
2.4 — Enhance the integrated emergency management system statewide.
5.1 — Update estimates of direct losses to be expected from earthquakes.
5.2 — Evaluate the indirect losses associated with earthquakes.
5.4 — Conduct lifeline collocation vulnerability studies.

ACTION

The Utah Division of Comprehensive Emergency Management (CEM), with the active support of the Commission's Awareness and Education Standing Committee, (AESC), has been involved it two important activities: (1) implementing Hazards United States (HAZUS), a geographic information system-based software program that projects casualties, damage, and lifeline disruption, and (2) providing Community Emergency Response Team (CERT) training. Both initiatives are central to the concept of ensuring that all segments of the state's population will be able to face the emergencies inherent in the aftermath of an earthquake.

HAZUS is a software program that identifies a community's vulnerabilities; CERT training gives its initiates the experience and expertise necessary to respond to community needs.

In 1997, CEM began implementing HAZUS, a Geographic Information System (GIS) program that recognizes earthquake hazards and assesses risks for communities. With its roots in an Applied Technology Council (ATC) pilot project funded by the Federal Emergency Management Agency (FEMA), HAZUS uses a GIS-based software program to map and display demographic information about individual communities, given the size and location of a hypothetical earthquake. HAZUS can estimate the amount of ground shaking, the number of casualties and buildings damaged, the impact on transportation systems, the extent of disruption to utilities, the number of people displaced from their homes, and the estimated cost of repairing projected damage and other effects.

HAZUS projections can be used before an earthquake to:

- develop earthquake-hazards mitigation strategies as countermeasures to potential losses and disruption,
- develop preparedness or contingency plans, and
- anticipate the nature and scope of response and recovery efforts.

After an event, HAZUS information can be used to:

- project immediate economic impact for state and federal resource allocation and support,
- activate immediate emergency recovery efforts, and

- formulate long-term reconstruction plans.

CEM is now in the process of gathering more information about Utah, to include site-specific details about geology, building inventory, utilities, transportation systems, and engineering and geotechnical data. Such information will allow CEM to increase the accuracy of the HAZUS estimates and the ability to customize those estimates to the specific conditions of individual communities. To that end, CEM is working with the University of Utah Seismograph Stations (UUSS) and the Utah State Automated Geographic Reference Center (AGRC) to collect site-specific data. An oversight committee, consisting of representatives from AGRC, CEM, and UUSS will provide direction and coordination with all participating agencies. Funding for the effort will come from FEMA and the CEM Earthquake Program.

In addition, CEM staff in 1999 created a HAZUS Data Users Group (HDUG) to help build up and facilitate the use of the database. HDUG receives training in the use of HAZUS, develops a clearinghouse and associated security for the database, takes on the responsibility of updating information with the HAZUS model, and uses HAZUS analysis to encourage actions aimed at reducing future earthquake damage. At its first meeting, the HDUG saw a demonstration of HAZUS, learned where the databases are stored and how to contribute to them, and received encouragement to enlist support of other potential users and organizations. In the future, the HDUG plans to:

- provide basic and advanced HAZUS training;
- execute a Memorandum of Understanding with AGRC, which has agreed to act as the clearinghouse for the data, provide users with password access so they can contribute and retrieve information, and create a firewall to protect proprietary information;
- update default data, to include allocating funds for staffing and other expenses; and
- motivate agencies and organizations to reduce future earthquake damage.

Potential HAZUS users include representatives from:

- city and county agencies such as building inspectors, emergency management teams, planning offices, public works, utilities, and water and sewer districts;
- state agencies such as Public Safety, State Lands, UGS, Automated Geographic Reference Center, Transportation, and USSC;
- federal agencies such as the USGS, Army Corps of Engineers, and Bureau of Reclamation;
- local colleges and universities;
- the private sector such as utilities, cable television providers, oil and gas refineries and pipeline companies, and other large employers; and
- other organizations, both secular and religious.

CEM, in January 2000, conducted HAZUS training for 20 state and local government participants. The training was the first in the country on HAZUS 99, the latest version from FEMA. The training was conducted by Ken Taylor, Earthquake Program Manager from North Carolina.

HAZUS has the potential to raise awareness and serve as a catalyst for change. It can identify hazards and vulnerabilities so communities can focus on solutions. HAZUS helps organizations explore options to prepare for and reduce the effects of earthquakes, and it can be used to compare benefits to costs on projects to ensure that dollars are spent wisely. Eventually, HAZUS can add modules that can reflect other hazards, such as wind, flood, wildfire, and landslides.

The second of CEM's major initiatives has been CERT training, which is necessary to provide citizens with the basic skills to handle their own needs and to respond to the needs of their communities in the event of a disaster. CEM sponsors the program, trains the trainers, and encourages local jurisdictions and organizations to incorporate CERT training in their own disaster preparedness activities.

The course consists of 21 hours of training in:

- preparedness, to include introduction to disasters, impact of disasters on infrastructure, hazards posed by buildings and nonstructural items, and the role of CERTs in disaster response;
- fire suppression, to include identifying and reducing potential fire hazards, basic fire suppression strategies, firefighting resources, and firefighting techniques;
- medical training, to include treatment strategies for life-threatening conditions and principles of triage, head-to-toe assessments, treatment for head wounds, fractures, sprains, burns, and other injuries;
- light search-and-rescue, to include priorities and resources, techniques for assessment and searching, removing victims, and rescuer safety; and
- psychology and team organization, to include post-disaster emotional environments, the Incident Command System, CERT strategies, tactics, and documentation.

The class ends with a course review and a disaster simulation exercise. CEM oversees the program and ensures that the guidelines for instruction and training are followed.

OUTCOME

HAZUS has the potential of reducing Utah's vulnerabilities to natural hazards, while CERT training brings together private and public sector elements and ensures that they work together with city, county, and corporate emergency planners. CEM promotes effective communication among, and enhances the relationships of, emergency management systems statewide.

REAL-TIME EARTHQUAKE INFORMATION SYSTEM AND STRONG-MOTION RECORDING

STRATEGIES ADDRESSED

2.4 — Enhance the integrated emergency management system statewide.
3.12 — Improve lifeline survivability in the event of an earthquake.
4.8 — Develop incrementally a strong-motion program.
4.9 — Develop a statewide, real-time earthquake monitoring system.

ACTION

Initiatives aimed at strong-motion instrumentation and developing capabilities for real-time earthquake information have long involved scientists, engineers, and emergency managers from Utah's state earthquake program.

Important state needs in this regard were defined in 1989 when a legislative study of "Earthquake Instrumentation Needs of Utah" was assigned to the Legislature's Interim Appropriations Committee and the Office of the Legislative Fiscal Analyst—leading to the creation of a blue-ribbon panel co-chaired by then Senator Craig A. Peterson. Unfortunately, the recommendations of the panel went largely unheeded, save for some small one-time state funding to the Utah Geological Survey in 1992 that enabled seven strong-motion instruments to be installed at scattered sites along Utah's main earthquake belt.

The efforts of many—including advocacy by the Commission during 1998 and 1999—finally bore fruit in 1999 with the announcement that the University of Utah Seismograph Stations (UUSS) would receive federal funding during the federal fiscal year 2000, under a cooperative project with the U.S. Geological Survey, to begin building a real-time urban strong-motion network in the Ogden-Salt Lake City-Provo urban corridor. Thanks to this funding, the University of Utah's earthquake-recording network is being modernized into a multipurpose, real-time earthquake information system. The primary aim is to improve earthquake safety in Utah's dramatically growing Wasatch Front area by providing faster and better information—especially for emergency response and earthquake engineering. A secondary aim is to have basic real-time capabilities in place before the 2002 Winter Olympics.

With the funding from the U.S. Geological Survey, UUSS is installing new sensors, digital processors, computer networks, and communications for this modernized system, which by late 2001 will provide: (1) automated broadcasts of the location and size of a potentially disruptive earthquake, within a few minutes of its occurrence, and (2) automated computer maps (called ShakeMaps), available on the World Wide Web within several minutes of any significant earthquake, showing the geographic distribution and severity of ground shaking. (A ShakeMap is analogous to a Doppler-radar image, giving a useful overview of the location and severity of a potentially threatening disturbance.)

By September 2000, twenty modern digital strong-motion instruments were added to the UUSS seismic network in the Ogden-Salt Lake City-Provo urban corridor. Added funding is being provided in 2001 to expand this urban network to more than 40 stations, enlarging the geographic coverage. This new urban strong-motion network in Utah is being built with seed-funding for an Advanced National Seismic System (ANSS), a large-scale initiative now pending before Congress. If the ANSS receives full funding, Utah's urban network would eventually expand to about 500 stations along the Wasatch Front.

Unlike conventional sensors in the University of Utah's seismic network, strong-motion accelerometers capture high-quality recordings of ground shaking and are designed to stay on scale during moderate to large earthquakes of magnitude 5 or greater. Recordings of strong ground shaking in structures and on the ground near the source of moderate to large earthquakes are fundamentally important in earthquake engineering for setting guidelines in building codes and for safe, cost-effective design and construction practices.

Strong-motion monitoring is integral to a real-time earthquake information system, particularly for providing rapid information to crisis managers—such as public safety officials and operators of utilities, hospitals, dams, and other critical facilities and lifelines—who must make informed decisions for response and recovery when an earthquake happens. Rapid estimates of damage, losses, and impacts on population based on real-time ground-shaking information have become important in meeting requirements for a formal Presidential Declaration of disaster. The information also expedites federal recovery assistance to individuals and communities.

Key elements in successfully completing and sustaining a real-time earthquake information system in Utah will be: (1) capital funding for a major part of the system from federal sources; (2) state funding for a minor part (e.g., to extend coverage to seismically dangerous parts of Utah such as Cache Valley, Brigham City, Richfield, and the St. George-Cedar City area), together with a firm commitment to providing at least part of the system's long-term operational support; and (3) private-sector involvement, particularly in extending the geographic distribution of sensors and perhaps in sharing resources for digital communications.

OUTCOME

With federal funding through the U.S. Geological Survey, and as part of building an Advanced National Seismic System, the University of Utah's earthquake-recording network is being modernized into a multi-purpose, real-time earthquake information system—with special focus on Utah's dramatically growing Wasatch Front urban corridor. Benefits to Utah will include real-time information for emergency management, critical information for earthquake engineering and improved building codes, and new and valuable information for scientific understanding of earthquakes in Utah.

A basic real-time earthquake information system will be in place in the Wasatch Front area before the 2002 Winter Olympics, when international attention will demand rapid information, in the unforeseen event of any disruptive local earthquake activity.

A UNIFIED UTAH EARTHQUAKE MASTER MODEL

STRATEGY ADDRESSED

4.10 — Monitor faults using GPS measurements.

ACTION

At the October 10, 1997, quarterly meeting of the Commission, Robert D. Smith, Ph.D., Professor of Geophysics at the University of Utah, presented a proposal for a "Unified Utah Earthquake Master Model," intended to be a vehicle for integrating various types of earth-science information for earthquake research and practical applications. He described new measurements from Global Positioning System (GPS) monitoring which indicated higher-than-expected rates of extensional strain across an area encompassing the Wasatch fault. These results could be factored into, and would increase, probabilistic estimates of the ground shaking hazard in the Wasatch Front area.

The Commission referred his proposal to the Geoscience Standing Committee (GSC) to answer four questions: (1) Do the high GPS rates indicate that the earthquake hazard in the Wasatch Front region is higher than previously estimated? (2) Do the high GPS rates warrant immediate action by the Commission? (3) Is this unified master model proposal technically applicable in Utah? and (4) How should the Commission proceed?

At the January 9, 1998, quarterly meeting, the GSC reported to the Commission that the higher GPS rates do not necessarily indicate an increased earthquake hazard because of uncertainties in the measurements themselves as well as in the interpretation of the cause of the higher rates of movement. The GSC recommended that more continuous-monitoring GPS instruments be installed, that further scientific work be done on extensional strain measurement and interpretation, and that a scientific workshop be held under the auspices of the Commission to develop a strategic plan to consider the master model proposal and other geoscience initiatives.

Dr. Smith has continued his GPS research with funding from the U.S. Geological Survey (USGS), concentrating on three elements: (1) installation and maintenance of four continuous recording GPS sites on the Wasatch Front; (2) incorporation of data from six Harvard Smithsonian-Caltech Basin-and-Range continuous GPS stations in the eastern Basin and Range, for a total of 10 stations; and (3) research on understanding time-varying behavior of the Wasatch normal fault incorporating GPS-derived motions, the paleoseismic record, and fault stress interactions.

OUTCOME

Smith's efforts have resulted in the establishment of a 4-station continuous GPS network on the Wasatch Front. With the installation of six Harvard/Cal Tech stations in western and central Utah, at least ten continuous GPS stations transmit data on a daily basis. Furthering a master model approach to analyzing earthquake behavior in Utah awaits consensus-building among scientific researchers regarding the viability of such an approach.

NATIONAL SCIENCE FOUNDATION REQUEST FOR PROPOSALS TO FUND EARTHQUAKE-ENGINEERING RESEARCH CENTERS

OBJECTIVES ADDRESSED

3 — Improve the seismic safety of buildings and infrastructure
4 — Improve essential geoscience information

ACTION

In 1996 the National Science Foundation (NSF) issued a request for proposals to fund earthquake-engineering research centers. The Commission unanimously voted to support a proposal from a consortium including Brigham Young University (BYU), Utah State University, the University of Utah, Portland State University, the Oregon Department of Geology and Mineral Industries, and the Utah Geological Survey.

The principal author of the proposal, Matthew Mabey, Ph.D., of the Geology Department at BYU, said the proposed Utah center would have a geotechnical-engineering, rather than a structural-engineering, emphasis. The center would initially have two goals: (1) engage in research to develop and implement methods for supplying geotechnical-engineering design parameters for the cost-effective reduction of losses, and (2) advance the ability to quickly identify the most vulnerable structures, leading to more cost-effective expenditures to increase the benefit-to-cost ratio for mitigation. The completed proposal was submitted to the NSF in October 1996.

OUTCOME

In April 1997, the National Science Foundation announced it was re-evaluating the program and postponed funding decisions. Funding was ultimately awarded to three other proposed centers in California, New York, and Illinois.

THE RELEVANCE OF SEISMIC SAFETY COMMISSIONS

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
3.1 — Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
3.14 — Reduce structural hazards in older private buildings by retrofitting to current seismic building requirements.

ACTION

The Commission opened its 2nd Quarterly Meeting of 1999 to outside advice, inviting Ron Lynn, the chair of Nevada Earthquake Safety Council, to relate how the Nevada group maintains its relevance.

The Nevada Earthquake Safety Council is an independent organization that "hustles for its money," Lynn noted, adding that seismic safety issues have to be made "real."

"In Utah," he said, "you are trying to educate the public about a low-occurrence/high-impact event. You need to bring your message down to real issues: building and retrofitting to mitigate earthquake damage is smart and increases property values; educating school children about the potential for earthquakes and ways to survive them is good for the future; enforcing building codes that require setbacks from fault lines is good business. Trust your constituents, and remember: all building codes—in a very real sense—are written in blood."

Lynn, who is the Assistant Director of the Clark County, Nevada, Building Department, spoke during a luncheon forum to address building code issues. The hottest topic was the Gateway Project, which will involve extensive remodeling of older buildings on Salt Lake City's near-west side. Lynn's presentation, "A Rational Approach to Building Codes: Practical Issues and Local Challenges Relating to Seismic Codes, Retrofit, and Fault-Setback Ordinances," sparked lively discussions among the structural engineers and architects present. Lynn stressed that this kind of communication needs to continue until a consensus is reached, and that contractors and building officials must be involved.

OUTCOME

The Commission resolved (1) to go into the 2000 State Legislative Session with proposed changes to its charter that would include language allowing it to solicit funds rather than rely only on a small annual legislative appropriation, and (2) to actively persuade Utah's Uniform Building Code Commission to adopt updated seismic codes for new construction and remodeling projects.

DISASTER-RESISTANT COMMUNITIES

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
1.3 — Disclose geologic hazards in real estate transactions.
3.3 — Improve the post-earthquake operational status of essential service buildings.
5.1 — Update estimates of direct losses to be expected from earthquakes [and mitigation strategies].
5.2 — Evaluate the indirect losses associated with earthquakes [and mitigation strategies].

ACTION

The challenge of improving earthquake safety in Utah inevitably faces changing circumstances and demands—which calls for versatility, both in focus and tactics. One prominent circumstance that has captured the Commission's attention is the growth dynamic in the greater Wasatch Front Area. Population in this area is well known to be growing dramatically from its 1995 base of 1.6 million and is projected to reach 2.7 million by 2020 and 5 million by 2050. This increases the urgency of taking actions that will make Utah's communities more disaster-resistant.

The Commission invited Natalie Gochnour, an economist in the Governor's Office of Planning and Budget, to its January 1998 meeting to present information gathered by the program *Envision Utah*, formerly known as the Utah Quality Growth Public/Private Partnership, sponsored by the Coalition for Utah's Future. Ms. Gochnour presented findings on population, transportation, air quality, water, and land use, all of which provided a useful perspective for the Commission in identifying future needs and priorities for earthquake-related mitigation actions. An inescapable fact is that Utah's future growth and development in the Wasatch Front area will take place right on top of the active Wasatch fault.

In terms of changing tactics, at the Commission's July 1999 quarterly meeting, the Awareness and Education Standing Committee (AESC) reported that they were working on two initiatives:

- making data on geologic hazards more accessible to policy- and decision-makers in Utah, and
- exploring ways to use lobbyists from private companies to advance the Commission's agenda in the State Legislature.

One of the premier issues identified by this committee was the creation of legislation that would mandate complete disclosure of geologic hazards to potential buyers of real estate. Utah does not now have such a requirement, and the committee will work with representatives and lobbyists from the real estate, construction, and insurance industries to make full disclosure a reality.

A tangible benefit of the close cooperation between federal, state, and local emergency managers in mitigating the effects of disaster was the awarding of FEMA funding to several Utah

communities for *Project Impact: Building a Disaster-Resistant Community*. Communities awarded grants by FEMA include: Centerville, 1998; Salt Lake City, 1999; Logan and Moab, 2000; and Provo, 2001. The grants, ranging from $150,000 to 500,000 will be used to develop long-term cooperative initiatives by continuously engaging and leveraging the resources of the city with the resources of its private sector *Project Impact* partners.

Project Impact is a nationwide effort aimed at protecting families, businesses, and communities by reducing the effects of disasters. FEMA, in awarding the grants, recognizes the strong infrastructure of these communities and the willingness of representatives from the public and private sectors to work together to mitigate hazards, both natural and human-caused. *Project Impact* will be managed by communities' emergency management offices in cooperation with CEM and FEMA.

OUTCOME

The Commission is firmly committed to take actions that will help make Utah's communities more disaster resistant—particularly in view of the dramatic growth and development in the greater Wasatch Front Area. Funding from FEMA to selected communities in Utah under Project Impact will directly aid in creating disaster-resistant communities.

COMMISSION MEETINGS OUTSIDE THE SALT LAKE CITY AREA

STRATEGIES ADDRESSED

1.1 — Inform citizens about earthquake hazards and risks.
5.1 — Update estimates of direct losses to be expected from earthquakes.

ACTION

The Commission traveled to Brigham City for its second quarterly meeting of 1998 to meet with the public as well as local and state officials from Box Elder, Cache, and Weber counties. The Commission's second quarterly meeting of 2000 was held in Provo at Brigham Young University (BYU) with representative from the communities in Utah County. Meeting in public and away from Salt Lake City provides an excellent opportunity for the Commission to spread its message of taking responsible action to promote earthquake safety in communities along the Wasatch Front. The Commission's second meeting of 2001 will be held in Ogden.

After some standard introductory presentations by various commissioners, the Brigham City meeting became an open discussion between the Commission and local officials, who asked what defensive actions could be taken to advance earthquake safety in northern Utah and how the Commission could help them achieve results. There was additional discussion about the political and economic problems the region faced in implementing prudent, defensive actions and what was needed that the Commission might be able to provide or facilitate. Local officials emphasized the need for timely information and updated maps of earthquakes and associated hazards. The officials believed they were doing a good job of planning for emergency response, especially in the first hours and days after an event — but there was less satisfaction with the capability for reducing exposure in advance of the event. Citizen awareness of and support for seismic safety issues were coming from schools and Parent-Teacher Associations, while resistance was noted in public sectors having to do with land-use planning. There followed a discussion on problems associated with enforcement of restrictions on building in unsuitable areas and whether building codes were adequate. Local officials believed they were doing a good job of plan review checks and quality control on contractors.

At the meeting in Provo at BYU, several speakers—at the invitation of the Commission—presented their views on issues related to earthquake hazards, safety, and emergency response and preparedness. Kerry Baum, Emergency Preparedness Coordinator for BYU, described efforts by the university to implement earthquake-safety measures on campus. These efforts include extensive employee training, food stockpiling, purchase of water-purification equipment, and non-structural reinforcement to reduce hazards. Les Youd, Chairman of the Civil and Environmental Engineering Department at BYU, discussed earthquake hazards within Utah County and related engineering techniques. Tricia Porter, Emergency Management Coordinator for Provo City, reported on the Provo Emergency Operations Center and implementation of its functions during future earthquakes. Chuck Hugo, Chief Building Official for Provo City, spoke about

construction techniques within the city and the relationship of infrastructure to earthquake hazards. Jerry Grover, Chair of the Utah County Commission, described county efforts to address earthquake hazards in comprehensive planning documents.

OUTCOME

Holding Commission quarterly meetings outside of the metropolitan area of Salt Lake County has become a valuable out-reach tactic. More meetings in other regions of the state are planned, and local officials and the general public welcome the visits and the open exchange of ideas and concerns.

PRIORITIES FOR THE FUTURE

The scope of what has to be done to improve earthquake safety in Utah demands simultaneous attention to the many facets of being prepared to (a) withstand, (b) respond to, and (c) recover from earthquakes. The diverse makeup of the Commission and its standing committees enables such attention. The Commission has identified nine important action items on which to focus next. All are relevant to three primary objectives in the Commission's 1995 strategic plan: (1) increase earthquake awareness and education; (2) improve the seismic safety of buildings and infrastructure; (3) improve—and effectively use—essential geoscience information.

In unranked order, the Commission's priorities for the immediate future are the following:

- Expand the Commission's "Prepared Schools" program to increase earthquake safety and disaster-preparedness in Utah's K-12 schools (see p. 3 and p. 5) and in institutions of higher learning.

- Advocate requirements for seismic improvements in older commercial and high-occupancy buildings during major remodeling or when certain other changes are made in order to increase life-safety during moderate to large earthquakes (see p. 17).

- Improve the survivability and post-earthquake usability of essential service buildings (see, for example, p. 19).

- Evaluate the seismic vulnerability of Utah's lifelines so that long-range seismic retrofit strategies can be developed (see p. 26 regarding transportation lifelines).

- Ensure that geologic-hazards investigations are performed for the safe siting of all new schools and critical public facilities.

- Continue assisting local governments with geoscience information and with guidance in planning and land-use in order to reduce risks from earthquakes and other geologic hazards (see p. 27).

- Support ongoing efforts by the University of Utah Seismograph Stations and the U.S. Geological Survey in developing urban strong-motion monitoring and a real-time earthquake information system in the greater Wasatch Front Area as part of an Advanced National Seismic System (see p. 37).

- Ensure that design professionals and building officials are kept current on relevant geoscience information.

- Advocate the disclosure of known geologic hazards in real-estate transactions so that homebuyers, prior to purchase, are appropriately informed of the risk they are assuming.

OTHER STRATEGIC OBJECTIVES

Since 1995 when the Commission created *A Strategic Plan for Earthquake Safety in Utah*, 27 (or three-fourths) of its 35 strategic objectives have either been successfully met or are being addressed in an ongoing way. Others not yet mentioned in this report and remaining to be addressed are the following:

2.2 — Develop effective exercise and training programs for hospitals
2.3 — Enhance communication capabilities for emergency responders
3.5 — Mitigate nonstructural hazards in government-owned buildings
3.7 — Improve safety and operational ability of older hospital buildings
3.9 — Improve the seismic safety of older homes
3.10 — Improve safety of mobile homes
3.11 — Prevent loss of historic buildings

Strategies 2.2 and 3.7 (hospitals) need the active participation and commitment of all the state's hospitals, for-profit and not-for-profit alike. Thankfully, some major health-care providers are already taking proactive measures. Hospitals occupy a unique position in any seismic mitigation scheme because they must remain operational in order to deal with casualties; no one else can fill that role. If hospitals cannot survive, casualties will be compounded.

With the implementation of *Project Impact* in Salt Lake City, and also with preparations for the 2002 Winter Olympics, communication capabilities for emergency responders (2.3) are being progressively enhanced—at least in the Salt Lake Valley. Communication capabilities for emergency response in other parts of Utah still need to be improved, and the Commission will use its influence to motivate needed actions.

The remaining strategies (3.5, 3.9, 3.10, and 3.11) will require more aggressive awareness and education, the commitment and involvement of communities and zoning agencies, and relevant legislation. Again, the Commission will use its influence to advocate needed improvement in these areas.

Mitigating the effects of earthquakes is a complex task. The effort begins with awareness, but has to be sustained with education, training, technical investigations, and a long-term commitment to risk reduction and preparedness. The Commission exists to help meet these challenges and will continue to do so.

APPENDIX A

THE STANDING COMMITTEES OF THE USSC, DECEMBER 2000

Awareness and Education Standing Committee
(incorporating an earlier separate committee on Emergency Management)

Robert D. Carey
Committee Chair
Utah Division of Comprehensive Emergency Management

Jan Gibbons
Davis School District

Andrew Glad
Sandy City Fire Department

Deborah H. Kim
University of Utah Medical Center

Brian Law
Davis County Emergency Services

Pat Lewis
State Farm Insurance Company

Ed O'Sullivan
Quake Pro

Tricia Porter
Provo City

Bruce A. Spiegel
Utah Division of Risk Management

Michael W. Stever
SLC Dept. of Mgmt Services

Valdee Wiltsey
Utah Office of Education

Former Committee Members During July 1996-June 2000
(including former members of Emergency Management Standing Committee)

Ann M. Becker, 1997-2000
URS Corporation

M. Lee Allison, 1996-1999
Utah Geological Survey

Cathy Bledsoe, 1996-1999
Utah State PTA Emergency Preparedness Committee

Jennifer Brown, 1999-2000
State Farm Insurance Company

Bob Halloran,1998-1999
Salt Lake County Fire, Emergency Services Bureau

Pat Iannone, 1996-2000
Utah Association of Realtors

Judy Johnson, 1998-1999
State Farm Insurance Companies

Gary Madsen, 1996-2000
Department of Sociology, Utah State University

Karen Mayne, 1996-1999
Provo City Police Department

Robert Nielson, 1998-1999
Mountain Fuel Supply Company

Deedee O'Brien, 1996-1999
Utah Geological Survey Board

Kathy Ochsenbein,1998-1999
Roy Junior High School

Patrick Reese, 1998-1999
Church of Jesus Christ of Latter-Day Saints

Alan D. Rindlisbacher, 1998-1999
Layton Construction Company

Paul Wanlass, 1996-2000
Salt Lake County Water Conservancy District

Engineering and Architecture Standing Committee

Barry H. Welliver
Committee Chair
Structural Engineers Association of Utah

Max A. Gregersen
CEntry Contractors & Engineers, Inc.

Thair Blackburn
Blackburn Architects

Parry Brown
Reaveley Engineers & Associates, Inc.

Ron Dunn
Dunn Associates, Inc.

Carl Eriksson
West Jordan Development Services

Roger Evans
Salt Lake City Corp.

Matthias Mueller
Utah Div. of Facilities Const. and Mgmt.

Barry Smith
Hart, Fisher, Smith & Associates

Former Committee Members During July 1996-June2000

James S. Bailey, 1996-2000
Allen & Bailey Engineers

Earle Eppich, 1996-1998
Reaveley Engineers & Associates, Inc.

William Juszcak, 1996-1998
Utah Division of Facilities Construction Management

Geoscience Standing Committee

Gary E. Christenson
Committee Chair
Utah Geological Survey

Walter J. Arabasz
University of Utah Seismograph Stations

Jon E. Bischoff
Utah Department of Transportation

Ronald L. Bruhn
University of Utah

Marvin W. Halling
Utah State University

Jeffrey R. Keaton
AMEC Earth & Environmental

Matthew Mabey
Brigham Young University

William R. Lund
Utah Geological Survey

James C. Pechmann
University of Utah Seismograph Stations

Joergen Pilz
AMEC Earth and Environmental

Kyle M. Rollins
Brigham Young University

James Wells
Utah Division of Water Rights, Dam Safety

T. Leslie Youd
Brigham Young University

Intergovernmental Relations Standing Committee
(assignment of Committee Chair pending)

Jay Aguilar
Bear River Association of Government

Walter J. Arabasz
University of Utah Seismograph Stations

Mark Bedel
Governor's Office of Planning & Budget

Kenneth H. Bullock
Utah League of Cities And Towns

Robert D. Carey
Utah Div. of Comprehensive Emergency Mgmt.

Diane Conrad
Salt Lake Olympic Organizing Committee

Jerry Grover
Mountainland Association of Governments

Prescott Muir
Prescott Muir Architects

David Owens
Five County Association of Governments

Carol Page
Wasatch Front Regional Council

Suzanne Winters
State Science Advisor

Lifelines and Infrastructure Standing Committee

David Nazare
Committee Chair
Utah Department of Transportation

Steven F. Bartlett
University of Utah

Robert D. Carey
Utah Div. of Comprehensive Emergency Mgmt.

Carl H. Carpenter
(Ground-Water Consultant)

Peter W. McDonough
PRIDE Engineering

Joergen Pilz
AMEC Earth and Environmental

Paul Wanless
Salt Lake County Conservancy District

Former Committee Members During July 1996-June 2000

James C. Golden, 1996-1999
Utah Dept. of Transportation

Guidelines Advisory Committee on Local Government Needs*

*Established in 1999 to advise the Commission's Geoscience Standing Committee and the Utah Geological Survey on local government needs for geoscience information to reduce risks from earthquakes and other geologic hazards.

Gary E. Christenson
Committee Chair
Utah Geological Survey

Carl Eriksson
Committee Advisor
West Jordan Development Services

Craig Barker
Weber County Planning

Darlene Batatian
Salt Lake County Planning

Jon Bischoff
Utah Department of Transportation

Ronald Bruhn
University of Utah

Scott Carter
Layton City Development Services

Andrew Jackson
Mountainlands Association of Governments

Jeffrey R. Keaton
AMEC Earth and Environmental

William R. Lund
Utah Geological Survey

Lane Nielson
Wasatch Front Regional Council

APPENDIX B

Enrolled Copy **H.B. 200**

UTAH SEISMIC SAFETY COMMISSION ACT AMENDMENTS

2000 GENERAL SESSION

STATE OF UTAH

Sponsor: Don E. Bush

AN ACT RELATING TO BOARDS AND COMMISSIONS; MODIFYING THE MEMBERSHIP OF THE UTAH SEISMIC SAFETY COMMISSION; ESTABLISHING FUNDING PARAMETERS; AND MAKING TECHNICAL CORRECTIONS.

This act affects sections of Utah Code Annotated 1953 as follows:

AMENDS:

63C-6-101, as last amended by Chapter 270, Laws of Utah 1999

63C-6-102, as enacted by Chapter 136, Laws of Utah 1994

63C-6-104, as enacted by Chapter 136, Laws of Utah 1994

Be it enacted by the Legislature of the state of Utah:

Section 1. Section **63C-6-101** is amended to read:

63C-6-101. Creation of commission -- Membership -- Appointment -- Vacancies.

(1) There is created the Utah Seismic Safety Commission consisting of [~~13~~] 15 members, designated as follows:

[~~(a) the commissioner of the Department of Public Safety;~~

] (a) the director of the Division of Comprehensive Emergency Management or his designee;

[~~(c)~~] (b) the director of the Utah Geological Survey or his designee;

[~~(d)~~] (c) the director of the University of Utah Seismograph Stations or his designee;

[~~(e)~~] (d) the executive director of the Utah League of Cities and Towns or his designee;

[~~(f)~~] (e) a representative from the Structural Engineers Association of Utah biannually selected by [~~the~~] its membership;

[~~(g)~~] (f) the director of the Division of Facilities and Construction Management or his designee;

[~~(h)~~] (g) the executive director of the Department of Transportation or his designee;

[~~(i)~~] (h) the State Planning Coordinator or his designee;

[~~(j)~~] (i) a representative from the American Institute of Architects, Utah Section;

[~~(k)~~] (j) a representative from the American Society of Civil Engineers, Utah Section;

[~~(l)~~] (k) a member of the House of Representatives appointed biannually by the speaker of the House; [~~and~~]

[~~(m)~~] (l) a member of the Senate appointed biannually by the president of the Senate[~~.~~];

(m) the commissioner of the Department of Insurance or his designee;

(n) a representative from the Association of Contingency Planners, Utah Chapter, biannually selected by its membership; and

(o) a representative from the American Public Works Association, Utah Chapter, biannually selected by its membership.

(2) The commission shall annually select one of its members to serve as chair of the commission.

(3) When a vacancy occurs in the membership for any reason, the replacement shall be appointed for the unexpired term.

Section 2. Section **63C-6-102** is amended to read:

63C-6-102. Meetings -- Duties -- Committees.

(1) The commission shall meet at the call of the chair, but not less than once each quarter.

(2) The commission shall:

(a) review earthquake-related hazards and risks to the state of Utah and its inhabitants;

(b) prepare recommendations to identify and mitigate these hazards and risks;

(c) prioritize recommendations and present them to state and local government or other appropriate entities for adoption as policy or loss reduction strategies;

(d) act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss reduction measures;

(e) prepare a strategic seismic planning document to be presented to the State and Local Interim Committee before the 1995 annual general session of the Legislature; and

(f) periodically update the planning document and monitor progress toward achieving the goal of loss reduction.

(3) The commission may:

(a) divide into or create subcommittees as it determines necessary to carry out its duties under this section[.]; and

(b) accept contributions from other private or public sources and seek grants or funding from the federal government for uses relating to seismic safety.

Section 3. Section **63C-6-104** is amended to read:

63C-6-104. Staffing and appropriated funds.

(1) Staff support to the commission shall be provided by the Division of Comprehensive Emergency Management and the Utah Geological Survey.

(2) Monies not expended by the Utah Seismic Safety Commission during a fiscal year are nonlapsing except that any balance of General Fund monies greater than $10,000 lapses to the General Fund.

APPENDIX C

STRATEGIC PLAN'S OBJECTIVES AND STRATEGIES

Objective 1: Increase earthquake awareness and education

Strategies
- 1.1 Inform citizens about earthquake hazards and risks.
- 1.2 Incorporate earthquake education in school curricula.
- 1.3 Disclose geologic hazards in real estate transactions.

Objective 2: Improve emergency response and recovery

Strategies
- 2.1 Establish Community Emergency Response Teams (CERTs) statewide.
- 2.2 Develop effective exercise and training programs for hospitals.
- 2.3 Enhance communication capabilities for emergency responders.
- 2.4 Enhance the integrated emergency management system statewide.

Objective 3: Improve the seismic safety of buildings and infrastructure

Strategies
- 3.1 Improve plan review procedures on new construction to ensure that buildings are being designed in accordance with current seismic code requirements.
- 3.2 Enforce the state amendment to the Uniform Building Code which requires building owners to install roof anchors and parapet bracing when reroofing their buildings.
- 3.3 Improve the post-earthquake operational status of essential service buildings.
- 3.4 Reduce structural hazards of government-owned buildings.
- 3.5 Mitigate nonstructural hazards in government-owned and -leased buildings.
- 3.6 Improve safety of older public school buildings.
- 3.7 Improve safety and operational ability of older hospital buildings.
- 3.8 Improve safety of older high-occupancy buildings (250 persons or more) to be structurally competent enough to withstand moderate to large earthquakes.
- 3.9 Improve the seismic safety of older homes.
- 3.10 Improve safety of mobile homes.
- 3.11 Prevent loss of historic buildings.
- 3.12 Improve lifelines survivability in the event of an earthquake.
- 3.13 Improve earthquake performance of water and waste-water systems.

Objective 4: Improve essential geoscience information

Strategies

- 4.1 Reduce earthquake losses by mapping and identifying geologic hazards.
- 4.2 Perform geologic-hazards investigations for critical public facilities.
- 4.3 Make land use compatible, through local government ordinances, with known hazards.
- 4.4 Ensure design professionals and building official are kept current on relevant geoscience information.
- 4.5 Determine appropriate seismic criteria and procedures for evaluating performance of existing dams.
- 4.6 Reduce earthquake-induced liquefaction risk to highway structures.
- 4.7 Determine appropriate seismic design coefficients for highway bridges.
- 4.8 Develop incrementally a strong-motion program.
- 4.9 Develop a statewide, real-time earthquake monitoring system.
- 4.10 Monitor faults using Global Positioning System (GPS) measurements.

Objective 5: Assess earthquake risk

Strategies

- 5.1 Update estimates of direct losses expectable from earthquakes.
- 5.2 Evaluate the indirect losses associated with earthquakes.
- 5.3 Conduct lifeline collocation vulnerability studies.

APPENDIX D

Prepared Schools Certification

Level I

____ Our alarms, which may include fire protection systems and possibly strobe lights, are maintained and in working order and are in compliance with the local Fire Marshal's inspection. *(R277-400-7 B (4) & R277-400-8 A)*

____ We hold fire drills once a month if we are an elementary school and every other month if we are a secondary school. *(R277-400-7 B) (Uniform Fire Code 1303.3.3.2.1) (Utah Fire Marshal's Rules and Regulations) (R710-4-3.9.2)*

____ We hold one other type of drill yearly i.e., earthquake drill, violent intruder, etc. *(R277-400-7 C)*

____ We hold an Emergency Preparedness Week prior to April 30 (preferably during the month of April) of each school year. *(R277-400-7 E)*

____ We have a first aid kit in the main office that is currently stocked and portable. *(Utah Administrative Code Rule R392-200-7-A-1)*

____ We have a record of all students on medication and/or receiving special health services. *(Utah Administrative Code 53A-11-601) (Utah Administrative Code Rule R392-700-7.3 & 4) (Guidelines for Children with Special Health Care Needs, p.23)*

____ We have provisions for back up medication for the special needs of students and staff in our school.

____ We have assessed and recorded the abilities of our staff i.e. C.P.R., C.E.R.T., First Aid, etc.

____ We have three people currently certified in first aid and C.P.R. *(Utah Administrative Code Rule R392-200-7 A) (Utah Administrative Code Rule R392-200-7-A-1)*

____ We have an active Safety Committee which includes an administrator, teacher, custodian, and a member of the P.T.A. *(R277-400-3 B & R277-400-4 A & B)*

____ We have a policy and procedure for contacting parents and releasing students following a disaster. *(R277-400-6 A & B)*

____ We have emergency procedures in place for evacuating students with special health care needs i.e., wheelchair bound, and those who use assisted walking devices. *(Guidelines for Children with Special Health Care Needs)*

Nonstructural hazards:

____ We hold an annual nonstructural hazard hunt in all classrooms.

____ We have defined our nonstructural hazards in easy-fix, low-cost, and long-term categories.

____ We have taken care of all easy-fix hazards.

Please note: The Utah State Board of Education Policies and Procedures have been listed in the parentheses following each item, unless otherwise noted.

Level II (includes everything in level I as well as the following):

____ We have invited our local police and fire departments to be a part of our safety committee. *(R277-400-3 B)*

____ We have the necessary equipment for special-need students and staff, such as backup power for a ventilator. *(Guidelines for Children with Special Health Care Needs)*

____ We have expanded our fire drills to include obstacles that will add confusion to the evacuation i.e., blocked doors, missing persons, etc.

____ We have a backpack (or container) in every classroom with the minimum of supplies suggested by the Schools Subcommittee for the Utah Seismic Safety Commission needed for a disaster. This container is checked and updated annually.

____ We have 10% or four persons, whichever is greater, of our full-time staff currently certified in CPR and first aid. Schools with less than 10 people on staff will be given special considerations.

____ We have a five-year plan to reduce long-term nonstructural hazards. We have addressed all low-cost nonstructural hazards.

____ We have completed a Hazard and Risk Assessment.

____ We have an all-hazards emergency response plan. Examples of school plans are available from the Division of Comprehensive Emergency Management. *(R277-400-4)*

____ We inform parents, students, and staff of their part in the plan annually. *(R277-400-5)*

____ We train and educate students and staff on emergency response procedures for the specific hazards compiled in our Hazard and Risk Assessment. *(R277-400-6)*

____ We hold annual drills which include evacuation of all persons in the building, accountability of the entire staff and student body, and release of students in accordance with the school plan. Each drill has been evaluated by our Safety Committee. *(R277-400-6 B) (Uniform Fire Code 1303.3.3.2.2)*

____ We have tested our plan in a tabletop exercise and have made the appropriate modifications to the plan**.**

____ We have submitted our school emergency response plan for review to the *Utah Seismic Safety Commission, c/o Bob Carey, 1110 State Office Building, SLC, UT 84114.*

What should be included in the School Emergency Response Plan:

____ Our plan includes procedures to respond to all the hazards compiled in the Hazard and Risk Assessment, including violence.

____ Our plan includes all policies and procedures listed in Level 1.

____ Our plan includes procedures for contacting school district personnel, the school nurse, and parents.

____ Our plan includes what students, teachers, staff, and others in the building should do during and immediately following an earthquake. (Some schools do not have earthquakes, but when students travel to an earthquake prone area they need to know what to do.)

____ Our plan includes a policy and procedure for sheltering the students for 24 hours.

____ Our plan has been disseminated to the district office, and the local fire and police departments for their information.

Web Page Resources:

Home page for School Subcommittee of the Utah Seismic Safety Council:
http://www.davis.k12.ut.us/emrprep/schsub/schsub.htm

Contents of backpack or bucket:
http://www.davis.k12.ut.us/emrprep/schsub/backpack.htm

How to evacuate a building:
http://www.davis.k12.ut.us/emrprep/schsub/bldevac.htm

Drill Evaluation:
http://www.davis.k12.ut.us/emrprep/schsub/drilleva.htm

Earthquake drills:
http://www.davis.k12.ut.us/emrprep/schsub/eqdrill.htm

Earthquake drill evaluation:
http://www.davis.k12.ut.us/emrprep/schsub/eqdrlevl.htm

Evacuation of School Grounds:
http://www.davis.k12.ut.us/emrprep/schsub/evacgrds.htm

Fire Alarm Log:
http://www.davis.k12.ut.us/emrprep/schsub/firelog.htm

Non-structural Hazard Hunt:
http://www.davis.k12.ut.us/emrprep/schsub/hazhunt.htm

Medical Release Form:
http://www.davis.k12.ut.us/emrprep/schsub/medrelse.htm

Missing Persons Form:
http://www.davis.k12.ut.us/emrprep/schsub/misngfrm.htm

Parent Release Form (who can I release the students to?):
http://www.davis.k12.ut.us/emrprep/schsub/parelse.htm

How to release students to parents:
http://www.davis.k12.ut.us/emrprep/schsub/re2prnts.htm

Student Release Form (actual sign out form):
http://www.davis.k12.ut.us/emrprep/schsub/srelfrm.htm

Workshop information flyer:
http://www.davis.k12.ut.us/emrprep/schsub/wkspflr.htm

APPENDIX E

SURVEY OF SEISMIC SAFETY INITIATIVES, 2000

The Commission, seeking to add to the insights gained in the 1996 survey of businesses and governments, polled those same audiences to learn more about their state of seismic safety awareness. Two separate questionnaires were sent: one to business organizations (appendix F) and one to cities and counties (appendix G).

The businesses were selected on the basis of their membership in or support of the Association of Contingency Planners. The presumption was that such businesses would be the most likely to have policies and procedures in place to deal with catastrophes and would also be the most likely to share their insights. A total of 52 businesses received the questionnaire; 18, or 35 percent, responded. All the businesses are located within UBC Seismic Zone 3.

Each questionnaire was quantified to a maximum score of 80 points, with total scores categorized into one of four types: Highly Aggressive (61-80 points), Aggressive (41-60), Attentive (21-40), and Minimal (up to 20).

Organizations that participated in the survey included:

Autolive ASP	6,000 employees
Bear River Mutual	52 employees
Bergen Brunswig	70 employees
Brigham Young Univ	3,500 employees
Deseret First C U	110 employees
First Security	2,000 employees
Flying J	1,000 employees
Franklin Quest	2,500 employees
IHC	22,000 employees
Novell	1,500 employees
Questar	1,800 employees
St. Mark's Hospital	1,200 employees
SPS Technologies	200 employees
Thiokol Corporation	3,400 employees
Utah Power	2,800 employees
Utah Valley State	2,000 employees
Workers Compensation	335 employees
Zions Bancorporation	6,000 employees

The other questionnaire went to all 29 counties (12 responses for 41 percent) and all cities in Utah with a population of more than 1,000 (31 of the 112 cities, or 28 percent, responded).

Counties that responded included:

Beaver	Zone 2B
Box Elder	Zone 2B/3
Cache	Zone 3
Duchesne	Zone 1/2B
Emery	Zone1/2B
Grand	Zone 1
Salt Lake	Zone 3
San Juan	Zone 1/2B
Sanpete	Zone 2B/3
Utah	Zone 2B/3
Wayne	Zone 1/2B
Weber	Zone 3

Cities that responded included:

Beaver	Zone 2B
Blanding	Zone 1
Enoch	Zone 2B
Enterprise	Zone 2B
Gunnison	Zone 3
Heber City	Zone 3
LaVerkin	Zone 2B
Logan	Zone 3
Manti	Zone 3
Midway	Zone 3
Monticello	Zone 2B
Naples	Zone 1
North Ogden	Zone 3
Ogden	Zone 3
Orangeville	Zone 2B
Panguitch	Zone 2B
Park City	Zone 3
Payson	Zone 3
Perry	Zone 3
Plain City	Zone 3
Providence	Zone 3
Provo	Zone 3

Richmond	Zone 3
Salt Lake City	Zone 3
Smithfield	Zone 3
South Ogden	Zone 3
Spanish Fork	Zone 3
Syracuse	Zone 3
Tremonton	Zone 3
Vernal	Zone 1
Wendover	Zone 2B

The organizations fell into the following Initiative Ranking categories (percentages are rounded to the next whole number, so some categories may not total exactly 100 percent): Highly Aggressive (10 of 18, or 55 percent), Aggressive (4 of 18, or 22 percent), Attentive (3 of 18, or 17 percent), Minimal (1 of 18, or 6 percent).

Although three of the state's largest employers rank as Highly Aggressive, 40 percent of the organizations in that category have fewer than 400 employees, indicating that the size of the organization is not a factor in whether it focuses on seismic safety issues.

The responses:

- **Question 1** (5 points) on policies and procedures in place: All organizations had some form of policies and procedures in place for disasters; 78 percent (14 of 18) addressed the issue of seismic safety specifically in their plans.

- **Question 2** (5 points) on whether seismic safety issues were discussed by employee councils or management teams: Four (22 percent) said they had never discussed these issues in any forum; 2 (11 percent) were making efforts to establish some way to bring these issues to the employees on a consistent basis; and 12 (67 percent) had discussed the issues with employees on at least an annual basis.

- **Question 3** (10 points) on the organization's own rating (from 1 — unaware, to 10 — fully informed) of its knowledge of earthquake risk factors: 72 percent (13 of 18) rated themselves as more than adequately informed.

- **Question 4** (5 points) on whether the organization was aware of training in earthquake safety for its safety and security personnel: 78 percent (14 of 18) were aware of such training; and 56 percent (10 of 18) provided that type of training in-house and on a regular basis.

- **Question 5** (10 points) on whether earthquake-response training was provided on a regular basis for safety and security people: 33 percent (6 of 18) sent their personnel to annual training, and 33 percent (6 of 18) provided it in-house; 11 percent (2 of 18) provided some training on occasion, and another 17 percent (3 of 18) made such training available more often than annually.

- **Question 6** (10 points) on whether other personnel in the organization knew about special training, who received it, and how often: 56 percent (10 of 18) reported having some process in place to keep every one else in the organization, including upper management, informed on a regular basis as to who the seismic safety experts within the organization were.

- **Question 7** (5 points) on whether the organization had ever retrofitted or upgraded any of its physical structures to meet earthquake code: 61 percent (11 of 18) reported that they had made some effort in the past four years to upgrade or retrofit one or more of these. Slightly less than a quarter of the respondents (22 percent, or 4 of 18) said their structures were all new so upgrading or retrofitting was not an issue.

- **Question 8** (5 points) on whether there was a perception that some of the buildings needed to be upgraded or retrofitted: 56 percent (10 of 18) said they were aware of some needs; and 33 percent (6 of 18) said there was no need.

- **Question 9** (5 points) on whether the organization had given any priority to retrofitting or upgrading needs: 61 percent (11 or 18) said the question did not apply or did not respond; 22 percent gave their needs a high priority; and 17 percent gave them a low priority.

- **Question 10** (10 points) on frequency of the review process for policy and procedures: 83 percent (15 of 18) said they reviewed their disaster plans on at least an annual basis; 6 percent (1 of 18) did it on a quarterly basis; and 11 percent (2 of 18) did not have a review process.

- **Question 11** (10 points) on involvement of management in the review process: 44 percent (8 of 18) involved upper management; 44 percent (8 of 18) involved to the middle-management level; and 12 percent (2 of 18) had no process.

The counties and cities questionnaire also had a maximum of 80 points, though with different questions.

Only one county (8 percent of the total responding) ranks in the Highly Aggressive category (61-80 points), and it is in Seismic Zone 2B/3. In the Aggressive category are three counties (25 percent); two are in Zone 3 and one in Zone 2B/3. Four counties (33 percent) are in the Attentive category; one in Zone 3, two in Zone 1, and one in Zone 1/2B. The Minimal category contains the final four (33 percent); one is in Zone 1/2B, one in Zone 2B, and one in Zone 2B/3.

Because of the distribution of counties throughout the categories, the survey indicated that the Seismic Zone did not play a significant role in any county's Initiative Ranking.

The responses:

- **Question 1** (5 points) on ordinances, codes, or planning: 75 percent (9 of 12) listed the Uniform Building Code (UBC) 1997 version as their guideline; 58 percent (7 of 12) listed the UBC and local planning or initiatives; and 25 percent (3 of 12) listed no ordinances, codes, or planning for seismic safety.

- **Question 2** (10 points) on whether the county commission discussed seismic safety issues: 8 percent (1 of 12) said it was discussed annually; 17 percent (2 of 12) said it was occasionally discussed; and 75 percent (9 of 12) said it was never discussed.

- **Question 3** (5 points) on whether building permits had been modified or denied because of earthquake safety issues in the last four years: 42 percent (5 of 12) said it had happened; and 58 percent (7 of 12) said it had never happened.

- **Question 4** (10 points) on building inspector knowledge of earthquake hazard issues: 67 percent (8 of 12) ranked themselves 5 or higher on a 10-point scale (1 = no knowledge); and 33 percent (4 of 12) ranked themselves lower than 5.

- **Question 5** (5 points) on their knowledge of seismic safety training available for their building inspectors: 42 percent (5 of 12) knew of or participated in at least two methods of training; 25 percent (3 of 12) knew of a course; and 33 percent (4 of 12) had no knowledge of training available.

- **Question 6** (5 points) on the number of public/government buildings retrofitted or upgraded in the past four years: 92 percent (11 of 12) had no knowledge of or said no such work had been done; and 8 percent (1 of 12) said there had been at least one incidence of that occurring.

- **Question 7** (5 points) on knowledge of public/government buildings that were in need of retrofit or upgrade to meet seismic standards: 58 percent (7 of 12) had no knowledge of such a need or indicated that no need existed within their counties; and 42 percent (5 of 12) said their were aware of

at least a few buildings that were in need.

- **Question 8** (10 points) on what priority ranking on a scale of 1 - 10 (1 = no priority) they would give the need for retrofit or upgrade: 17 percent (2 of 12) ranked the priority at 5 or higher; and 83 percent (10 of 12) put the priority at lower than 5.

- **Question 9** (5 points) on whether they thought building permits issued in the past four years were in compliance with existing codes (on a scale of 1 - 10, 1 = non-compliance): 75 percent (9 of 12) put themselves at a 5 or higher; and 25 percent (3 of 12) said they didn't know.

- **Question 10** (5 points) on instances where work had to be interrupted or was otherwise affected because of seismic safety issues: 8 percent (1 of 12) said it had happened at least once; 25 percent (3 of 12) said they didn't know if it had happened; and 67 percent (8 of 12) said it had never happened.

- **Question 11** (10 points) on whether there was a review process for seismic safety policies and procedures: 8 percent (1 of 12) had annual discussions; 25 percent (3 of 12) reviewed the policies at least occasionally; and 67 percent (8 of 12) either had no review process of didn't know of any.

- **Question 12** (10 points) on whether anyone in authority participated in the review process: 67 percent (8 of 12) said they either had no process, didn't know of a process, or reviewed the policies at the building inspector level; and 33 percent (4 of 12) said the process involved county officials or elected officials.

Of the cities that responded to the survey, 39 percent (12 of 31) had populations less than 2,500; 19 percent (6 of 31) had populations between 2,500 and 5,000; 16 percent (5 of 31) had populations of between 5,000 and 10,000; 13 percent (4 of 31) had populations of between 10,000 and 25,000; and 13 percent (4 of 31) had population of more than 25,000.

In addition, 65 percent (20 of 31) of the cities responding are in Zone 3; 26 percent (8 of 31) are in Zone 2B; and 9 percent (3 of 31) are in Zone 1. That correlates fairly well with the overall averages, which show that 71 percent (80 of 112) of all the cities in Utah that received the survey are in Zone 3; 24 percent of them (27 of 112) are in Zone 2B; and 4 percent (4 of 112) are in Zone 1.

Of the cities that responded, 26 percent (8 of 31) ranked as Highly Aggressive with Seismic Initiative scores of between 61 and 80. All but one of the cities are within Zone 3, and the other is within Zone 2B. One has a population of between 1,000 and 2,500; three have populations of between 5,000 and 10,000; two have populations of between 10,000 and 25,000; and two had populations of more than 25,000.

In the Aggressive category, with Seismic Initiative scores of between 41 and 60, were 26 percent (8 of 31) of the responding cities. Again, all but one are within Zone 3, and the other is within Zone 1. Two have populations of between 2,500 and 5,000; two, between 5,000 and 10,000; two, between 10,000 and 25,000; and two, more than 25,000.

Fewer cities, 19 percent (6 of 31) made up the Attentive category with Seismic Initiative scores of between 21 and 40. Two are in Zone 1; two in Zone 2B; and two in Zone 3. Four have populations of between 1,000 and 2,500; and two, between 2,500 and 5,000.

The Minimal category had 29 percent (9 of 31) with Seismic Initiative scores of 20 or lower. Five are in Zone 2B and four are in Zone 3. Eight have populations of between 1,000 and 2,500; and one, between 2,500 and 5,000.

The Seismic Initiative scores of the cities seem to be affected by their population. The cities that ranked lowest on the scale were among the smallest, but no city with a population of over 5,000 ranked less than Aggressive. All four of the largest cities scored in the Aggressive or Highly Aggressive category.

The responses (the questionnaire was the same as the one used for the counties):

- **Question 1** (5 points): 77 percent (24 of 31) relied on the UBC and/or other building codes (IBC, UCBC); 42 percent (13 of 31) relied on the UBC and some local initiatives; 16 percent (5 of 31) had no ordinances; and 6 percent (2 of 31) had only local initiatives to follow.

- **Question 2** (10 points): 58 percent (18 of 31) either didn't know or didn't have any reviews or discussions at the city level on seismic hazards; 26 percent (8 of 31) discussed the issue at least occasionally; 16 percent (5 of 31) discussed the issue on at least an annual basis.

- **Question 3** (5 points): 32 percent (10 of 31) had denied some permits in the past four years; 58 percent (18 of 31) did not; 10 percent (3 of 31) didn't know.

- **Question 4** (10 points): 45 percent (14 of 31) rated themselves at 5 or higher on a scale of 1 - 10 (1 = no knowledge); 42 percent (13 of 31) rated themselves at less than 5; 13 percent (4 of 31) didn't know.

- **Question 5** (5 points): 32 percent (10 of 31) detailed specific training programs they knew of or had participated in; 36 percent (11 of 31) said they knew of some training programs available; 32 percent (10 of 31) knew of no training available.

- **Question 6** (5 points) on the number of public/government buildings retrofitted or upgraded in the past four years: 71 percent (22 of 31) had no knowledge of or said no such work had been done; 29 percent (9 of 31) said there had been at least one incidence of that occurring.

- **Question 7** (5 points): 81 percent (25 of 31) said they knew of some public/government buildings that needed seismic upgrades or retrofitting; 19 percent (6 of 31) said they either didn't know of any or said there were none.

- **Question 8** (10 points): 29 percent (9 of 31) rated the priority for upgrading or retrofitting public/government buildings at 5 or higher on a scale of 1 - 10 (1 = no priority); 71 percent (22 of 31) put that priority at less than 5.

- **Question 9** (5 points): 68 percent (21 of 31) rated their compliance at 5 or higher on a scale of 1 - 10 (1 = non-compliant); 32 percent (10 of 31) said they either didn't know or were at 0 on the scale.

- **Question 10** (5 points): on instances where work had to be interrupted or was otherwise affected because of seismic safety issues: 23 percent (7 of 31) said it had happened at least once; 77 percent (24 of 31) said they didn't know if it had happened or said it had never happened.

- **Question 11** (10 points): 19 percent (6 of 31) have periodic review of seismic safety ordinances at the city level; 23 percent (7 of 31) have occasional reviews; 58 percent (18 of 31) have no review process or did not know of any.

- **Question 12** (10 points): 52 (16 of 31) percent said they didn't know who was involved in the review process or didn't have a review; 48 percent (15 of 31) were able to detail the people involved in the review process.

APPENDIX F

SURVEY QUESTIONNAIRE FOR BUSINESS ORGANIZATIONS

1. Please list or briefly describe the policies and procedures in your organization that relate to earthquake safety.

2. Since July 1, 1996, how many times were seismic safety policies and procedures formally discussed by your employee council or management team?

3. How would you rate your knowledge of earthquake risk factors, such as surface fault rupture, liquefaction, and ground shaking? Rate your knowledge on a scale of 1 (unaware) to 10 (fully knowledgeable).

4. What training is available to you or your safety and security people to help update/gain knowledge of earthquake risk factors?

5. Have you or any of your safety and security people been trained specifically in how to respond to earthquake emergencies? Please specify what training was received and when anyone last attended that training.

6. Who else in your organization, including upper management, knows who has special training or expertise in earthquake response? How is that information disseminated, and how often?

7. Has there ever been an effort to upgrade or retrofit your building(s) for earthquake safety? Please specify what was done.

8. In your opinion, are there structures your organization currently uses that are in need of seismic upgrades/retrofitting? Please specify what those needs are:

9. How would you prioritize each need listed in the previous question on a scale of 1 (no priority now) to 10 (immediate concern).

10. How often do you review your earthquake safety policies and procedures? Circle one:
Annually Quarterly Other *(specify)* Don't Know Does Not Apply

11. Who is involved in the review process? *(Please specify by title; if there is no review process, please indicate)*

12. How many employees does your organization have in Utah?

APPENDIX G

SURVEY QUESTIONNAIRE FOR CITIES AND COUNTIES

1. Please list or briefly describe ordinances, development codes, and planning in your city/county that relate to earthquake safety.

2. Since July 1, 1996, how many times were questions of earthquake safety formally discussed by the city council/county commission? Please describe.

3. Since July 1, 1996, were there occasions when seismic risk was a consideration in denying or modifying building/development/construction permits? Please briefly describe.

4. How would you rate the building inspectors in your jurisdiction as to their knowledge of earthquake risk factors, such as surface fault rupture, liquefaction, and ground shaking? Rate on a scale of 1 (unaware) to 10 (fully knowledgeable).

5. What training is available to your building inspectors to help them update/gain knowledge of earthquake risk factors?

6. Since July 1, 1996, how many public/government buildings in your area (excluding schools) have been upgraded or retrofitted for seismic safety?

7. Again excluding schools, and taking into consideration the earthquake hazard in your region, approximately what percentage of public/government buildings in your area are in need of seismic upgrades/retrofitting?

8. How would you prioritize that work on a scale of 1 (no priority now) to 10 (immediate concern).

9. Since July 1, 1996, have building/development/construction permits issued in your region been in compliance with your local seismic ordinances? Please rate on a scale of 1 (non-compliant) to 10 (fully compliant).

10. How many instances have there been in your region when building, development, and construction work were interrupted or otherwise affected because it was not in compliance with your local seismic safety ordinances?

11. How often do you review your seismic safety ordinances? Circle one:
Annually After Elections Other *(specify)* Don't Know Does Not Apply

12. Who is involved in the review process? *(Please specify by title; if there is no review process, please indicate)*

The Map Modernization Program

Business Case Plan

For the

State of Utah

Department of Public Safety
Division of Emergency Services

Floodplain Management Office

Prepared by

Judy Watanabe &
Nancy Barr

FLOOD MAP MODERNIZATION

State Business Plan

UTAH

I. What is Utah's Vision for supporting Multi-Hazard Flood Map Modernization (Map Mod)?

Utah's vision of supporting the Map Modernization Program is to act as the Mapping **Program Administrator/Project Manager** and manage the flood hazard mapping activities for the State of Utah. This will involve overseeing the hiring and management of contract engineers, development of timelines and schedules, organizing meetings and promoting meeting and the delivery of final flood mapping products. The CAP Coordinator will provide a program management structure that motivates partners to share responsibilities and costs and also aligns partner missions to produce quality flood hazard mapping in the State of Utah in a timely manner.

a) **What are Utah's current mapping efforts? -** Utah's current mapping efforts consist of supporting FEMA's mapping projects through the coordination of meetings, attending all meetings, resource of information to contractor, resource to community on map status, ordinance updates and technical assistance.

b) **How is the flood hazard data currently stored?** - Utah's flood hazard data is mostly on hard copy maps. Only Salt Lake County and portions of Utah County have a DFIRM. Maps have been stored on CD as tiff files, however updates to these CD's are slow and the paper maps are still the most up-to-date.

c) **What is Utah's current flood hazard mapping status?**
Utah's flood hazard mapping consists of projects managed by FEMA Region VIII. There are numerous studies "in progress." The FY03 Map Mod money went to these "in progress" studies to finish studies that were already underway. FY03 funds were dedicated to complete a study in Utah County studying three streams. This study was also managed by FEMA but involves the State Utah CAP as a partner in the coordination of this study. FEMA Region VIII selected the contractor as part of the ID/IQ list of contractors.

The State of Utah currently does not have its own flood hazard mapping program. The CAP Coordinator has supported the mapping efforts of FEMA Region VIII in communicating with the community and the project engineer to better coordinate and facilitate the sharing of information and meeting arrangements. This Map Mod Program will be an opportunity to get more flood hazard mapping completed in Utah.

d). **What does Utah want to achieve in the Map Mod Program?**
Utah wants and needs more accurate and timely floodplain mapping that is managed by the state. Through the Map Modernization program, the State of Utah can be an effective partner in this goal.

The use of GIS mapping technology is always a priority and an integral part of the mapping process. Our main focus will be on providing new detailed mapping to the many critical areas in this state where approximate flood zones currently exist. Many communities in Utah do not have the capability to view and use digitized floodplain

maps, but they are in need of detailed mapping accurately depicting the 100-year base flood. Utah's goal is to provide the "**highest quality possible**" in this mapping program where all partners are satisfied with the finished product.

e). **Utah's State Plans** – In 2002, Utah prepared a Map Modernization Implementation Plan (attachment A) for the State outlining Utah's mapping priorities and floodplain mapping needs. This Plan details the types of map upgrades needed by each community in the state and outlines the upgrades needed to reinforce the NFIP goals and purposes. This plan also discusses the cost associated with some of the needed mapping. During a three-year performance period, it is estimated that mapping will exceed $4 Million dollars.

II.) What are Utah's Needs and Plan/Strategy (for a 5-Year period)?

The floodplain maps in Utah are some of **the oldest maps in the Country**. Approximately 25% of the maps are 20+ years old. Over 40% of the map panels have never been printed. Around 30% of the state has never been mapped for flood hazards. Salt Lake County accounts for the 1% that has had maps printed since the year 2000 and is really the only county to receive recent mapping. There are many areas that are seeing **significant development** that do not have accurate floodplain maps or any mapping at all. Utah's average age of Flood Insurance Rate Maps is **15 years** or older. In many cases, the older maps reflect outdated flood hazard information that limits their utility for insurance and floodplain management purposes.

The mapping situation in Utah is in **severe need** of attention. Utah is the **4th fastest growing state in the Country.** Yet our communities are plagued with inaccurate flood mapping. Communities are trying to regulate development using flood maps that barely show main streets and floodplains that don't exist and new floodplains that aren't mapped. It is difficult for these local administrators to make wise floodplain management decisions with these archaic tools.

In 2002, Utah developed a **Map Modernization Implementation Plan** for the State (attachment A) detailing Utah's need for new and more accurate flood hazard mapping. Utah will use this plan, as it will be a useful tool in formulating and initiating future flood mapping endeavors. The plan implementation process will receive the highest priority and will allow Utah to effectively mitigate and identify flood hazards statewide. This plan identifies needs and creates a framework to coordinate flood mapping efforts and monitor its progress.

(1) What Activities will the Utah CAP MAP Manage?

Under the Utah CAP, the program administration and project management for the mapping activities will be coordinated by the CAP Coordinator with help from the State Hazard Mitigation Officer. The management activities will include:

- managing a program consisting of multiple flood mapping projects
- overseeing contractors for the development of new floodplain mapping
- creating and fostering partnerships with other interested state agencies
- studying and producing of digital flood hazard mapping
- hiring of independent review of hydrologic and hydraulic activities
- ensuring the maps meet FEMA technical standards
- overseeing agreements and timelines
- developing and disseminating outreach material
- hiring of mapping program coordinator

(2) How will Utah's mapping program achieve the goals listed in the Multi-Hazard Flood Map Modernization Objectives?

(a) (i). maintain a premier data collection and delivery system.

▫ The State's **Automated Geographic Reference Center (AGRC)** will store and provide access to all maps that are produced under the Map Mod program for the State of Utah. Additional servers may be needed to house and maintain these maps. AGRC will be a partner in this program and take on the responsibilities of being the primary repository of the digital data. AGRC has the program **ARC-IMS** which is an Internet based map storage system. Floodplain delineations will be stored as ArcView layers that will be accessible by the public over the Internet from AGRC. The DFIRM layers prepared by outside contractors will be projected to a geographic coordinate system that is **compatible** with the other base map layers provided by AGRC. Layers can be downloaded from the web page or will be provided on CD by request. This activity will be initialized in year one and continue annually. This will provide easy access by the user community to flood hazard data and other data to support risk management.

▫ Currently AGRC houses many interactive maps and coordinates with many state agencies to compile and store these maps. The "ground-work" has been done to allow multiple participants to use and contribute data. AGRC has set a system that is **easy to use**, **flexible** and **adaptable** allowing for future technological advances and enables the archiving of historical data and efficient data storage and retrieval. Their system will allow accessibility from many applications and users while ensuring information accessible through the system meets national standards with appropriate **security**.

(ii) Achieve effective program management.

▫ The Utah CAP proposes to have the **maximum level of participation** in this program. It will manage all of the mapping activities for the state. Identified in the **2002 Map Modernization Implementation Plan** (see Attachment A) for the State of Utah, mapping priorities have already been established. Those priorities will be reevaluated and better detailed as funding becomes available and communities wish to participate in the identified mapping activities. The reevaluation of the plan will occur regularly and will better define the program management goals and mapping activities.

▫ Utah CAP will be the **lead agency** in the state's efforts to support and participate in FEMA's Map Mod Program.

▫ Utah CAP has developed an **approved list of engineering firms** and will use this list to subcontract for assistance in conduct and/ or assisting in the collection of field data, modeling, conducting studies and reviewing studies.

▫ The Mapping Administrator/ Project Manager (Utah CAP) will ensure **quality**, **timeliness** and **delivery** within **pricing constraints**, continuously **monitor** and **track progress** by regularly disseminating **reports**, and provide a **reliable performance management** system.

(iii) Build and maintain mutually beneficial partnerships.

▫ The Utah CAP will develop a **Flood Mapping Resource Board** to reduce redundancies and maximize the usefulness and efficiencies of partner contributions. This Board will meet regularly to foster **partnerships**, share information, and review mapping data.

▫ This Board will be comprised of various federal, state, and local agencies interested in floodplains, wetlands, resource coordination, mapping, water resources, etc. These partnerships will achieve **shared outcomes** through mentoring and assistance, ensuring reliable and usable data, accessible for widespread use, and will **reduce redundancies** in all programs involved.

(iv) Expand and better inform the user community.

▫ Utah is committed to providing **enhanced communication** to the user community. Through the development of brochures, newsletters, websites, and meetings, the community will be better informed of all aspects of floodplain mapping, NFIP regulations, and available products and services.

▫The Utah High and Dry **newsletter** will provide map modernization information updates to a wide audience including federal, state, local agencies as well as engineers, contractors and consultants. This newsletter is a committed activity under the CAPSSSE grant agreement plan with FEMA.

▫ **The Utah Floodplain and Stormwater Management Association** will provide the venue for workshops and technical sessions for the purpose educating partners on the various aspects of floodplain mapping. The conferences held by the UFSMA, will allow for information to be disseminated to local floodplain administrators, contractors, consultants, state agencies, federal agencies and engineers.

▫ A **webpage** will be designed to update and inform the user community of map studies status, map mod initiatives and state mapping priorities. This webpage will link to the new mapping products (DFIRMs).

(b). For each program administration and management activity identified, describe your staff capabilities, existing resources, and training needs

▫ **Staffing** will be expanded as funding becomes available. Currently, there is limited staff to implement the Map Mod Program. DES currently has two GIS Specialists on staff that will assist in the coordination of GIS

flood mapping activities. With additional funding, the state will hire one FTE as a Mapping Coordinator and hire a contract engineer for quality assurance and independent review. The CAP Coordinator will oversee this program as well as the CAPSSSE Program. The Mapping Coordinator will be responsible for managing the mapping activities.

▫ **Resources** will be developed and maintained through **proactive agency coordination**. Utah has developed partnerships with numerous other state, federal and local agencies that will act as great resources to the Map Mod Program. Below are listed some of the agencies and committees Utah DES will work with in coordination of this program:

- Division of Water Resources
- Dept. of Natural Resources
- Automated Geographic Reference Center
- Army Corps of Engineers
- Utah Department of Transportation
- Association of Governments
- Resource Development Coordination Committee
- River Basin Coordination Committee
- State Hazard Mitigation Team
- Utah Floodplain and Stormwater Management Association (UFSMA)

▫**Training**

Training is needed in ARC-GIS and ARC-IMS. One class is offered this February. The Utah CAP Coordinator and the Utah SHMO will be taking this class to better understand the digital mapping tools. Other training in project management and FEMA Mapping process will be needed. The Utah CAP Coordinator and SHMO have taken the CTP course. Additional GIS training will also be made available to DES GIS Specialists. These training courses will enhance the capabilities of the Utah Mapping program to be an effective and valuable partner in the mapping process.

Based on funding levels, DES will conduct and sponsor training. Training will occur on a yearly basis. The intention of the training is to educate partners on the Map Mod Program and FEMA's mapping process.

(c). What are the existing shortfalls (staffing or other resources)?

The Utah CAP is located in the **Division of Emergency Services** and does not have engineering staff available. However, we have access to **engineers** and **hydrologist** through the Department of Natural Resources and private contractors.

A percentage of the funding will be used for administration of the grants. This will vary depending on the funding level.

(d). How do other plans in Utah relate to the Map Mod Objectives?

The **Envision Utah** Public/Private Partnership was formed to guide the development of a broadly and publicly supported Quality Growth Strategy - a vision to protect Utah's environment, economic strength, and quality of

life for generations to come. Five years of scenarios analysis, research and public involvement have helped Envision Utah bring the topic of planning and preparing for growth to the forefront of the public mind. The Envision Utah's document discusses the NFIP goals and FEMA's Flood Insurance Rate Maps. It also lists strategies for flood-prone areas listing restriction of fill as a primary strategy. Although Envision Utah does not name the Map Mod Program, the program goals are similar to each other in that both programs are **developing urban planning tools for quality growth**. The Map Mod definitely has developed goals to protect structures from recurrent flooding by identifying those that are in floodplains through accurate mapping. As Utah continues to grow and develop in the outlying areas, accurate and timely mapping is a strategy that must be in the forefront.

(e). What mapping projects will be initiated this year?

Depending on funding levels, the first year mapping projects will include **Davis County** and **Cache County**. Davis County has one major canyon that has not been studied. Development continues to occur on this alluvial fan as homes encroach the canyon's floodplain. Currently it is an approximate A zone. A detailed analysis is needed for this area. Other map maintenance is needed including incorporating LOMRs into a PMR and boundary changes. Approximately 36 panels are in need of some mapping. An estimated cost of $517,000 is needed to complete the map studies for this county.

Cache County will require some H & H be completed. Most of the developed area is an approximate A zone with a one inch=2000 mile scale. A detailed study is needed along the US89/US91 corridor to allow the county to make sound floodplain management decisions. Approximately 12 panels need to be restudied. An estimated cost of $350,000 is needed for this county.

As more funding becomes available, **Tooele County** will be added. Development is quickly occurring in this County. Currently, most of the county is a D zone. There are flood hazards that need to be identified and homes that need to be protected by flood insurance.

The 2002 Map Modernization Program Plan for the State of Utah **further identifies the priorities** for the mapping projects for future years. Please refer to that plan for a more detailed analysis of Utah's mapping priorities.

(3) **What is Utah's Project Management Plan**

Each planning activity will follow a 12-step process to flood mapping that will improve productivity by reducing the number of hours spent, enabling faster response to special problems, maintaining an accurate and thorough contracting and invoicing history of all study contracts and providing a uniform and timely report of the status of contracts across the state.

1. **Selection Process**

   Adjusting study priorities may occur due to funding limitations. Once a community is selected then a meeting will occur with the State and

the local communities. Discussion of mapping areas and local matches will occur at this initial meeting.

2. **Contractor Selection Process**
   Contractors will be chosen based on qualifications and have been selected in coordination and compliance with the State procurement procedures. The State in conjunction with the local communities involved will select the contractor for the study.

3. **Time and Cost Meeting**
   Meeting at the community with the State and the contractor who will be doing the study. Purpose of this meeting is to define the scope of work, find available data, and do a preliminary field study. Following this meeting, the cost of the study is negotiated and the contract is awarded.

4. **Study Begins**
   Tasks are identified and study responsibilities are detailed. Once the data is completed, it is submitted to the locals and State for review. An independent contract engineer (hired by the state) reviews material and reports any special problems.

5. **Hydrology review meeting**
   The purpose of this meeting between the State and locals is to review the initial hydrology data. This meeting occurs 4-6 months after the study has begun. An independent contract engineer (hired by the state) reviews material and reports any special problems.

6. **Intermediate Meetings**
   This takes place once the hydraulics draft is completed, approximately 3-4 months after the hydrology review meeting. This meeting is with the communities, contractor, State, Engineer.

7. **Study goes to Michael Baker Jr. Engineers**
   The map is reviewed by Michael Baker Jr. Engineers for accuracy

8. **Final Meetings/ Community Coordination Meeting**
   Preliminary study is presented to the community. The purpose of this meeting is to answer any questions they may have, as well as to make sure they understand it is the responsibility of the community to verify street names and accuracy of the map in this regard. This meeting occurs one month after Baker has completed their review.

9. **Public Notice**
   Notice of where the public can review the preliminary map must be published for two weeks.

10. **Appeal Process**
    With specific data that substantiates a change, the preliminary map may be appealed.

11. Compliance Period

The community has up to six months to modify their floodplain ordinance to reflect the new map.

12. New Map is Printed

Often times the new map can be printed during the compliance period.

There will be other coordination not specified in these 12 steps. Numerous emails, web page postings, budget tracking, filing of special problems reports and other coordination meetings will be held as needed. Since the contractor and project manager will all be in Utah, it will be easier to hold a meeting in a short time frame.

ii) **Utah's project timelines?**

As outlined above, the time frame will vary in accordance to the detail of study needed. Some mapping projects may take longer than others. Special problems may delay the study further. **Funding issues** may also delay study deadlines. The goal is to have detailed studies completed in **36 months**. Davis County could be done in that time frame due to available data and resources at the local level. Cache County may take longer due to terrain and few existing resources.

iii) **Resources/Staffing** (state, local, federal, contractor)

Resources have been discussed in section **II.2.b**.

Staffing has been discussed in section **II.2.b**.

iv) **Deliverable(s**)

Maps will be delivered in required digital format under the specs in *FEMA 137 Guidelines and Specifications for Flood Hazard Mapping Partners*. Deliverables will be tracked and will be submitted in a timely fashion.

v) Reporting

Reporting will be completed quarterly on each mapping activity. Reports will be sent to FEMA Region VIII. Updates on the mapping progress will be posted monthly on the state's mapping website.

vi) Quality assurance

An **independent review** by a hydrologist will assure the quality of the engineering completed for each mapping activity. A resource board may also review the data for correctness.

III). Performance Goals/Cost and Schedule Measures (tracking)

1. Each project will have its own needs and reporting requirements will reflect those needs. This is all dependent on the scope of work of the individual project. Each project will be measured on the following four categories:

Baseline
Benefits
Accomplishments
Product

- FEMA will provide a web-based system for tracking and reporting cost, schedule and performance. Describe how you will ensure that this system is supplied with required information.

It will be a requirement of the contractor to supply this information to the State.

IV). Alternatives/Varying Funding Levels

1. Given the following alternative funding levels, describe federal funding, state/locality/partner funding, and performance over a 5-year period:

a. **Full** - Utah is expecting full funding from FEMA for the Map Mod Program. Any match will be generated at the local level during the initial project coordination meeting. As funding levels fluctuate, projects will be adjusted accordingly.

b. **Medium** – There will be limited mapping projects if the funding is reduced. Mapping projects will be reevaluated and aligned with funding.

c. **Low** –There will be limited mapping projects if the funding is reduced. Mapping projects will be reevaluated and aligned with funding.

2. State or Locally Funded

There are **no state or locally funded mapping activities** that do not require Federal funds.

3. Explain how FEMA funding will fill the shortfalls identified in Section II. FEMA funding is necessary for an effective flood mapping program in Utah.
Local flood mapping partners will contribute at a level that is appropriate for their community and according to the amount of Federal dollars that are committed to each project.

4. Explain how the State/local match, where applicable, will be provided.

- The State match is a soft match.
- The local match will be generated at the local level during the initial project coordination meeting.

Map Modernization Plan for

Utah

Prepared by:

Utah Department of Public Safety,
Division of Emergency Services and
Homeland Security

Salt Lake City, Utah

August 2002

Executive Summary

This Map Modernization Plan for Utah will be a useful tool in formulating and initiating future flood map endeavors. The Plan implementation process will receive the highest priority and will allow Utah to effectively mitigate and identify flood hazards statewide.

The State of Utah's diverse landscape and communities are under constant threat from geologic and hydrologic hazards. Federally declared flood disasters were issued in 1983, 1984, and 1989. Although Utah's precipitation is the second lowest in the country, the State's flooding history is significant. Over 1,500 cloudburst floods have been recorded in the last 160 years causing millions of dollars in damages. Utah's 2.2 million inhabitants are clustered in relatively small geographic areas at the base of steep mountain ranges, with 90 percent of the population concentrated in the Wasatch Front Region. Flooding along the Wasatch Front thus impacts a relatively small area, but a comparatively large population.

Utah has been part of the NFIP Community Assistance Program since 1991. Currently, there are 201 communities identified by FEMA with flood hazards. Of those communities, 186 participate in the NFIP. Utah has also participated in the Flood Mitigation Assistance Program since it began in 1997, and has helped 12 communities develop flood mitigation plans. Utah supported mapping as a State Cooperating Technical Partner (CTP). The State of Utah supports the Utah Floodplain Management Association. This Association conducts annual conferences, roundtable discussions, and sponsors training on numerous mapping and compliance topics.

With the Federal government's commitment to initiating FEMA's National Map Modernization Program, the State of Utah can now be an effective partner in the flood mapping process. The Utah Map Modernization Plan ardently is only a beginning, both in detail and in action. Implementing this plan will be an evolutionary process that will adjust to changing priorities, new information and technology, and broader community support. This plan identifies needs and creates a framework to coordinate flood mapping efforts and monitor its' progress.

Acknowledgments
The State wishes to acknowledge Michael Baker Jr., Incorporated, for their support and dedication to this planning project. A special thanks to Nathan Burgess and Bryon Elwell from the Salt Lake City Baker office for all their hard work.

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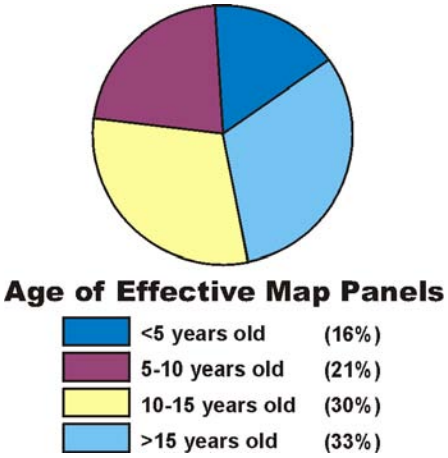
Background and Purpose of Plan

The Federal Emergency Management Agency's (FEMA's) flood hazard maps are essential tools for flood hazard mitigation in Utah and in the United States in general. As shown in the figure below, most of the flood hazard maps in Utah have become outdated.



In many cases, the older maps reflect outdated flood hazard information that limits their utility for insurance and floodplain management purposes. Additionally, most of the maps were prepared using now outdated road network information and manual cartographic techniques, which make the maps difficult for State and local customers to use and expensive for FEMA and Utah to maintain. In addition, FEMA has not produced flood maps for many communities in Utah**.**

To address this problem, the President's budget for Fiscal Year (FY) 2003 (which starts on October 1, 2002) includes $351 million for initiating FEMA's national Map Modernization Program. Similar funding levels are proposed for subsequent fiscal years.

This Plan was prepared to assist FEMA in the development of regional and national plans for implementing the FEMA Map Modernization Program. This Plan summarizes the role that Utah will play in completing the required mapping activities and how these activities will be managed and performed. This Plan identifies mapping priorities, explains how mapping priorities were established for each county in Utah**,** and outlines an approach for addressing these mapping priorities.

In accordance with Government Performance Results Act (GPRA) performance measures suggested for the Map Modernization Program by the Office of Management and Budget, the details of this Plan have been developed with consideration given to FEMA accomplishing the following:

- Reducing the average age of the flood maps nationwide from over 13.6 years to 6 years or less;
- Producing digital flood hazard maps with up-to-date flood hazard data for the 15-percent highest priority areas in the state; and
- Developing flood hazard maps for one-half of the unmapped, floodprone communities in Utah.

Utah's Role in the Flood Hazard Mapping Program

Maximum Level of Participation—Utah will manage all of the mapping activities in the state. The specific activities that Utah will manage will depend on the Federal funding commitment to update the flood maps in the state. The state will encourage a local and state match. The nature and scope of the state's mapping activities will be detailed in our Cooperating Technical State (CTS) agreement based on the state's identified mapping needs assessment.

The additional funding available through the CAP, ($50,000) will be used to support a Mapping Coordinator position and/or an independent contractor to assist in the mapping review process.

Based on Utah's planned level of participation, the role the State will play in future flood hazard mapping efforts, and how such efforts will be managed and performed are listed below:

- *What agency will take the lead for the State in the floodplain-mapping program?* The Utah Department of Public Safety, Division of Emergency Services and Homeland Security will be the lead state agency for the floodplain-mapping program.

- *What other agencies and/or organizations will be involved, and what will their roles be?* Federal, State, and local agencies involved in water resources, water development, water conservation and planning, public works, public utilities, flood control, planning and development, transportation, and GIS, will assist in identifying data resources needed in the flood mapping process.

- *Are their existing agreements with communities or other agencies that could be used? (e.g., data sharing agreements, IT service agreements, etc.)* There are currently no formal agreements outside current CTP's that could be utilized in this process.

Mapping Needs Assessment and Priority Setting Approach

To fully evaluate the mapping needs in Utah, the Department of Public Safety, Division of Emergency Services and Homeland Security performed a mapping needs assessment in June and July 2002. This mapping need assessment included the following tasks:

- Reviewing and updating the information in the FEMA Mapping Needs Update Support System (MNUSS) database;

- Soliciting mapping needs information from counties and communities;

- Reviewing available community-specific data;

- Assigning map upgrade methods and priorities to each county; and

- Assessing whether the proposed map update options would achieve the GPRA performance measures and revise the map update methods accordingly.

This mapping needs assessment was undertaken in cooperation with, and with the support of FEMA and FEMA's Flood Map Production Coordination Contractor (MCC). The following data were collected and assessed on a county-by-county basis:

- Age of the existing maps;
- Known mapping needs as recorded in the FEMA MNUSS database;
- Status of existing maps (digital, manual, none);
- Existing or potential local mapping partners;
- Number of unmapped, floodprone communities;
- Number of communities;
- Availability of existing base map, topographic data, and/or flood hazard data (including data from other State agencies);
- Number of Letters of Map Change processed during the last 10 years;
- Population and population growth (U.S. Census and/or State-developed figures);
- Flood insurance claims and/or repetitive losses;
- Format of existing maps (countywide or community-based format); and
- Ongoing map updates, including updates being undertaken by regional agencies or communities under the CTP Program.

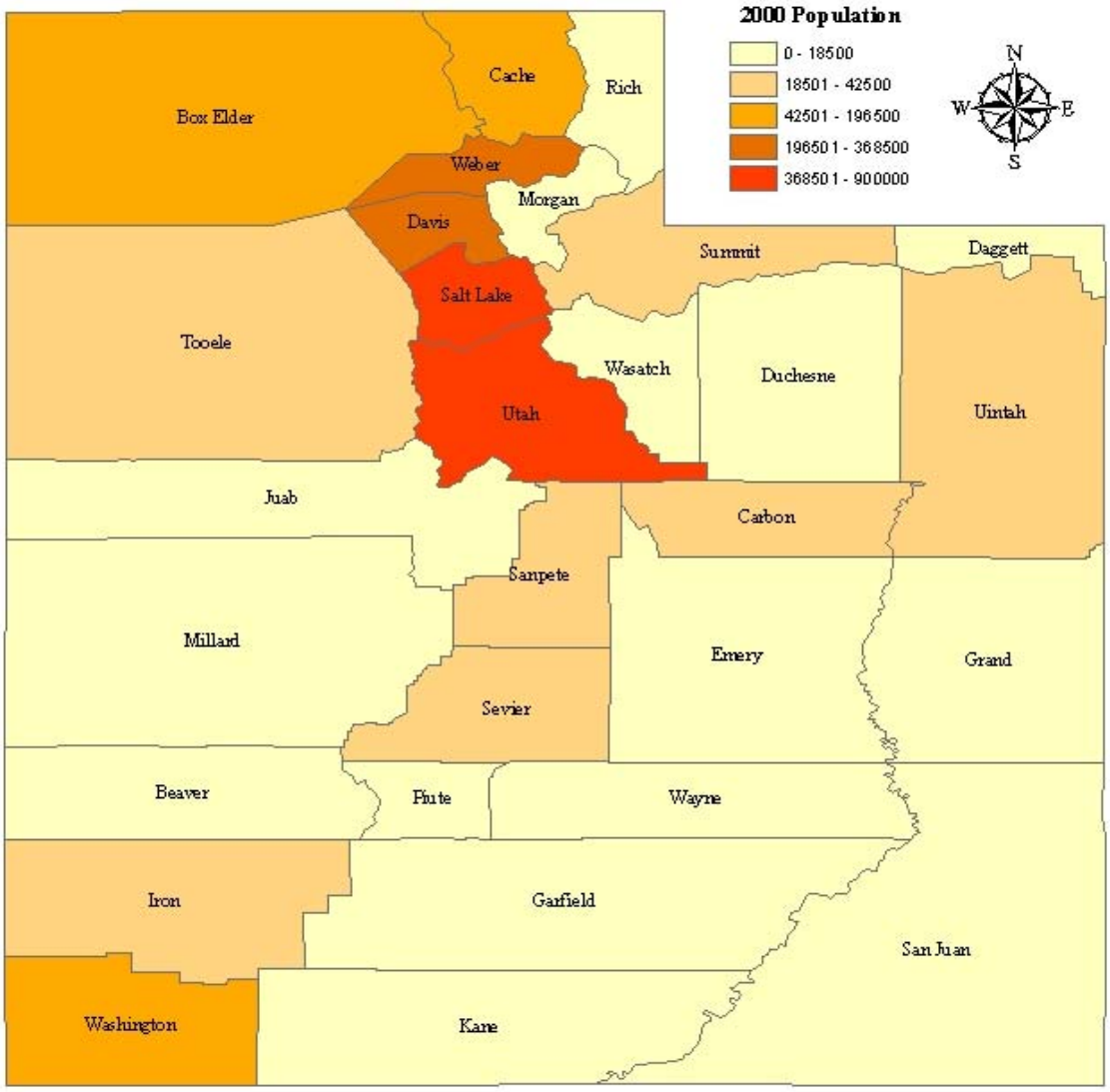
To supplement the MNUSS data, other data provided by FEMA, and data available in various State agency offices, the Utah Department of Public Safety, Division of Emergency Services and Homeland Security undertook additional data collection and outreach activities.

The Utah Department of Public Safety, Division of Emergency Services and Homeland Security distributed letters to Floodplain Managers throughout the state to request information on mapping needs. The Utah Department of Public Safety, Division of Emergency Services and Homeland Security, with the support of the MCC, then conducted telephone interviews with 11 counties. Copies of the documents used for the data collection and outreach activities (e.g., letters, questionnaires) are included in Appendix A.

A complete listing of the data collected in this process is provided in Appendix B.

Upon completion of the mapping needs assessment, the Utah Department of Public Safety, Division of Emergency Services and Homeland Security ranked each county to determine the order in which the counties' mapping needs should be addressed. To evaluate Utah's mapping needs, various data were collected and assessed on a county-by-county basis. Priorities were established based on Population (Figure 1), Population Growth (Figure 2), Local contribution potential, FIRM age (average years) (Figure 3), whether the county could be considered "Emergency", "Priority", or "Routine", and on the availability of existing base map, flood, and topographic data. Each data source was evaluated and assigned points to determine an overall prioritized ranking. Counties with the highest points were assigned the highest priority. The results of the ranking and priority-setting process are summarized in Table 1.

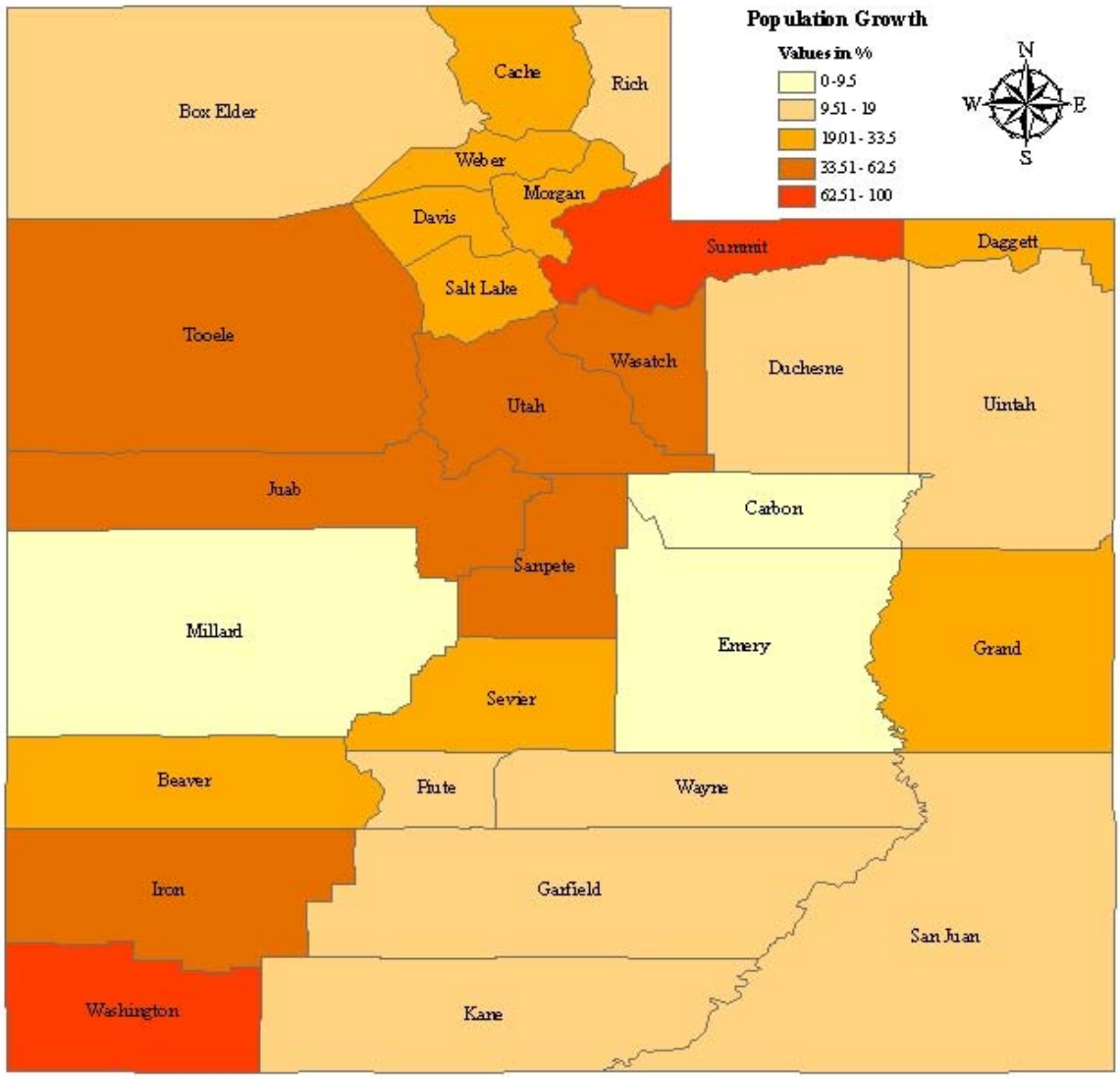
Figure 1
Utah Population by County in 2000



Source:
ESRI Data and Maps Series data compiled
from the 2000 U.S. Census.
Coordinate System: Geographic
Datum: NAD83

Miles
0 12.5 25 50 75 100

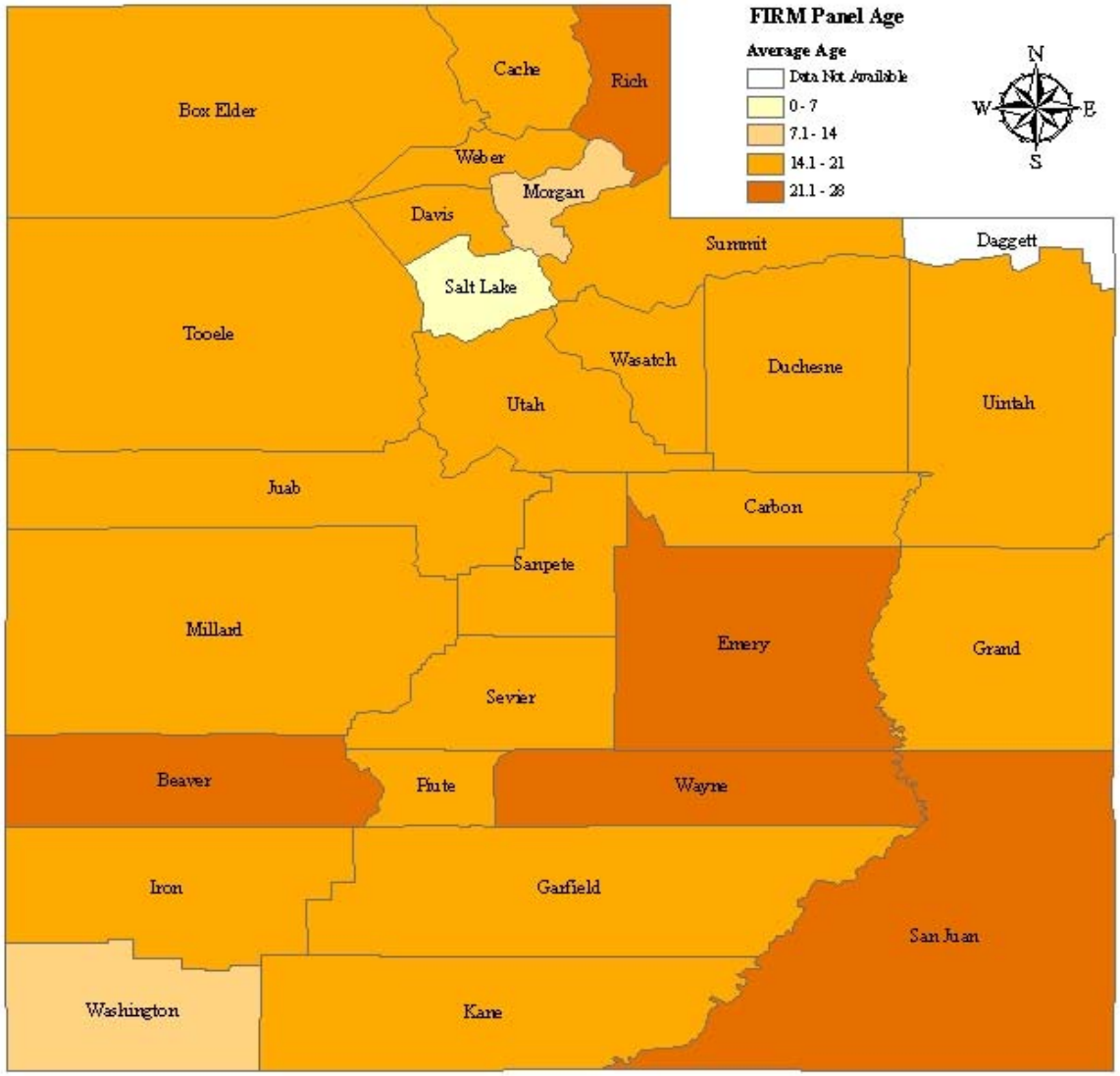
Figure 2
Utah Population Growth by County
1990 to 2000



Source:
ESRI Data and Maps Series data compiled
from the 2000 U.S. Census.
Coordinate System: Geographic
Datum: NAD83

Miles
0 12.5 25 50 75 100

Figure 3
Average Age of FIRM Panels by County



Source:
FEMA Flood Map Status Information Servis (FMSIS)
Coordinate System: Geographic
Datum: NAD83

Miles
0 12.5 25 50 75 100

Proposed Approach to Addressing Mapping Needs

To address the prioritized mapping needs, the Utah Department of Public Safety, Division of Emergency Services and Homeland Security evaluated the map production options that are available. For the purposes of this Plan, the options have been categorized as Level 1 Map Upgrades and Level 2 Map Upgrades. A brief description of each is provided below.

- Level 1 Map Upgrades: Level 1 Map Upgrades are improvements to existing flood maps that are not based on the development of new detailed flood hazard information. These improvements may include converting the flood maps to a GIS-based digital format, incorporating an improved base map (such as digital orthophoto quarter quadrangles), redelineating existing floodplain boundaries based on updated topographic data, refinement or addition of Zone A, and/or incorporating existing flood hazard data developed by Federal, State, or local agencies for purposes other than the FEMA Flood Hazard Mapping Program areas.

- Level 2 Map Upgrades: Level 2 Map Upgrades are improvements involving the development of new detailed flood hazard information. These upgrades typically require updated topographic data, structure and cross-section surveys, hydrologic and hydraulic engineering analyses, and floodway and floodplain boundary delineation.

The costs associated with Level 2 map upgrades typically will be significantly higher than the costs associated with Level 1 map upgrades.

The Utah Department of Public Safety, Division of Emergency Services and Homeland Security then evaluated various scenarios to determine the best combination of the above activities to achieve the GPRA performance measures. Based on this evaluation, the Utah Department of Public Safety, Division of Emergency Services and Homeland Security submitted the highest priority recommendations shown in Table 1 to FEMA. A complete, county-by-county listing is provided in Appendix C.

Utah's average age of Flood Insurance Rate Maps (FIRMs) is 15 years or older. In many cases, the older maps reflect outdated flood hazard information that limits their utility for insurance and floodplain management purposes. Additionally, most of the maps were prepared using now outdated road network information and manual cartographic techniques, which make the maps difficult for State and local customers to use and expensive for FEMA and Utah to maintain. In addition, FEMA has not produced FIRMs for many communities in Utah. Areas of growth continue to focus on the Wasatch Front and Southwestern Utah. Communities need current and accurate flood hazard data to implement the required NFIP floodplain management regulations.

Table 1 – Map Production Summary for FY 2003 Funding

County	Planned Community Upgrades			Reduction in Average Age of Maps by FY 2006	Unmapped Communities To Be Mapped by FY 2006
	Level of Upgrade	No. of Communities	No. of Panels		
Cache	1		12		
	2		12		
	Total	22	24	18.2	6
Davis	1		36		
	2		12		
	Total	17	48	16.9	3
Iron	1		53		
	2		8		
	Total	9	61	15.6	5
Morgan	1		8		
	2		9		
	Total	6	17	11.4	4
Summit	1		33		
	2		9		
	Total	17	42	15.6	13
Tooele	1		15		
	2		11		
	Total	21	26	18.7	14
Uintah	1		56		
	2		5		
	Total	14	61	15.8	12
Utah	1		51		
	2		20		
	Total	26	71	17.6	12
Wasatch	1		8		
	2		9		
	Total	6	17	17.5	3
Washington	1		35		
	2		14		
	Total	23	49	13.0	12
Weber	1		45		
	2		27		
	Total	19	72	18.2	8
Sevier	1		26		
	2		8		
	Total	13	34	15.0	2
Total	1				
	2				
	Total	193	522	16.2	94

Proposed Approach to Map Production

As discussed above, a primary role for the State and its partners will be the management of some mapping activities. Mapping activities will include scoping, outreach & community coordination, digital base map collection/coordination, digital base map development, field surveys, hydrologic & hydraulic analyses, floodplain mapping, digital FIRM production, and post-preliminary processing.

A discussion of how these mapping activities will be managed is as follows:

- *Who will perform the Level 1 and Level 2 upgrades? (State contractors, FEMA IDIQ contractors, other federal agencies, etc.)* State contractors will perform the Level 1 and Level 2 upgrades. In addition, Federal, State, and local agencies involved in water resources, water development, water conservation and planning, public works, public utilities, flood control, planning and development, transportation, and GIS, will assist in identifying and providing data resources needed in the flood mapping process. As a Cooperating Technical State, the State will retain their own contractors.

- *Who will direct/manage these mapping activities? Explain why the agency(ies)/ organization(s) is appropriate for the task – e.g., experience in management flood studies and/or water resources projects, currently responsible for floodplain management, etc.* The State Floodplain Manager (SFM), under the Utah Department of Public Safety, Division of Emergency Services and Homeland Security will direct and manage the mapping activities. The SFM is currently responsible for overseeing all floodplain management activities in the state. The State Hazard Mitigation Officer (SHMO) will dedicate 50% of her time to the mapping projects. Combined, the FPM and SHMO have over 20 years of experience in the NFIP. The SFM, the SHMO, and the Planner will direct and manage all mapping activities for the state under this new program. The additional funding available through the CAP ($50,000) will be used to support a mapping program and/or an independent contractor to assist in the mapping review process.

- *Specific resources and/or capabilities of the agency.* The Utah Department of Public Safety, Division of Emergency Services and Homeland Security has committed to a contract employee and a half time Full Time Employee (FTE) to administer the mapping program. DES has a GIS specialist on staff to support the program objectives.

- *Previous or ongoing flood study or data collection activities.* Weber County currently has a contract with FEMA to digitize the Flood Insurance Rate Maps for the entire county. Unincorporated Summit County is currently being restudied in the Snyderville Basin area. The study is complete and will be submitted to FEMA soon. Effective maps should be out September 2003. FEMA is restudying the upper reaches of Little and Big Cottonwood Creeks, Willow Creek in Sandy, and portions of Midas Creek. Tooele County is currently developing a flood study for the area east and north of Tooele City to include Erda and Lake Point. Eureka is being restudied as a joint project between the EPA and FEMA. Alpine is currently negotiating a scope of work between FEMA and the COE. Centerville Canyon and Deuel Creek are an ongoing study with the COE. Annabella is in the final stages of a flood study on their alluvial fan with FEMA and the COE. Salt Lake County is in phases 3 and 4 of a FEMA funded restudy along Little Cottonwood Creek, Big Cottonwood Creek, Midas Creek and Willow Creek.

- *Amount of work that the Agency and its mapping partners are capable of managing.* With one half time FTE, a contract planner, and other Division support staff, DES will be the project manager for all mapping projects in the State. The State of Utah intends to apply to become a Cooperating Technical State.

- *The approximate level of funding required to accomplish the proposed work.* The activities to be performed by the State are estimated to cost approximately $5,849,100 million. Approximately $4,679,280 million of this amount will be provided by FEMA to the State, and the State will provide approximately $1,169,820, through both in-kind and cash contributions.

- *How the State will fulfill the cost-share match?* The State will encourage and promote any and all cost-sharing efforts. The following positions will support the State cost share, half FTE, contract planner, GIS specialist, other State agencies to include agency personnel and equipment; Water Resources, AGRC, Utah Geological Survey, Water Quality, University of Utah, Utah State University, Weber State University, Utah Valley Community College, and Brigham Young University.

Estimated Costs to Complete Proposed Mapping Activities

The activities to be performed by the State are estimated to cost approximately $5,849,100 million. Approximately $4,679,280 million of this amount will be provided by FEMA to the State, and the State will provide approximately $1,169,820, through both in-kind and cash contributions. The costs for each county are listed in Table 2. The unit costs that were used in preparing these estimates are the same unit costs used in FEMA's Blue Book. Refer to Appendix D for a detailed breakdown of costs in the Summary of Planned Map Update Projects.

Table 2 – Estimated Costs of Planned Production

County	Level 1 Upgrade Panels	Level 2 Upgrade Panels	FEMA Contribution ($)	State Contribution ($)	Total Cost
Cache	12	12	$284,640	$71,160	$355,800
Davis	36	12	$414,240	$103,560	$517,800
Iron	53	8	$420,900	$105,225	$526,125
Morgan	8	9	$205,380	$51,345	$256,725
Summit	33	9	$343,080	$85,770	$428,850
Tooele	15	11	$273,360	$68,340	$341,700
Uintah	56	5	$382,140	$95,535	$477,675
Utah	51	20	$632,640	$158,160	$790,800
Wasatch	8	9	$205,380	$51,345	$256,725
Washington	35	14	$433,620	$108,405	$542,025
Weber	45	27	$737,640	$184,410	$922,050
Sevier	26	8	$286,960	$71,740	$358,700
Total	378	144	$4,679,280	$1,169,820	$5,849,100

Appendix A. Data Collection and Outreach Activities Documentation

June 18, 2002

Dear

The Federal Emergency Management Agency (FEMA) has appropriated funding for floodplain mapping for the next three years. Your community has been placed on this three-year priority list for new floodplain maps. We have enclosed a checklist for you to complete to assess your community's mapping needs. Michael Baker Jr. Engineering company will be contacting you during the next two months to further assess your needs and develop a scope of work for the mapping.

This is a rare opportunity for the State of Utah. The age of Utah's maps are some of the oldest in the country. We may never get this opportunity again. Any help you can supply to give the most accurate and detailed information would be greatly appreciated.

We appreciate your help in this new mapping program. If you have any questions regarding this new mapping initiative, please call either Nancy Barr at (801) 538-3721 or Judy Watanabe at (801) 538-3750.

Sincerely,

Nancy Barr
State Mapping Coordinator

Judy Watanabe
State Floodplain Manager

Enclosure

cc: County Emergency Management Program Director

Flood Mapping Checklist

Name_____
Job Title_____
Community_____
Address_____
City_____**State**_____ **Zip** _____
Phone _____**FAX** _____
Email _____

Please answer the following questions: Please note that your answers will not change the current ranking for floodplain mapping. This is just to help our contractors in the initial planning process.

1. Do you feel your floodplain maps are incorrect? ☐ yes ☐ no
   a. If so, where?_____
   _____

2. Have your community's boundaries recently changed? ☐ yes ☐ no

3. Do you have aerial photography of your community? ☐ yes ☐ no

4. Do you have a base map showing streets and boundaries of your community? ☐ yes ☐ no

5. Do you have a GIS person on staff? ☐ yes ☐ no

6. Do you have an Engineer on staff? ☐ yes ☐ no

7. Do you have a licensed surveyor on staff? ☐ yes ☐ no

Additional Comments on your floodplain mapping needs
_____
_____
_____
_____.

Please fax completed form and any other information to Nancy Barr at (801) 538-3772 as soon as possible. We appreciate your help. Thank you.

Appendix B. Resultant Data Collection

County: Utah County
Contact: Mr. Clyde Naylor, County Floodplain Manager
Telephone: 801-370-8000
Date: July 12, 2002

We contacted Mr. Clyde Naylor of Utah County on July 12, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Naylor indicated that the floodplains in need of revising are Spanish Fork River, Hobble Creek, and especially the area in the vicinity of Santaquin Canyon, which is experiencing a significant amount of growth. The county has aerial photography from satellite imagery taken in the year 2000. The county also has 1990 contours at a 5-foot interval. Mr. Naylor indicated that there is no funding available to participate in floodplain revisions. The county has a survey crew and a GIS Department. Clyde was not aware of any hydrologic studies that had been conducted in the county.

County: Iron County
Contact: Mr. David Yardley, County Floodplain Manager
Telephone: 435-477-8300
Date: July 12, 2002

We contacted Mr. David Yardley of Iron County on July 12, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Yardley indicated that the floodplains in need of revising are for the communities of Paragonah, Enoch, and Cedar City. Cedar City has been actively involved in flood control projects that have altered the floodplains in the area. Recently, another flood control project was completed by Cedar City in Fiddlers Canyon. The county does not have aerial photography for the entire county. When needed, the county uses Agricultural Stabilization and Conservation Schedule (ASCS) aerial photography provided by the United States Department of Agriculture - Farm Service Agency (USDA-FSA). The USDA-FSA may have contours available but Mr. Yardley was not sure. The county contracts out all of their survey work but they do have a GIS department. Mr. Yardley indicated that the county did not have any funding available to participate in floodplain revisions. Mr. Yardley indicated that the Central Iron County Water Conservancy District (CICWCD) might have conducted hydrologic studies in the county. He suggested contacting Scott Wilson from Wilson & Wilson who may have done work in the area for the CICWCD. Mr. Yardley also suggest contacting Steve Plat, County Engineer, who may have funding available to participate in floodplain studies.

County: Iron County
Contact: Steve Plat, County Engineer
Telephone: 435-865-7515
Date:
Attempted to call 7/31/2002. Left message.

County: Washington County
Contact: Ms. Deonne Goheen
Telephone: 435-634-5701
Date: July 12, 2002

We contacted Ms. Deonne Goheen of Washington County on July 12, 2002, to discuss the (MMIP) being prepared for the State of Utah. Deonne did not indicate any specific areas that needed floodplain revisions but made the general statement that revisions need to be made along all major wash boundaries. The county has 1993 aerial photography, which they are in the process of trying to update, and they do have a GIS Department. All of their survey work is contracted out to Bush & Gudgell. Deonne indicated that she had already sent information to Judy Watanabe, State Floodplain Coordinator.

County: Wasatch County
Contact: Mr. Al Mickelsen
Telephone: 801-654-3211
Date: July 12, 2002

We contacted Mr. Al Mickelsen of Wasatch County on July 12, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Mickelsen indicated that the majority of the growth is occurring within the unincorporated sections of the county. The areas identified by Mr. Mickelsen that were in need of floodplain revisions were Midway City, the Provo River, Snake Creek, and Deer Creek. A major restoration project has been conducted on the Provo River and has altered its floodplain from that presented on the existing maps. In addition, since the publication of the FIRMs, the Jordanelle Dam was constructed. This has had a major effect on the FIRMs. The county has aerial photography from the early 1980's at 2-foot and 10-foot contours. The county has a GIS department but they contract out their survey work. The county has limited funding for participating in floodplain revisions and has not budgeted for this task. Mr. Mickelsen believes that hydrologic studies have been conducted for the Provo River Restoration but was unaware of any other studies.

County: Weber County
Contact: Mr. Kyle Price
Telephone: 801-399-8054
Date: July 18, 2002

We contacted Mr. Kyle Price of Weber County on July 18, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Price identified the town of Uintah, the Weber River near Riverdale, and the Ogden Valley as the areas in need of immediate floodplain revisions. Within the Ogden Valley are the towns of Eden and Liberty that have been designated as Zone A. The floodplains for this area were not studied when the maps were prepared in the early 1980's. The floodplain maps in the City of Riverdale and the Weber River were revised in 1995. The county has a very progressive GIS department. They currently have a contract with FEMA to digitize the floodplain maps for the entire county. This project is nearing completion. They also have a survey crew and aerial photography of the county from the year 2000. In addition, they have Digital Elevation Models (DEMs) of several areas in the county. In particular, the have a DEM of the Ogden Valley area with break lines and points and is accurate to producing 2-foot contours. Mr. Price was not sure if the county had funds available to participate in the floodplain mapping and suggested contacting Curtis Christensen on this issue.

County: Weber County
Contact: Mr. Curtis Christensen
Telephone: 801-399-8007
Date: July 31, 2002

Response Emailed on 7/31/2002. Mr. Christensen stated that this is a good time to approach the county commission, as they will be starting their budgeting process very soon. He thinks that the county would be able to provide some assistance with county employees. It is possible that the county would also assist in funding a project but until the level of funding is determined, it would be difficult to get any firm commitment.

County: Morgan County
Contact: Mr. Kent Smith
Telephone: 801-845-4007
Date: July 18, 2002

We contacted Mr. Kent Smith of Morgan County on July 18, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Smith indicated the areas in need of floodplain revisions are East Canyon Creek, the Weber River, and the area around the town of Mountain Green that has been experiencing a significant amount of growth. The majority of the existing floodplain delineations in the county are designated as Zone A. Morgan City, which is located within the county, is a NFIP participant and has their own floodplain maps. The county has older aerial photography of the county. They have more recent aerial photography for the Mountain Green area. The County has a GIS department but they contract out their survey work. Mr. Smith indicated that the county did not have any funding they could contribute to the floodplain revisions.

County: Davis County
Contact: Mr. Barry Burton
Telephone: 801-451-3279
Date: July 18, 2002

We contacted Mr. Barry Burton of Davis County on July 18, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Burton indicated that the floodplain maps for Farmington and Centerville have recently been updated. Since publication of the original floodplain maps, there have been several boundary changes that are not reflected on the current maps. The areas of the county that Mr. Burton indicated were in need of floodplain revision are the Great Salt Lake and everything west of I-15. Very little floodplain delineation has been done in the area west of I-15 and this is the area that is experiencing the most growth in the county. The published floodplain elevation for the Great Salt Lake needs to be revised. The FEMA elevation does not reflect the existing conditions of the Great Salt Lake. In addition, the United State Army Corps of Engineers performed a study on the Great Salt Lake and came up with a different 100-year floodplain elevation. Mr. Burton feels these numbers need to be consistent with each other. The county has aerial photography and contours. The also have a licensed surveyor on staff and a GIS department.

County: Tooele County
Contact: Mr. Ray Johnson
Telephone: 435-843-3160
Date: July 18, 2002

We contacted Mr. Ray Johnson of Tooele County on July 18, 2002, to discuss the (MMIP) being prepared for the State of Utah. Mr. Johnson indicated that floodplain revisions are needed in the areas north of the City of Tooele, in particular, Middle Canyon and Settlement Canyon areas. Residential development has been occurring in the Middle Canyon area. Another problem area is in the City of Erda. Properties in this area are routinely being flooded by stormwater discharges after major rainfall events. Mr. Johnson indicated that the major flooding problems in the county are from stormwater discharges after rainfall events. This problem is particularly evident in the area north of the City of Tooele to Lakepoint. The county has aerial photography for the populated areas of the county. Mr. Johnson stated that unpopulated areas of the county, such as Skull Valley, would not need to be studied. The county has a GIS department and survey capabilities. Mr. Johnson indicated that the county would have some funding for flood control projects.

County: Cache County
Contact: Lorene Greenhalgh
Telephone: 435-752-8327
Date:

Attempted to call 7/12/2002. Left message.
Attempted to call 7/18/2002. Left message.
Attempted to call 7/31/2002. She is out of the office until 8/12/2002.

County: Uintah County
Contact: Dale Peterson
Telephone: 435-781-0770
Date:

Attempted to call 7/12/2002. Left message.
Attempted to call 7/18/2002. Left message.
Attempted to call 7/31/2002. He is out of the office until 8/12/2002.

County: Summit County
Contact: Derrick Radke
Telephone: 435-336-3250
Date:

Attempted to call 7/12/2002. Left message.
Attempted to call 7/18/2002. Left message.
Attempted to call 7/31/2002. He is out of the office until 8/7/2002.

Summary of State Contacts

Community Name and State Ranking	unmapped	age of maps	cost share (Y/N)	Level	Questionnaire received	Comments
Unincorporated Utah Co.	**N**	**20**	**Y**	**2**	**Y**	**countywide format requested**
Alpine	N	19	Y	2	y	new H & H needed
American Fork	N	21	Y	2	Y	new H & H needed
Highland	N	20	Y	2	y	on county maps, new community, has not been mapped
Lehi	N	19	Y	2	y	new map reflects new boundaries only
Lindon	N	16	Y	1	Y	Incorporate LOMRs
Mapleton	N	22	Y	2	Y	new H & H needed
Orem	N	17	Y	1	Y	Need accurate & updated material
Genola	N	20	Y	1	Y	part of unincorporated county
Payson	N	21	Y	2	Y	Need accurate & updated material
Pleasant Grove	N	20	Y	1	Y	boundary changes
Salem	N	22	Y	1	Y	boundary changes
Santaquin	N	20	Y	2	Y	boundary changes and review of H & H
Saratoga Springs	N	1	Y	1	Y	reflect new map on countywide
Spanish Fork	N	16	Y	2	Y	East & west areas incorrect
Springville	N	17	Y	2	Y	Need accurate & updated material
Eagle Mountain	N	20	Y	1	Y	Review H & H
Cedar Fort	N	20	Y	1	Y	Review H & H
Woodland	N	20	Y	1	Y	Review H & H
Elkridge	N	20	Y	1	Y	Review H & H
Cedar Hills	N	20	Y	1	Y	Review H & H
Goshen	N	20	Y	1	Y	Review H & H
Elberta	N	20	Y	1	y	Review H & H
Fairfield	N	20	Y	1	Y	Review H & H
Vineyard	N	20	Y	1	Y	boundary changes
Unincorporated Davis County	N	20	Y	1	Y	countywide format requested
North Salt Lake	N	20	Y	2	Y	new H & H needed
Woods Cross	N	23	Y	2	Y	Need accurate & updated material
Sunset	N	23	Y	1	Y	Incorporate LOMRs
Syracuse	N	20	Y	1	Y	Incorporate on countywide
Clinton	N	20	Y	1	Y	Incorporate on countywide
Bountiful	N	11	Y	1	Y	Incorporate on countywide
Centerville	N	10	Y	2	Y	Incorporate on countywide, LOMRs, Fan study
Farmington	N	6	Y	2	Y	Great Salt Lake study, incorporate on countywide
Clearfield	N	22	Y	1	Y	Incorporate on countywide
Kaysville	N	20	Y	2	Y	H & H, boundary changes

Community Name and State Ranking	unmapped	age of maps	cost share (Y/N)	Level	Questionnaire received	Comments
Layton	N	19	Y	2	Y	H & H, boundary changes
Fruit Heights	N	20	Y	2	Y	H & H, boundary changes
South Weber	N	20	Y	1	Y	Incorporate on countywide
Unincorporated Cache County	N	21	Y	2	Y	H & H, boundary changes, countywide format
Wellsville	N	21	Y	2	Y	Need accurate & updated material
Hyrum	N	22	Y	1	Y	H & H review
Providence	N	18	Y	1	Y	Incorporate on countywide
Millville	N	25	Y	2	Y	H & H, and boundary changes
Mendon	N	22	Y	2	Y	H & H needed
Logan	N	17	Y	2	Y	Need accurate & updated material
River Heights	Y	unmapped	Y	2	Y	H & H, boundary changes
Nibley	N	16	Y	1	Y	Incorporate on countywide
Paradise	N	26	Y	1	Y	new boundaries
Richmond	N	22	Y	1	Y	new boundaries
Hyde Park	N	22	Y	1	Y	new boundaries, review of H & H
North Logan	N	16	Y	1	Y	new boundaries, review of H & H
Smithfield	N	16	Y	2	Y	H & H needed
Clarkston	N	22	Y	1	Y	boundary changes
Lewiston	N	21	Y	2	Y	Need accurate & updated material
Trenton	Y	unmapped	Y			
Newton						
Amalga						
Cove						
Petersboro						
Cornish						
Unincorporated Weber County						
Farr West						
Plain City	N	19	Y	2	Y	
Marriott-Slatersville						
Pleasant View						
North Ogden						
Ogden	N	19	Y	2	Y	Need accurate & updated material
Liberty						
Eden						
Huntsville						
Roy						
Uintah						
Riverdale						
Washington Terrace	?	?	Y	?	Y	
South Ogden	N	20	Y	2	Y	
Hooper						
West Warren						
Harrisville						
West Haven						
Unincorporated Iron County						

Community Name and State Ranking	unmapped	age of maps	cost share (Y/N)	Level	Questionnaire received	Comments
Paragonah	N	17	Y	2	Y	Need accurate & updated material
New Castle						
Brian Head						
Parowan	N	16	Y	2	Y	
Kanarraville						
Summit						
Enoch						
Cedar City	N	17	Y	2	Y	
Unincorporated Tooele County						
Lake Point						
Stansbury Park						
Erda						
Tooele	N	12	Y	2	Y	
Stockton	N	21	Y	1	Y	
Rush Valley						
Dugway						
Bauer						
Mills Junction						
Grantsville						
Delle						
Wendover						
Salt Springs						
Gold Hill						
Ibapah						
Faust						
Vernon						
Ophir						
Unincorporated Washington County						
New Harmony	N		Y	2	Y	
Toquerville						
Leeds						
La Verkin	Y		Y	1	Y	Need floodplain maps
Virgin						
Hurricane	N	?	Y	2	Y	Need accurate & updated material
Hilldale						
Enterprise	N	15	Y	2	Y	mapping on north & west sides of city incorrect
Gunlock						
St. George	N	11	Y	2	Y	panels not printed that are now developed
Ivins						
Santa Clara						
Central						
Veyo						
Damerron Valley						
Diamond Valley						
Middleton						
Washington	N	8	Y	2	Y	
Rockville	Y		Y	2	Y	Need floodplain maps
Springdale						
Winchester Hills						
Unincorp. Uintah County panels 14, 15						
Vernal	N	16	Y	2	Y	Municipal boundaries not shown, no base flood elevation

Community Name and State Ranking	unmapped	age of maps	cost share (Y/N)	Level	Questionnaire received	Comments
Soldier Summit						
Naples						
Maeser						
La Point						
Ballard	N	?	Y	2	Y	
Gusher						
White Rocks						
Tridell						
Randlett						
Leota						
Ouray						
Bonanza						
Unincorporated Morgan County – needs good base map						
Morgan City	N	14	N	2	Y	Need accurate & updated material
Peterson						
Stoddard						
Croydon						
Enterprise						
Unincorporated Summit County						
Henefer						
Coalville	Y	?	Y	2	Y	Need floodplain maps
Wanship						
Oakley						
Marion						
Hoytsville						
Pineview						
Upton						
Kamas						
Francis						
Woodland						
Peoa						
Park City	N	14	Y	1	Y	
Summit Park – part of County						
Jeremy Ranch – part of County						
Silver Creek Junction						
Wasatch County – above Jordanelle						
Heber	N	15	Y	2	Y	Need accurate & updated material
Charleston						
Midway						
Wallsberg						
Timberlakes						

Appendix C. County-by-County Ranking Table

County	FIRM age	Local Contribution	Population Growth	Emergency, Priority, Routine	Existing Data	Total	Comments
Beaver	5	4	1	3	2	15	
Box Elder	5	4	1	3	2	15	
Cache	5	4	2	4	4	19	
Carbon	5	4	1	2	4	16	
Davis	5	5	2	4	5	21	
Daggett	5	2	2	2	2	13	Unmapped
Duchesne	5	2	2	2	2	13	Unmapped
Emery	5	2	2	2	3	14	
Garfield	5	3	1	3	2	14	
Grand	5	2	2	2	2	13	Non-part.
Iron	5	4	4	3	4	20	
Juab	5	2	2	2	3	14	
Kane	5	4	1	2	3	15	
Millard	5	3	2	2	3	15	
Morgan	4	4	3	3	4	18	
Piute	5	3	1	3	2	14	
Rich	5	2	1	2	2	12	Unmapped
Salt Lake	1	4	2	2	3	12	
San Juan	5	2	1	2	2	12	Unmapped
San Pete	5	4	2	3	3	17	
Sevier	5	4	2	3	3	17	
Summit	5	4	5	4	4	22	
Tooele	5	5	4	4	4	22	Unmapped
Uintah	5	4	2	4	4	19	
Utah	5	5	3	4	4	21	
Wasatch	5	4	2	3	4	18	
Washington	5	4	3	3	4	19	
Wayne	5	2	1	2	2	12	Unmapped
Weber	5	4	2	3	4	18	

A description of each data source and score are listed below:

FIRM age – FIRMS that were 15 years or older were given a 5 in the ranking scale; FIRMS that are 10 years old received a 4; FIRMS that are 3 years old received a 2; and, FIRMS that were effective during the last year were given a 1.
Local Contribution (soft match) – As a part of Utah's County surveys, communities were asked if they could contribute to new maps. A 5 ranking scale indicates the community has an active GIS, engineering, and surveying capabilities. A 4 indicates some GIS, engineering, and surveying capabilities; a 4 indicates some capabilities; a 2 indicates no GIS, some engineering and surveying; and, a 1 indicates no soft match capabilities.
Population data – 2000 U.S. Census

Emergency, Priority, or Routine – Projects started in Year 1 received a 4 ranking, projects in year 2 received a 3, projects in year 4 received a 2. This section reflects the fiscal year that the mapping projects would be started and reflects the State's priorities.
Existing Data (Topographic, Base Maps, and Flood data) – Describes the availability of data and maps to support new mapping. This information comes from Federal, State, and local partners.

Please Note:
≥18 = High priority (obligated in FY2003)
17-14 = Medium priority (obligated in FY2004)
≤13 = Low priority (obligated in FY2005)

Appendix D. Summary of Planned Map Update Projects

The Palmer Drought Severity Index

Palmer Drought Severity Index, an index, developed by Wayne Palmer in the 1960's, which measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is "standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc.

U T A H
DROUGHT RESPONSE PLAN

UTAH
DEPARTMENT OF NATURAL RESOURCES
AND
DIVISION OF EMERGENCY SERVICES AND HOMELAND SECURITY

1993
(Revised - 2003)

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UTAH DROUGHT RESPONSE PLAN

1. Situation

Utah has experienced periods of drought since the pioneers first settled in the Salt Lake Valley. The lengthy droughts of the I930's and I950's caused significant economic problems for the state. While the drought of 1976-77 was not as long, the consequences were still intense and costly. Precipitation fluctuates greatly in Utah's relatively arid climate. As the demand for water continues to increase, even temporary shortages in supply can be disruptive to the normal process in urban and rural environments. Two or more consecutive years of significant reduction in precipitation, particularly snowfall in the mountains, could have far-reaching impacts.

When droughts occur, the state experiences a variety of problems. If identified and evaluated, problems can be dealt with in an organized and cost-efficient manner. The most significant impacts relate to agriculture, municipal water supplies, tourism, and wildlife preservation. Electric power generation and water quality can also be adversely affected. The frequency and magnitude of wildfire occurrences can also be increased by drought conditions.

A timely application of the state's available resources can reduce drought effects. When the impacts of drought exceed the state's response capabilities, an existing state program would facilitate preparation of requests for federal assistance.

2. Purpose

The purpose of the Drought Response Plan is to provide an effective and systematic way for the state of Utah to deal with emergency drought problems.

3. Defining Drought

There is no universally acceptable definition of drought. Further, drought creates unusual management problems due to the uncertainty surrounding its occurrence, duration, magnitude, and severity. The climatological and hydrological parameters normally used in defining drought are precipitation, soil moisture, snowpack, runoff, recharge, evapotranspiration, and temperature. Several indices employ indicators to measure the intensity or severity of drought. For purposes of a state response plan, drought must be objectively quantified to trigger specific state actions.

3.1 Drought Index

The Surface Water Supply Index (SWSI) incorporates multiple hydrologic/climatological components into a single, objectively derived index value for each major basin in the state. It focuses on surface water supplies derived from melting snow, which account for most of the annual flow of the state's major streams. Reservoir storage and current precipitation amounts are also taken into account in appraising available or forecasted water supplies. When spring arrives, the moisture represented by the melting snowpack is translated into streamflow and is included

in the water supply assessment. The SWSI unifies these various components into a single index value useful for management decisions in times of impending or current water shortage. SWSIs have been developed for the major basins in Utah and can be used as an "objective" trigger for drought action.

4. Description

To maximize effectiveness, a state drought response plan must include: (1) an assessment system which continually monitors water supply so that deteriorating conditions can be identified early enough for appropriate actions to be taken, (2) a response system to meet existing or growing needs which are beyond local capabilities, and (3) a centralized point of coordination and control. The relationship between these components is depicted in Attachments 1 and 2.

4.1 State Drought Coordinator

Responsibility for preparation and timely implementation of the Utah Drought Response Plan lies with the State Drought Coordinator, who is appointed by the Governor. The State Drought Coordinator (currently, the executive director of the Utah Department of Natural Resources), will chair both the Drought Review and Coordinating Committee and the Drought Response Committee.

4.2 Assessment System

The assessment system is comprised of the Water Supply Availability Committee, Drought Review and Reporting Committee (DRRC), and the Impact Task Forces. The DRRC and task forces are activated by the State Drought Coordinator's Memorandum of Potential Drought Emergency. (See attachment 3. Page 13)

4.2.1 Water Supply Availability Committee (WSAC)

- Chaired by Division of Water Resources
- Makes assessments and projections (in comparison to historical norm) on:
  - Snowpack
  - Soil moisture
  - Reservoir levels
  - Groundwater levels
  - Precipitation
  - Temperature
  - Streamflow
- Selects and/or develops formats for reporting the above assessment projection information
- Provides report of water supply conditions to State Drought Coordinator for action.

4.2.2 Drought Review and Reporting Committee (DRRC)

- Activated by memorandum from the State Drought Coordinator
- Chaired by State Drought Coordinator (SDC), with membership (as a minimum) to

include the chair of each Impact Task Force
- The Vice-chair is the director of Division of Emergency Services and Homeland Security
- Monitors activities of the Impact Task Forces to ensure comprehensiveness, timeliness, and adequacy of procedures and reports
- Aggregates and develops assessments, projections, and trends
- Makes timely reports to leadership, the news media, and other members of the response team
- Ensures inter-task force and inter-government (to include federal agencies) coordination
- Makes recommendation to activate Drought Response Committee (DRC)

4.3 Impact Task Forces

The task forces gather water availability and drought impact information and disseminate this information (through the Drought Review and Reporting Committee) to leadership and to the response agencies of state government. The task forces delineate problem areas and impacts, which generate needs that cannot be met locally and must therefore be responded to by the state. The task forces will normally be chaired by midlevel managers drawn from state government who can deal with a very broad range of government and private data sources.

Task force leadership provides the news media with impact assessments and information pertinent to task force responsibility. Information releases of a broader scope will be made by the Office of the Governor, Drought Review and Reporting Committee, and the State Drought Coordinator. (Detailed information on task forces, i.e. composition, duties, operating procedures, etc., is shown in Annex A.)

4.3.1 Task Force 1 - Municipal Water and Sewer Systems

- Chaired by Department of Environmental Quality
- Identifies existing and potential drought related problems
- Assesses capability of municipal water systems and sewer systems to withstand drought impacts
- Assesses municipal fire fighting capability related to low system pressures or supplies
- Reports findings to:
    - Drought Review and Reporting Committee
    - Lead response agencies
    - Economic Task Force (loss data)

4.3.2 Task Force 2 - Agriculture Industry

- Chaired by Department of Agriculture
- Identifies existing and potential drought problems
- Emphasizes assessment of impacts on soil erosion, crop and livestock loss, and insect and pest problems
- Reports findings to:

- Drought Review and Reporting Committee
- Lead response agencies
- Economic Task Force (loss data)

4.3.3 Task Force 3 - Commerce and Tourism

- Chaired by Department of Community and Economic Development.
- Identifies existing and potential drought problems, especially in major industrial and commercial sectors.
- Assesses impacts such as loss of sales tax revenues, increases in unemployment, and decreases in tourism visitation levels and lodging receipts.
- Reports findings to:
  - Drought Review and Reporting Committee
  - Lead response agencies
  - Economic Task Force (loss data)

4.3.4 Task Force 4 - Wildfire Protection (exists through interagency agreements)

- Coordinated by Division of Forestry, Fire and State Lands
- Identifies high priority threats
- Assesses fire protection capabilities/resources and outside sources of assistance

4.3.5 Task Force 5 - Wildlife

- Chaired by Division of Wildlife Resources
- Identifies existing and potential drought problems. (Emphasis on assessments should be losses of game, fish, and non-game wildlife.)
- Reports findings to:
  - Drought Review and Reporting Committee
  - Lead response agencies
  - Economic Task Force (loss data)

4.3.6 Task Force 6 - Economic Impacts

- Chaired by Office of Planning and Budget
- Identifies existing and potential drought problems within area of responsibility
- Aggregates economic loss data from other task forces
- Reports findings to:
  - Drought Review and Reporting Committee
  - Lead response agencies

Note: Other task forces may be organized/activated as drought intensifies and need arises, e.g. energy and health.

4.4 Response System

When it is evident that drought related problems exceed the capacity of the local entities to continue without assistance the DRRC will recommend that the Governor proclaim a Drought Emergency. Once the Governor proclaims a Drought Emergency the Drought Review and

Reporting Committee shall become the Drought Response Committee.

4.4.1 Drought Response Committee (DRC)
The DRC is chaired by the State Drought Coordinator, and is comprised of senior level managers of the involved state departments. The DRC will act in concert with or through the lead agencies and will: (1) review unmet needs identified by task forces and lead agencies, (2) identify and recommend means to meet those needs, (3) ensure inter-agency coordination, and (4) determine when deactivation should occur. (Attachment 2 depicts relationship of the DRC to the DRRC, task forces, and lead response agencies.)

The response system is based upon existing statutory authorities. As specific impacts are identified and assessed by the various task forces, these impacts are reported to the concerned lead agency and to the Drought Review and Reporting Committee. When a lead agency receives an impact assessment, which requires a response, action is through existing programs according to established department criteria. State action is taken only when local capabilities cannot cope with existing or growing needs. (Lead agencies are responsible for making news releases concerning their programs. Authority for releases covering overall status and direction of drought response is the responsibility of the State Drought Coordinator.)

Drought problems normally will be assigned as follows:

Water shortages	Department of Natural Resources
Wildfire and wildlife	Department of Natural Resources
Agricultural problems	Department of Agriculture
Municipal water, sewer systems and health problems	Department of Environmental Quality
Commerce and tourism	Department of Community and Economic Development
Economic problems	Office of Planning and Budget
Life-threatening situations	Department of Public Safety

As other response needs become apparent, additional lead agencies will be established. (See Annex B for details on Lead State Agencies and Drought Response Committee.)

5. Plan Activation

As indicated in section 3, some type of objective mechanism is needed to trigger the various levels of activity in a State Drought Response Plan. The Surface Water Supply Index (SWSI) has been selected as the most representative index for determining the potential availability of Utah's projected seasonal water supply.

5.1 Criteria

The State Drought Response Plan will be activated according to calculated values of the Surface Water Supply Index (SWSI). (SWSI values will be published by NRCS on a monthly basis for the major basins in the state.) Important drought plan trigger points related to the SWSI are shown below.

5.2 Sequence of Actions

Surface Water Supply Index	Drought Response Phase	Actions Taken
0 to plus indices	Normal Conditions	1. Surface Water Supply Index maps are generated each month by NRCS and sent to Division of Water Resources (UDWR) and State Drought Coordinator (SDC). 2. UDWR reviews maps, monitors for isolated drought problems.
0 to -1.0 Emerging Drought	Normal Conditions	1. UDWR monitors maps, discusses trend with SDC.
-1.0 to -2.0	Phase 1	1. WSAC monitors trends. 2. WSAC provides the SDC news media with status information.
-2.0 in any river basin	Phase 2	1. SDC Memorandum activates Drought Review and Reporting Committee (DRRC) and TF's 1 - 5. 2. SDC meets with TF chairpersons to outline Phase 2 activity. 3. TF's 1 - 5 make an initial assessment of the impact in the drought basin. 4. The Drought Review and Reporting Committee (DRRC) makes periodic reports to the Governor. 5. TF chairpersons interface with news media for their areas of concern. 6. Lead agencies undertake response actions, which are within their normal programs and with the resources available. 7. The Drought Review and Reporting Committee delineates any unmet needs, which cannot be handled through the normal channels of a lead department.

Surface Water Supply Index	Drought Response Phase	Actions Taken
When declared by Governor on advice of DRRC	Phase 3	1. DRRC prepares a Governor's Proclamation of Drought Emergency. 2. Governor's Proclamation activates the Drought Response Committee (DRC). 3. TF's 1 - 5 continue to make assignments and reports. 4. Unmet needs are passed to the DRC. 5. The DRC determines which needs can be met by reallocation of existing resources. Those needs which cannot be met will be listed and are forwarded to the Governor with recommendations 6. DRC assembles data needed to support a request by the Governor for federal drought assistance. 7. State Drought Coordinator interacts with the Federal Emergency Management Agency (FEMA) and the Division of Emergency Services and Homeland Security.
Receding Drought	Phase 3	1. DRC determines all requirements for assistance are now being met within established channels. 2. DRC terminates activity, issues final report.
at -2.0	Return to Phase 2	Task Forces 1 - 5 continue to make assessments and reports.
at - 1.5	Return to Phase 1	Task Forces 1 - 5 terminate activity, issue final report.
at -0.5	Return to normal conditions	Division of Water Resources continues to monitor the Surface Water Supply Availability Index Maps.

6. Drought Relief Problems

There are state and federal programs that can provide relief from drought impacts. State programs for relief are few in number and limited in scope, while federal programs are more numerous and broad. All of these programs are dependent on annual funding appropriations, which vary significantly from year to year. Therefore, the usefulness of these programs at any particular point in time may be limited. As drought conditions intensify:

- appropriations may be increased;
- or initiatives may be established for new legislation

When drought occurs over a multi-state region (as during the 1976-77 drought), the possibilities for new federal legislation are significantly enhanced. Normally the president does not approve major emergency declarations with follow-on relief programs for drought. On the other hand, when extremely serious events occur which are associated with drought and which clearly overextend the state's capacity to provide relief, then such a declaration may be possible.

(For more detailed information on existing state and federal relief programs see Annexes C& D.)

7. Coordinating Instructions to All Drought Assessment and Response Agencies

- The general sequence of actions will be in accordance with Section 5.2 of this plan.
- Expenses to support activities are subject to normal fiscal constraints of respective agencies. Requests for special funding will be forwarded through the appropriate coordinating agency, DRRC or DRC to the Governor.
- Local governments and public associations assisting state agencies in the identification and assessment of drought impacts, respond within their capabilities and request state assistance when needs cannot be met locally.
- Meeting frequency of task forces and the DRC will be established by the chairpersons.
- Frequency of situation reports, assessments, and reports of inter-agency response actions will be as recommended to the Governor by the State Drought Coordinator.
- Task force chairpersons and lead response agency representatives are authorized to respond to questions from the news media or issue news releases concerning their specific areas of responsibility. Where questions of potential conflict arise, inquiries should be referred to the Drought Review and Reporting Committee Chairperson (State Drought Coordinator). Major policy announcements on overall drought assessment and response program status will be made by the Office of the Governor or the State Drought Coordinator.
- When a drought disaster is federally declared for Utah, the State Drought Coordinator will become the coordinating officer.
- If a drought emergency is declared through the Federal Emergency Management Agency (FEMA), the director of Division of Emergency Services and Homeland Security (DES) will serve as the state liaison officer and Governor's authorized representative, by prior agreement, to access the state's letter of credit and activate

the disaster relief provisions of Public Law 93-288.

Attachment 1

Attachment 2

Attachment 3

Date

TO: Commissioner of Agriculture
Executive Director, Department of Community and Economic Development
Executive Director, Department of Environmental Quality
Executive Director, Department of Public Safety
Director, Office of Planning and Budget
(Others as required)

FROM: Executive Director, Department of Natural Resources

SUBJECT: Activation of the Utah Drought Response Plan

Drought conditions have developed along the ( ) and ( ) River Basin(s) to the degree that counties in the ( ) and ( ) are likely to receive severe impacts to various sectors of their economy. If present trends continue, other river basins and sectors of the entire state's economy may soon be affected.

As State Drought Coordinator, I have decided to activate the State Drought Response Plan so that specific impacts may be identified, and expeditious and effective remedial action may be taken.

As of the date of this memorandum, the Utah Drought Response Plan is in effect; the following actions, as specified in the plan, will be taken.

(1) The Drought Review and Reporting Committee will be activated under chairmanship of the executive director, Department of Natural Resources.

(2) All Impact Task Forces (TF): municipal, wildfire, agriculture, commerce and tourism, wildlife, and economic will be activated. The TF chairpersons will call their first meeting as soon as possible after the Drought Review and Reporting Committee meeting.

(3) All addressees will assign: (1) A senior level manager who can commit the resources of the agency as a drought coordinator, and (2) TF chairpersons and participants as indicated in Annex A “Task Force Organization”.

Attachment 3 (Continued)

Name
Date
Page 2

(4) Lead agencies for drought response will be prepared to take action as appropriate.

(5) Weekly/Bi-weekly situation reports will be submitted starting the ( ).

By this memo I am requesting that each of you forward names, titles, and office and home telephone numbers of your drought coordinators and TF chairpersons to the executive director, Department of Natural Resources by ( ). You may elect to use your present disaster coordinator in the role of drought coordinator.

I recognize this effort imposes a burden beyond the normal workload. However, a potentially serious situation exists. This creates a need for priority attention and I appreciate your full cooperation.

Attachment 4

EXECUTIVE ORDER
PROCLAMATION
DISASTER EMERGENCY

WHEREAS, drought conditions exist in _____beginning on or about and such conditions present a serious threat to public health, safety and property; and

WHEREAS, economic damages are occurring in _____because of drought and have the potential to greatly worsen if left unattended; and

WHEREAS, these conditions will worsen as the drought persists; and

WHEREAS, immediate action is required to respond to and alleviate the damage and suffering from drought; and

WHEREAS, these conditions do create a disaster emergency within the intent of the Disaster Response and Recovery Act of 1981;

NOW THEREFORE, I, _____ Governor of the State of Utah, by virtue of the power vested in me by the constitution and the laws of the state of Utah, do hereby order as follows:

It is found, determined and declared that a "State of Emergency" exists due to the aforesaid drought statewide and that such area is declared to be a disaster area for the remainder of the drought period requiring aid, assistance, and relief available pursuant to the provisions of the state statutes, and the State of Utah Emergency Operations Plan, Volume II, Natural Disaster, which is hereby activated.

IN WITNESS WHEREOF, I have set my hand and caused to be affixed the Great Seal of the State of Utah. Done at the State Capitol in Salt Lake City, Utah, this day of _____.

Michael O. Leavitt
Governor

ATTEST:

Olene Walker
Lieutenant Governor

ANNEX A

ASSESSMENT SYSTEM
TASK FORCES/COMMITTEES

PURPOSE/ORGANIZATION/OPERATING PROCEDURES

Drought Review and Reporting Committee
Water Supply Availability Committee

Task Force	1 - Municipal Water and Sewer Systems
	2 - Agriculture Industry
	3 - Commerce and Tourism
	4 - Wildfire Protection
	5 - Wildlife
	6 - Economic Impacts
	7 - Energy (when activated)
	8 - Health (when activated)

ANNEX A

1. Drought Review and Reporting Committee

1.1 Situation

As drought conditions develop and intensify so that the varied impacts and needs can be identified, assessments of these impacts and needs must be developed so that an effective response can be generated.

1.2 Purpose

The Drought Review and Reporting Committee is the "heart" of the drought assessment system. It will receive reports from the Water Supply Availability Committee and Impact Task Forces; aggregate assessments and projections; evaluate overall conditions; develop recommendations for drought response; and make timely reports to leadership, the news media, and the response system (Lead Response Agencies).

1.3 Organization

The Drought Review and Reporting Committee is composed of the chairpersons of the Water Supply Availability Committee and Impact Task Forces and chaired by the State Drought Coordinator (executive director, Department of Natural Resources). The vice-chairperson will be the director of the Division of Emergency Services and Homeland Security. Composition of the committee is as follows:

Chairperson - State Drought Coordinator
Vice-chairperson - director of Division of Emergency Services and Homeland Security
Members- Chairperson - Water Supply Availability Committee
Impact Task Forces:
- Municipal Water and Sewer
- Agriculture Industry
- Commerce and Tourism
- Wildfire Protection
- Wildlife
- Economic Impacts
- Energy (when activated)
- Health (when activated)

Other: Departmental drought coordinators for Lead Response Agencies may attend meetings as observers.

1.4 Execution

1.4.1 Concept/Approach

The Drought Review and Reporting Committee is the key to the effectiveness of the assessment system. The committee will review written assessments of the Impact Task Forces and summarize the findings for transmission to the Governor. On a more frequent basis, or as conditions dictate, significant activities / information will be relayed to the Governor in a situation report.

1.4.2 Tasks

- Review Water Supply Availability Committee assessments and projections.
- Review written assessments and projections of need prepared by Impact Task Forces.
- Aggregate task force assessments and provide situation reports to the Governor as needed.
- Provide information to the public and news media.
- Coordinate initial interagency, local, and private responses within existing programs and resources.
- When growing needs require a response beyond existing programs and funding, prepare a "Drought Emergency Proclamation" for Governor's signature to activate the State Drought Response Committee.
- Provide situation reports, advice and other support to the Drought Response Committee, including recommendations for funding response activities.

1.5 Implementation

- After activation, meeting frequency will be determined by the committee chairperson
- Committee will produce reports necessary to perform tasks.

2. Water Supply Availability Committee

2.1 Situation

As drought conditions worsen so that trends in water availability in comparison with the historical norm can be identified, there is a need to develop timely supply assessments so an effective response can be generated.

2.2 Purpose

The Water Supply Availability Committee, when activated, will collect water availability data, evaluate this data, make assessments as to changes (based on frequency analyses) in availability and make trend projections, identify key areas of water shortage, and report these activated assessments and projections to the State Drought Coordinator, Impact Task Forces, and Review and Reporting Committee.

2.3 Organization

The Water Supply Availability Committee is composed of representatives of the following agencies, and may be expanded as new resource agencies are identified:

Division of Water Resources (agency providing chairperson)

National Weather Service
Office of State Climatologist
U.S. Bureau of Reclamation
State Engineer
Division of Emergency Services and Homeland Security
U.S. Geological Survey
Natural Resources Conservation Service

2.4 Execution

2.4.1 Concept/Approach

Committee members will utilize their various information resources to develop water availability statistical data and trends. Data collection, evaluation, and reporting will be focused on major problem areas across the state (by drainage basin or by geographical/political subdivision).

2.4.2 Tasks

- Review and update this annex upon activation of the committee.
- Make assessments and projections by basin (in comparison to the historical norm) on:
  - Snowpack
  - Soil moisture
  - Reservoir levels
  - Streamflow
  - Precipitation
  - Temperatures
- Obtain site-specific data to provide other task forces with water availability/storage estimates by river basins.
- Select or develop specific formats for reporting the above assessment and projection information.
- Determine requirements for routine and special reports.
- Respond to special data requirements of the other assessment task forces.
- Identify resource information gaps and make recommendations to address them.

2.5 Implementation

(Action Plan). Based on the various resource information capabilities and data banks, the Water Supply Availability Committee will take the following actions to carry out its tasks:

2.5.1 Provide, on a monthly basis, a Water Availability Report to the State Drought Coordinator comprised of information on snowpack/precipitation, streamflow, reservoir storage levels, Surface Water Supply and Palmer indexes, and forecasted weather. The basis of this report will be:

- Snowpack, precipitation, streamflow, and reservoir storage levels:
  - January 1 through June 1 - Monthly Water Supply Outlook

published by NRCS, as supplemented.
    - June 1 to January 1 - Data provided by the National Weather Service, NRCS, and Office of the State Climatologist
- Palmer Index, as provided by the National Weather Service/State Climatologist.
- Surface Water Supply Index, as provided by the Division of Water Resources and NRCS.
- Weather forecasts, as provided by the National Weather Service

2.5.2 Provide supplemental reports whenever a significant weather event occurs or a special report requirement exists.

2.5.3 Coordinate special data requirements of the other Impact Task Forces with resource agencies.

2.5.4 Continuous emphasis will be placed on improvement of the committee's capability to provide accurate and timely assessments of water availability.

2.5.5 The committee will meet at the call of the chairperson.

2.5.6 Adjustments to the action plan will be made as necessary, with the approval of the committee.

2.6 Capabilities

- Reports normally available by agency

2.6.1 Natural Resources Conservation Service (NRCS)

- Monthly report titled "Water Supply Outlook", covering snowpack, stream flow, and reservoir storage conditions.
- Weekly snow-precipitation update
- Ability to call up automated SNOTEL sites for current data.
- Soil moisture conditions

2.6.2 Office of the State Climatologist

- Weekly precipitation/heating degree updates by climatological division
- Comparisons to the historical norms
- Adjusted Palmer Drought Indices by climatological division
- Capacity to develop probability projections based on historical records

2.6.3 United States Geological Survey (USGS)

- Measures of well levels throughout the state; Some are measured on a monthly basis.
- Stream stage data, based on reporting stations. Some are telemetered.
- Joint programs with state agencies for special projects under a limited time frame

2.6.4 National Weather Service - SLC Forecast Center and Colorado River Basin Forecast Center

- Daily 3-5 day forecast
- Weekly
  - Palmer Drought Index
- Semi-monthly
  - Average monthly precipitation and temperature outlook for next 30 days - Received near 1st and 15th.
- Monthly
  - 90-day precipitation and temperature outlook - received during last week of the month.
  - Water Supply Outlook from River Forecast Center (January 1 to June 1)

2.6.5 State Engineer

- Approximately 40 river commissioners distribute and measure water according to water rights filing and can give a daily status of the situation.
- Database of all in-state reservoirs: river commissioners can provide status on a daily basis.
- Area engineers become directly involved in all questions of distribution within their respective areas during drought conditions.

2.6.6 U.S. Bureau of Reclamation

- Reports on bureau-owned systems to include reservoir levels, forecast inflows, and releases.

3. Municipal Water and Sewer Systems Task Force

3.1 Situation

As drought conditions worsen for municipal water and sewer systems, there is a need to develop a process for timely assessments, response mechanisms, and follow-up procedures for such an event.

3.2 Purpose

The Municipal Water and Sewer Task Force is established to make assessments on the impact suffered by municipalities during a drought. These assessments will be based upon the most recent data available from each system manager or engineer, both in terms of prevention and resolution. The task force will be responsible for advising the Drought Review and Reporting Committee as to the potential problems and the necessary responses to address unmet needs.

3.3 Organization

The Municipal Water and Sewer Task Force is composed of representatives of the following

agencies, and may be expanded as needed throughout the season:

Division of Environmental Quality - (agency providing chairperson)
Department of Community and Economic Development
Division of Emergency Services and Homeland Security
Utah League of Cities and Towns
USDA - Farmers Home Administration
Division of Water Rights
Division of Water Resources
Other agencies as needed

3.4 Execution

3.4.1 Concept/Approach

Task force members will utilize various sources of information to develop estimates of impact on municipal systems. Data collection, evaluation, and reporting will be focused on major problem areas likely to occur in municipalities. When potential or actual municipal impacts and local need are identified, they will be reported to the Drought Review and Reporting Committee along with a response recommendation indicating possible sources of assistance. All estimates will consider assessments formulated by the Water Supply Availability Committee. Essential tasks to be performed by this committee are shown below.

3.4.2 Tasks

Identify sources of water supply: Reservoir, streamflow, and wells for both municipal and semi-public water systems. Assess water and sewer system drought susceptibility due to:

- Loss of supply;
- Seniority of water rights;
- Water quality standards;
- Other;
- Make recommendations to address identified impacts;
- Estimate costs associated with the implementation of all recommended programs and actions.

3.5 Implementation

The task force will meet as necessary to review and update procedures and situations throughout the state. Response agencies will take action where indicated and appropriate; all actions will be noted to the task force. All grants, loans or other emergency assistance measures will be reported monthly to the Drought Review and Reporting Committee. These reports may be more frequent depending upon the need.

4. Agricultural Industry Task Force

4.1 Situation

The length and degree of intensity of a drought period produces an impact on the state's agricultural industry that can be devastating to many farmers and ranchers. As drought

conditions escalate so that impacts on agriculture can be identified, there is a need to develop timely assessments so that an effective response can be generated.

4.2 Purpose

The Agricultural Industry Task Force is established to assess the impact of the drought upon the agriculture industry and the agriculture community. The Task force shall collect and evaluate data, making assessments and projections, identifying sources of assistance. The task force will be responsible for advising the Drought Review and Reporting Committee as to the potential problems and the necessary responses to address unmet needs.

4.3 Organization

The Agricultural Industry Task Force is composed of representatives of the following agencies and may be expanded as needed throughout the drought period:

Department of Agriculture (agency providing chairperson)
State Food and Agriculture Committee
Bureau of Land Management
Forest Service
Division of Water Resources
Division of Water Rights
Other agencies as needed

4.4 Execution

4.4.1 Concept/Approach

The Food and Agriculture Committees (FAC), at county and state levels, are the key to an effective and timely assessment of statewide agricultural drought impacts and local needs. The Federal Emergency Operations Handbook describes the functions of the FAC (See Annex E). Response to natural disasters, including drought, is an important responsibility of the FAC. The committees are usually comprised of members from federal agencies (i.e. ASCS, NRCS, RECD, ES) with representation from county commissions, emergency program directors, and other appropriate officials.

4.4.2 Procedure

- ASCS County Executive Directors request local FAC to gather applicable data assessing impacts of the drought. Regular reports of emergency areas and approved programs will be compiled and issued by ASCS.
- As needed, state agencies will conduct additional investigations and make reports necessary to trigger state drought related programs.
- State FAC will share findings with Utah Department of Agriculture (chairperson, Agricultural Task Force).
- Chairperson, Agricultural Task Force will report impacts/needs/losses to Drought Review and Reporting Committee and to lead response agency.
- The State Drought Coordinator, when appropriate and in cooperation with state FAC, will submit requests for natural disaster designation through the Governor's office.

4.5 Implementation

- When activated, the task force will meet at the call of the chairperson recognizing that a significant amount of the assessment and reporting will be accomplished through the already functioning county and state FACs.
- Extremely close liaison between the state FAC and the task force chairperson will be needed to keep the State Drought Coordinator (chairperson, Drought Review and Reporting Committee) informed of drought impacts and responses.

5. Commerce and Tourism Task Force

5.1 Situation

Utah periodically experiences drought of varying degrees which impacts commerce and tourism within the state. One of the first industries impacted is the ski industry, which is highly dependent on early and/or a substantial snowpack. As soon as impacts on commerce and tourism can be identified, there is a need to develop assessments so that an effective response can be generated. There are no regularly funded drought response programs, so legislative action would be required to establish and finance mitigation activities.

5.2 Purpose

The Commerce and Tourism Task Force will collect impact data, evaluate this data, and make assessments as to severity of impact. Based on water availability data, the task force will make impact projections, identify possible sources of assistance, and report these assessments and projections to the Drought Review and Reporting Committee. Collected data would be used to initiate the legislative process to meet drought needs.

5.3 Organization

The Commerce and Tourism Task Force is composed of representatives of the following agencies and may be expanded at discretion of the task force chairperson:

Department of Community and Economic Development (agency providing chairperson)
Division of Parks and Recreation
Department of Employment Security
Other Agencies as needed:

Utah Ski Association	U.S. Forest Service
National Park Service	County governments
Bureau of Land Management	

5.4 Execution

5.4.1 Concept/Approach

Task force members will utilize their various sources of information to develop estimates of impact on commerce and tourism. Data collection evaluation and reporting will be focused on major problem areas likely to occur. When potential or actual impacts and local needs are

identified, they will be reported to the Drought Review and Reporting Committee along with a response recommendation indicating possible sources of assistance. All estimates will consider assessments formulated by the Water Supply Availability Committee.

5.4.2 Tasks

- Assess losses in sales and receipts by economic segment/sector.
- Estimate levels of unemployment. Identify major segments impacted by unemployment as well as geographic or political subdivisions of the state most severely impacted.
- Recommend means to resolve identified problems. Consider mitigation activities such as public awareness programs.
- Estimate costs associated with the implementation of all recommended programs and actions.

5.5 Implementation

- Task force will be activated in accordance with the drought severity indicators as shown in the sequence of actions for activation of the State Drought Response Plan. Once activated, the task force will meet at the call of the chairperson and provide assessment reports to the Drought Review and Reporting Committee as determined necessary or as scheduled, i.e., weekly, monthly.

6 Wildfire Protection Task Force

Note: The Wildfire Protection "Task Force" is in actuality an ongoing, existing network of local, county, state and federal fire agencies, operating under interagency agreements. For the purposes of Utah's Drought Response Plan, the Utah Division of Forestry, Fire and State Lands is listed as Coordinator of this group.

6.1 Situation

The threat of wildfire in rural and forested areas is a weather-dependent activity that occurs annually. The problem is usually seasonal, but it can and does occur year-round in Utah. Drought conditions, however, increase the severity of wildfire threat and strain normal fire defenses. As drought conditions worsen, there is need to make assessments and identify potential short- and long-range fire protection impacts. Such evaluations are essential so that ongoing protection programs can be effectively strengthened to counter the expected threats.

6.2 Purpose

The Division of Forestry, Fire and State Lands (DFFSL), as part of its normal role, will coordinate daily, make wildfire impact projections, and recommend reinforcements necessary to maintain defenses against the threats.

6.3 Organization

DFFSL will coordinate with interagency fire partners through existing cooperative fire

protection agreements, which define the roles and responsibilities of each participating fire agency. In conjunction with this is the Annual Great Basin Mobilization Guide, which defines fire agencies' and managers' roles at various preparedness levels for the purpose of coordinating resources over a regional area.

Under the cooperative fire protection agreements, the Utah Annual Operating Plan defines the process of working cooperatively with its interagency partners. The state is further divided into Interagency Dispatch Areas which deploy the supplies or resources to respective fires. County Fire Wardens work hand-in-glove with their respective interagency dispatch center. With multiple fire starts or as individual fires grow, resource needs are requested and coordinated through local interagency centers. When available local resources are exhausted, additional resources are mobilized through regional interagency coordination centers. (Eastern Great Basin Fire Region)

6.4 Execution

Through normal operating procedures, local fire conditions and the availability of suppression resources are reported daily. These daily fire situation reports are readily available at a local, state, regional (http://www.blm.gov/utah/egbcc/index.htm) and national level (http://www.nifc.gov/news/sitreprt.pdf), if needed.

The Annual State Operating Plan policy provides for the State Fire Management Officer to determine weekly the availability of state-controlled suppression resources to meet state needs, and coordinate with other agencies our interagency needs to give or receive assistance.

7. Wildlife

7.1 Situation

The length, degree, and geographical area of a drought period can produce a variety of impacts on wildlife. As drought conditions intensify and impacts on wildlife are identifiable, there is a need to develop timely assessments so that an effective response can be generated.

7.2 Purpose

The Wildlife Task Force will collect related impact data, make assessments as to severity, make impact projections, identify sources of resolve and/or assistance, and plan for preventative measures. Assessments and projections will be reported to the Drought Review and Reporting Committee.

7.3 Organization

Membership of the Wildlife Task Force primarily includes, but is not limited to, individuals from the Division of Wildlife Resources. The division is structured into five regions statewide with a central administrative office in Salt Lake City. Each regional office is responsible for implementation of wildlife programs within established boundaries. The five regional offices are located in Ogden, Springville, Vernal, Price, and Cedar City. The task force will be

composed of members from the following agencies:

Division of Wildlife Resources (agency providing chairperson)
Regional Offices, Division of Wildlife Resources
U.S. Forest Service
Bureau of Land Management
U.S. Fish and Wildlife Service
Other agencies as needed

7.4 Execution

7.4.1 Concept/Approach

Task force members will utilize various sources of information to develop estimates of impact on wildlife. Data collection, evaluation, and reporting will be focused on major areas where problems are~~as~~ likely to occur. When potential or actual impacts and local needs are identified, these will be reported to the Drought Review and Reporting Committee along with a response recommendation indicating possible sources of resolve and/or assistance.

7.4.2 Tasks

- Review and update this annex to include task force operating procedures.
- Estimate wildlife losses and make projections for long-term effect on major species.
- Advise various measures which can be taken to preserve wildlife.
- Make recommendations to solve wildlife problems. Consider public awareness programming.
- Estimate costs associated with implementing all recommended programs and actions.

7.5 Implementation

- When activated, the task force will meet on schedule determined by chairperson.
- The task force will submit assessment reports to the Drought Review and Reporting Committee as necessary and/or as requested by the committee.

8. Economic Impacts Task Force

8.1 Situation

Utah experiences periodic droughts, which result in significant impacts on the state's economy. As drought conditions escalate to a point where impacts can be identified, there is a need to develop assessments and projections so that an effective response can be generated.

8.2 Purpose

The Economic Impacts Task Force, when activated, will collect data and assess the overall impact of the drought upon the state's economy. The Task Force will report to the State Drought Coordinator, Impact Task Forces, and the Drought Review and Reporting Committee. The data collected will be used to initiate the legislative process to meet drought needs.

8.3 Organization

The task force will include representatives from the following agencies:

Office of Planning and Budget (agency providing chairperson)
Department of Social Services
University of Utah Bureau of Economic Business Research
Department of Agriculture
Department of Commerce
Department of Insurance
Financial Institutions
Department of Employment Security
Other agencies as needed

8.4 Execution

8.4.1 Concept/Approach

Task force members will utilize their various sources of information as well as data from other task forces to develop estimates and projections of economic impact. Data collection, evaluation, and reporting will be focused on major problem areas likely to occur. When significant economic impacts and local needs are identified, they will be reported to the Drought Review and Reporting Committee indicating recommendations for response.

8.4.2 Tasks

- Upon activation, review and update this annex.
- Identify significant revenue losses of local and state governments.
- Identify economic impacts by sector of activity: commerce, tourism, agriculture, and industry.
- Conduct simulation modeling to produce economic impact projections as required.
- Make recommendations to solve problems.
- Estimate costs associated with implementing all recommended programs and actions.

8.5 Implementation

- The task force, when activated, will meet at the call of the chairperson
- Using information provided by task force member agencies, current conditions

will be reviewed and their effects on the economy will be assessed. Reports will then be provided to the Drought Review and Reporting Committee on an "as required" basis. (List of possible reports, which could be generated by task force members, may be appropriate.)

9 Energy Task Force

(Annex to be published when task force is activated.)

10. Health

(Annex to be published when task force is activated.)

ANNEX B

RESPONSE SYSTEM
LEAD AGENCIES/DROUGHT RESPONSE COMMITTEE

ORGANIZATION/OPERATING PROGRAMS

1. Drought Response Committee
2. Municipal Water/Sewer Systems
3. Agriculture
4. Commerce and Tourism
5. Wildfire
6. Wildlife
7. Economic Losses
8. Energy
9. Public Health

1. Drought Response Committee (DRC)

1.1 Situation

When lead response agencies become overburdened and find difficulty in coping with growing problems, a need exists for an organization to be formed of senior level management from affected lead agencies to address these issues.

1.2 Purpose

When activated, the Drought Response Committee will review impact task force statements of unmet needs, address these needs, or make recommendation to the Governor for action.

1.3 Organization

The Drought Response Committee will be composed of senior level representatives of the lead drought response agencies of state government and chaired by the State Drought Coordinator. Membership is as follows:

State Drought Coordinator - Chairperson

Representative - Department of Agriculture

Representative - Department of Environmental Quality

Representative - Department of Community and Economic Development

Representative - Division of Emergency Services and Homeland Security

Representative - Office of Planning and Budget

Representative - FEMA Region - (advisory only)

Other participants as needed/designated by the committee chairperson

1.4 Execution

1.4.1 Concept

The Drought Response Committee, when activated by the Governor upon recommendation of the Drought Review and Reporting Committee, will address those unmet needs and issues identified by the Impact Task Forces and lead response agencies. Actions within the authority of the representatives of this committee will be taken to resolve those matters brought before the committee. Matters not within the authority of this committee to resolve will be forwarded to the Governor with recommendations for action. Policy decisions made by the Governor will be implemented through this committee.

1.4.2 Tasks

- Review task force statements of unmet needs to recognize and identify alternate

choices for response.

- Develop, coordinate, and recommend solutions to impact problems involving:
  - Executive branch actions to include inter-departmental or outside support (possible federal declaration). This could also include recommending the appointment of a departmental staff position(s) or field representative(s) or other special drought-related personnel.
- Initiate state legislative actions, including requests for funding.
- Program implementation, monitoring, and approval.
- Ensure inter-agency coordination (e.g., news media releases)
- Determine when drought intensity has receded to the point that there is no longer a need for the DRC to function.

1.5 Implementation

- The DRC, when activated, will meet on the call of the chairperson.
- A written report will be submitted to the Governor indicating the significant items brought before this committee, any actions taken by the committee, and any matters being recommended for executive action.
- The DRC may request special reports from:
  - Impact Task Forces
  - Response agency program managers
  - Other sources of assessment/response expertise

2. Drought Response - Municipal Water and Sewer Systems

- Lead agency: Department of Environmental Quality
- Cooperating agencies: Division of Emergency Services and Homeland Security, Division of Water Rights, Division of Water Resources, Department of Community and Economic Development, Utah League of Cities and Towns, Rural Economic and Community Development.

2.1 Coordinating Procedures

The goal of the task force is to help alleviate or diminish the effects of drought on public drinking water suppliers or sewer system operations. Part of this effort will involve providing financial assistance. Ordinarily, such assistance is provided by the Board of Water Resources, the Drinking Water Board, Rural Economic and Community Development, the Water Quality Board, and the Community Impact Board. When severe drought conditions exist, and funds are available, the Water and Sewer Task Force may distribute loan or grant funds to systems having extreme drought problems.

2.2 Response Programs

2.2.1 Department of Environmental Quality

- Maintain and distribute periodic report on drinking water systems experiencing drought-related problems.

- Respond to drinking water shortages to protect public health.
- Expedite review of Safe Drinking Water Committee Board (SDWC) or Water Pollution Control Committee (WPCC) loan requests for drought-related problems.
- Provide guidance and technical expertise for drinking water systems affected by drought
- Water quality monitoring programs and water quality criteria to maintain beneficial use of the waters of the state and allow reuse of wastewater.

2.2.2 Department of Community and Economic Development

- Provide loans and grants through the Community Impact Board for drinking water projects. In an emergency situation, applications for such funds could be expedited.
- Provide financial assistance through the Disaster Relief Board to political subdivisions (subject to legislative authorization and appropriation).

2.2.3 Division of Water Rights

- Approval for the emergency construction of new or replacement wells.
- Emergency processing of applications to appropriate new sources of water or change existing approved right to new points of diversion, place of use, or nature of use.

2.2.4 **Rural Economic and Community Development**

- Water and sewer financial assistance program

2.2.5 Division of Emergency Services and Homeland Security

- Activate and coordinate state and federal disaster relief resources and programs.
- Emergency fire suppression assistance
- Emergency communications
- Emergency public information

2.2.6 Board/Division of Water Resources

- Loans for water supply and conservation projects
- Technical assistance, including geo-technical for establishing potential well sights
- Education program for water conservation

2.2.7 Utah League of Cities and Towns

- Provide task force information on drought problems and needs
- Provide cities and towns with information on state resources

2.3 Typical Problems/Obstacles to Response Action

2.3.1 Emergency situations, calling for immediate action, may arise and the normal funding process from various state agencies may take too long.

- No grant funds available for emergency disbursing to needy systems.

3. Drought Response - Agriculture

- Lead Agency: Utah Department of Agriculture
- Other cooperating agencies: State Food and Agricultural Committee (U.S. Department of Agriculture Agencies), Division of Water Resources, Bureau of Land Management, Forest Service, Division of Water Rights, and others as needed.

3.1 Coordinating Procedures

To help alleviate or diminish the effects of drought on the agricultural industry, the Department of Agriculture, as lead agency, shall act as liaison between various state and federal agencies and the State Drought Coordinator.

3.2 Response Programs

The currently available state and federal drought-related response programs are listed in Annexes C & D. Lead agency and cooperating agencies will complete, as needed, all tasks necessary to trigger appropriate assistance programs.

3.3 Typical Problem/Obstacles to Response Action

3.3.1 Emergency situation frequently require financial assistance beyond the capability of state programs.

3.3.2 Emergency declarations not made at federal level impede access to available federal programs.

3.3.3 Federal agencies' response is often slower than the need and program interpretations can be restrictive.

3.3.4 Coordination of efforts between local, state, and federal programs can create time delays.

4. Drought Response - Commerce and Tourism

- Lead Agency: Department of Community and Economic Development
- Other cooperating agencies: Utah Division of Parks and Recreation, Department of Work Force Services, Utah Ski Association, U.S. Forest Service, Bureau of Land Management, and National Park Service

4.1 Coordinating Procedures

Agencies concerned with commerce and tourism will assemble on call by Department of Community and Economic Development. They will meet as frequently as required to

develop responses to an actual or threatened drought. Telephone information may be used in lieu of formal meeting when conditions warrant.

4.2 Response Programs

When receiving notification of significant unmet local needs, the Department of Community and Economic Development will coordinate actions within the capability of the agencies concerned. The department will report the results of such actions to the DRRC and/or DRC, if activated.

Response programs may include:

- When available, expedite federal loan or loan guarantee programs for business.
- Develop and disseminate information for tourists and news media, directing visitors to areas capable of receiving visitation.
- Coordinate information releases in an effort to offset tourism losses.
- Render direct technical assistance to cities, counties and business associations eligible for drought related financial assistance.

4.3 Typical Problems/Obstacles to Response

Availability of short-term financial assistance to business affected by the drought is extremely limited if not in most instances non-existent. This will dictate greater limitation on the part of the state in determining who will receive such assistance.

It is difficult to keep the state or national news media from focusing on the "worst case scenario" and ignoring normal or good alternatives available.

There is a lack of discretionary funds to counter adverse publicity with a professional campaign.

5. Drought Response - Wildfire Protection

- Lead Agency: Department of Natural Resources, Division of Forestry, Fire and State Lands (DFFSL)

5.1 Coordinating Procedures

Normal wildland fire events utilize the existing fire suppression mechanism of the coordinated plans of local, state and federal resources. DFFSL policy provides for pre-positioning of resources to deal with local conditions to meet emergency needs.

When a wildfire threatens a community, the DFFSL Fire Management Officer notifies the Federal Emergency Management Agency (FEMA) and the Division of Emergency Services and Homeland security (DES). Funds to support fire suppression are available through the Fire Management Assistance Grant Program (FMAGP).

Under an existing interagency agreement between DFFSL and the Utah National Guard, in

an emergency and with the approval of the Governor of the State of Utah, the State Forester can call upon the National Guard for assistance with equipment, supplies, and other resources. The Governor would need to execute a declaration of local emergency on a monthly basis in which National Guard support is required, and DFFSL would obtain such declarations from the DES.

5.2 Funding

The DFFSL has an existing suppression program and a suppression fund, which provides for suppression costs to the state and to counties in the program. In some years this fund has been exhausted, and supplemental appropriations have had to be made. If this occurs the drought committee and other entities will be notified.

5.3 Wildfire Prevention

Various fire prevention tools can be and are initiated depending on severity to prevent human-caused fires. These include:

- Special printing of items (leaflets, badges, restaurant cards, bumper stickers, etc.)
- Special news media materials
- Highway checkpoints with special warnings/information
- Engine spark arrestor requirements/inspections
- In conjunction with other agencies, mobilize strike teams of fire prevention specialists

In addition, the Annual Operating Plan provides for fire restriction and closure in accordance with state law (65A-8-10). Those steps are initiated based on degree of severity.

Also, in conjunction with other agencies, strike teams of fire prevention specialists can be mobilized to enhance public awareness. These have proven to be very effective.

5.4 Emergency Watershed Protection

The loss of vegetation from wildfire exposes the soil and subjects the watershed to erosion and flooding. Quick and effective rehabilitation can reduce those risks of soil loss and impacts. Emergency watershed protection provisions are available from federal agencies (see Appendix 1.1.4).

6. Drought Response - Wildlife

- Lead agency: Department of Natural Resources, Division of Wildlife Resources (DWR)
- Cooperating Agencies: State, federal and private conservation groups that have authority or interest in wildlife and their habitat. Federal agencies of primary interest will include the U.S. Forest Service, Bureau of Land Management and U.S. Fish and Wildlife Service.

6.1 Coordination Procedures

Concerned agencies will meet at the request of DWR, as needed. Because DWR has the major capability to respond to drought impacts, internal directives will generally cover coordination procedures. Situation reports will be made to DRRC and/or DRC, as required.

6.2 Response Program

The division will respond to wildlife problems associated with drought within the limits of its own manpower and funding. If problems exceed the capabilities of the division, requests for supplemental manpower and funding will be made.

6.3 Typical Problems/Obstacles to Response

- Urgent requests for use of Conservation Pool/instream flow water
- Lack of adequate manpower or funding needs.
- Time constraints in responding to problems, especially those resulting in fish losses in streams and reservoirs.

7. Drought Response - Economic Impacts

- Lead agency: Office of Planning and Budget
- Cooperating agencies: All other state departments as well as the local and federal agencies and public and private organizations) individuals concerned with response to impacts of drought.

7.1 Coordinating Procedures

The Office of Planning and Budget is responsible for monitoring the costs incurred by state agencies in responding to a disaster. In cases where these expenses cannot be absorbed within a department's existing appropriation or other outside sources, they will determine the best manner to acquire the necessary funds to reimburse the department for these extraordinary expenses.

7.2 Response Programs

The Office of Planning and Budget will work with the affected departments and the Governor in determining which source of additional funding would be most appropriate. Some of the possible options are:

- Transfer from other programs within the affected department
- Transfer from other departments
- Request to the legislature for supplemental funding
- Recommendation for special funding built into following year's appropriation
- Recommendation that the Governor call a special session of the legislature to obtain the required funding

The Office of Planning and budget may also take the lead in other response roles in the event of a severe drought. If state revenues decline drastically from the projections used to establish the state-spending limit, an-across-the-board budget cutting exercise may be necessary.

7.3 Typical Problems/Obstacles to Response

A very severe drought requiring an extensive state response could also result in a decline in state revenues, limiting the state's ability to respond.

Reimbursement to state departments for extraordinary expenses incurred in responding to a drought or other disaster are usually made after the fact, and a department has no guarantee that all its expenses will be reimbursed.

8. Drought Response - Energy

- Lead Agency: Energy Office

To be published when energy impacts (shortages, disruptions) are forecast and begin to occur.

9. Drought Response - Public Health

- Lead agency: Department of Environmental Quality

To be published when public health problems begin to occur.

ANNEX C

FEDERAL DROUGHT ASSISTANCE PROGRAMS

The following listing of federal programs and authorities that address drought-related needs are for reference purposes. Federal agencies administering the program should be consulted for currency, eligibility, and uses of a particular program.

1. U. S. Department of Agriculture

1.1 Rural Economic and Community Development (RECD)

1.1.1 Emergency Loans

The purpose of the program is to assist family farmers, ranchers, and aquaculture operators with loans to cover losses resulting from major natural disasters, including drought. These loans can be used for annual farm operating expenses and for other essential needs necessary to return the disaster victims' farming operations to financially sound bases so that they can return to private sources of credit as soon as possible. Assistance ranges between $500 and $500,000. Loan funds may be used to repair, restore, or replace damaged or destroyed farm property (real and chattel) and supplies, which were lost or damaged as a direct result of a natural disaster. Under certain conditions, funds may be used to refinance secured and unsecured debts made necessary by the disaster or finance adjustments in farming, ranching, or aquaculture operations in order to restore or maintain the operations on a sound financial basis equivalent to pre-disaster potential.

1.1.2 Soil and Water Loans - OMB10.416

This program is intended to facilitate improvement, protection, and proper use of farmland by providing adequate financing and supervisory assistance for soil conservation; water resource development, conservation, and use; forestation; drainage of farmland; the establishment and improvement of permanent pasture; the development of pollution abatement and control facilities on farms; and development of energy conservation measures and other related conservation measures. Loan funds may be used to: level land; carry out basic land treatment practices, including liming, fertilizing, and seeding; establish permanent pastures and farm forests; establish forestry practices; improve irrigation; develop water supplies for home use and livestock; develop energy conserving measures; purchase pumps, sprinkler irrigation systems and other irrigation equipment; acquire water rights; restore and repair ponds, tanks, ditches, and canals for irrigation; dig ditches and install tile to drain farmland; develop ponds and water control structures for fish production; and carry out pollution control and abatement on farms.

1.1.3 Water and Waste Disposal Systems for Rural Communities -OMB 10.418

This program provides basic human amenities, alleviates health hazards and promotes the orderly growth of rural areas by meeting the need for new and improved rural water and waste disposal facilities. In 1988, loans ranged between $4,000 and $6,818,200, with an average of $499,063. Grants ranged between $4,500 and $2,136,000, with an average of $363,899.

Funds may be used for installation, repair, improvement, or expansion of a rural water facility including distribution lines, well pumping facilities and associated costs, and the installation, repair, improvement or expansion of a rural waste disposal facility including the collection and treatment of sanitary, storm, and solid wastes.

Municipalities, counties, and other political subdivisions of a state, such as districts and

authorities, associations, cooperatives and not-for-profit corporations, and Indian tribes are eligible. Assistance is limited to communities of 10,000 people or less, with priority given to communities of less than 5,500. Applicants must: (1) be unable to finance the proposed project from their own resources or through commercial credit at reasonable rates and terms, and (2) have the legal authority necessary for constructing, operating, and maintaining the proposed facility or service and for obtaining, giving security for, and repaying the proposed loan.

Eligibility was expanded to communities of 15,000 or less for drought relief under the Disaster Assistance Act of 1989.

1.1.4 Watershed Loans - OMB 10.419

These loans are available to local organizations to develop and carry out plans to protect, develop and utilize land and water resources in small watersheds. Assistance ranges between $19,800 and $300,000, with an average of $133,276.

Loan funds may be used to help local sponsors provide the local share of the cost of watershed improvement for flood prevention, irrigation, drainage, water quality management, sedimentation control, fish and wildlife development, public water based recreation, and water storage and related costs. The total amount of WS loans in any one watershed cannot exceed $10,000,000.

Sponsoring local organizations, such as municipal corporations, soil and water conservation districts, or other not-for-profit organizations in approved watershed areas are eligible for assistance. Applicants must have authority under state law to obtain, give security for, and raise revenues to repay the loan and to operate and maintain facilities financed with the loan.

1.1.5 Resource Conservation and Development Loans - OMB 10.414

This program is designed to provide loan assistance to local sponsoring agencies in authorized areas where acceleration of resource conservation, development, and utilization programs will increase economic opportunities for local people. Assistance ranges between $12,840 and $500,000, with an average of $97,981. Loan funds may be used for: (1) rural community public outdoor-oriented water based recreational facilities; (2) soil and water development, conservation, control and use facilities, (3) shift-in-land use facilities; (4) community water storage facilities; and (5) special purpose equipment to carry out the above activities.

City, county and state agencies, and local non-profit corporations are eligible. Resource Conservation and Development (RC&D) areas are eligible provided they are: (1) financially sound; (2) sponsor the RC&D measure for which the loan is requested and included in the RC&D project plan; and (3) have authority to borrow funds, repay the loan, and pledge security for the loan and to operate the facilities or services provided.

1.1.6 Other RECD Loan Programs

A variety of other loan programs are available from RECD which provide loans to groups, including governmental bodies, to develop water systems, which could contribute to alleviating water shortages in rural areas. Information on specific requirements and eligibility for each of the following programs is available from county RECD offices.

- Farm Ownership Loans - Assistance for buying, improving or enlarging farms, including the improvement of on-farm water supplies. As of February 1990, the applicable interest rate was 8.755. Interest rates are subject to periodic revisions.
- Farm Labor Housing Loans and Grants - Assistance for the development of low-rent housing for domestic farm laborers including the development of water, sewage disposal, heating, and lighting systems. As of February 1990, the applicable interest ranged between 1% and 0.2%. Interest rates are subject to periodic revision.
- Home Improvement and Repair - Assistance for general home improvement, including the development of sanitary water and waste disposal systems. As of February 1990, the applicable interest rate was 8.75%. Interest rates are subject to periodic revision.
- Rural Rental Housing Loans - Assistance for repair and development of streets and water and waste disposal systems. As of February 1990, the applicable interest rate was 8.75%. Interest rates are subject to periodic revision.
- Non-Farm Enterprise Loans - Assistance for development of water and waste disposal systems essential to the enterprise. As of February 1990, the applicable interest rate was _____%. Interest rates are subject to periodic revision.
- Commercial Facility Loans - Assistance for the development of utilities and other associated costs. For applicants at or below the poverty line, the applicable interest rate is 5%. For intermediate applicants, the interest rate is 6%. For all others, the interest rate is 7%. These are the current rates as of February 1990. Interest rates are subject to periodic revision.

1.2 Farm Services

1.2.1 Emergency Conservation Program - OMB 10.0154

This program enables farmers to perform emergency conservation measures to control wind erosion on farmlands, or to rehabilitate farmlands damaged by wind erosion, floods, hurricanes, or other natural disasters and to carry out emergency water conservation or water enhancing measures during periods of severe drought. Examples of the sorts of activities which can be performed under this program include: renting irrigation pipe, lining conveyance systems, installing tail water recovery systems, and developing water supplies for grazing livestock. Assistance ranges between $3 and $64,000. The average award is $1,780.

Emergency cost-sharing is limited to new conservation problems created by natural disasters which, if not treated, will impair or endanger the land, materially affect the productive capacity of the land, represent damage that is unusual in character and, except for wind erosion, is not the type of damage that would recur frequently in the same area. In addition, qualifying applications are for circumstances so costly to rehabilitate that federal assistance is necessary if the land is to be returned to agricultural use. Severe drought situations for water enhancing measures are to be determined by the deputy

administrator, State and County Operations, Farm Services.

Owners, landlords, tenants, or sharecroppers on a farm or ranch, including associated groups, who bear a part of an approved conservation practice in a disaster area, are eligible to apply for cost-share conservation activities. Applicants are advised to contact their local county Farm Services office after a natural disaster has occurred to determine eligibility and application deadlines.

1.2.2 Agricultural Conservation Program - OMB 10.063

The purpose of this program is to control erosion and sedimentation, encourage voluntary compliance with federal and state requirements to solve point and non-point source pollution, improve water quality, encourage energy conservation measures, and assure a continued supply of necessary food and fiber. The program is directed toward the solution of critical soil, water, energy, woodland, and pollution abatement problems on farms and ranches.

Conservation practices are to be used on agricultural land and must be performed in accordance with applicable specifications. Wildlife conservation practices must also conserve soil or water. Program participants are responsible for upkeep and maintenance of practices installed with cost-share assistance. The cost-share assistance does not apply if the primary purpose is to bring new land into production.

Owners, landlords, tenants, or sharecroppers, including associated groups, on a farm or ranch who bear the cost of an approved conservation practice are eligible for cost-share-assistance.

1.2.3 Water Bank Program - OMB 10.062

This program is designed to conserve surface waters; preserve and improve the nation's wetlands; increase migratory waterfowl habitat in nesting, breeding, and feeding areas in the United States; and secure national environmental benefits. Assistance ranges between $8 and $65 per acre, with an average of $16.00 per acre.

Ten-year agreements are made with landowners to help preserve important nesting, breeding, and feeding areas of migratory waterfowl. As part of the agreements, participants agree in return for annual payment not to drain, burn, fill, use for agricultural purposes, or otherwise destroy wetlands areas determined by the Secretary of Agriculture. The program is coordinated with the Department of Interior and uses technical and related services of state, federal, and private conservation agencies.

Landowners and operators of specified types of wetlands in designated important migratory waterfowl nesting, breeding, and feeding areas are eligible.

1.2.4 Emergency Feed Assistance Program

This program makes CCC-owned feed grains available for sale at reduced prices to eligible livestock producers in counties designated by the Secretary of Agriculture as

disaster areas due to drought. This program is administered under Section 407 of the Agricultural Act of 1940.

1.2.5 Emergency Feed Program

This program provides cost-sharing for livestock producers who must purchase feed in excess of normal purchases due to production losses incurred by natural disasters. Eligible producers may receive assistance for purchasing the type feed, including hay, best suited for the livestock operation, in amounts not to exceed the smaller of feed needs or feed loss. The program can be implemented by the Deputy Administrator, State and County Operations, upon request by a county committee for and concurrence of the state committee.

1.2.6 Acreage Conservation Reserve

Cropland acreages are reduced under production adjustment programs and placed in an acreage conservation reserve (ACR) for an entire growing season. Haying and grazing of eligible cover crops is permitted in drought emergencies. Authority to implement haying and grazing of ACR designated under the Agriculture and Food Act of 1981 is vested in the ASCS Deputy Administrator, State and County Operations, but may be delegated to state committees of ASCS.

1.3 Natural Resources Conservation Service

1.3.1 Watershed Protection and Flood Prevention (Small Watershed Program)

The purpose of this program is to provide technical and financial assistance in planning and carrying out works of improvement to protect, develop, and utilize the land and water resources in small watersheds. Project purposes include watershed protection, flood prevention, agricultural water management, recreation, municipal and industrial water supply, and fish and wildlife Development. In addition, during times of emergency or drought, emergency authority is granted to haul water for livestock in communities with demonstrated need. Assistance per state ranges from $20 to $6,100,000, with an average of $1,700,000.

Assistance is provided in planning, designing, and installing watershed improvement works. Cost-sharing assistance is also available for watershed protection, flood prevention, irrigation, drainage, sedimentation control, fish and wildlife, and public water-based recreation. Long-term credit is available to help local interests with their share of the costs. Watershed area must not exceed 250,000 acres and the capacity of a single structure is limited to 25,000 acre-feet of total capacity and 12,500 acre-feet of floodwater detention capacity.

Eligible are any state agency, county or group of counties, municipality, town or township, soil and water conservation district, flood prevention or flood control district, Indian tribe or tribal organization, or any other nonprofit agency with authority under state law to implement, maintain, and operate watershed works of improvement.

1.3.2 Soil and Water Conservation - OMB 10.092

This program is designed to plan and implement a national soil and water conservation program, and to provide leadership in conservation, development, and productive use of soil, water, and related resources. An ancillary part of this program, the Soil Survey, provides published soil interpretations for widespread use by agencies, organizations, and individuals.

Technical assistance to the general public includes planning and applying soil and water conservation practices and treatment, and furnishing technical soil and water conservation resource information to state and local governments.

1.3.3 Resource Conservation and Development - OMB 10.901

This program is intended to encourage and improve the capability of state and local units of government and local nonprofit organizations in rural areas to plan, develop, and carry out programs for resource conservation and development. Assistance ranges between $l0,000 and $500,000, with an average of $40,000.

Technical and financial assistance is available only for Resource Conservation and Development (RC&D) areas authorized for assistance. Assistance is available for the planning and installation of approved measures specified in RC&D area plans, to conserve and improve the use of land, develop natural resources, and improve and enhance the social, economic, and environmental conditions in rural areas. Grant funds are available only for the federal cost share part of construction contracts.

1.3.4 Snow Survey and Water Supply Forecasting - OMB 10.907

This program provides information on forthcoming seasonal water supplies from streams that derive most of their runoff from snowmelt. Water supply forecasts are available to farm operators, rural communities and municipalities for water resource management purposes and hydro meteorological data is available for reservoir regulation and streamflow management purposes. The data collected through the snow survey system is shared with the Joint Agriculture Weather Facility of the World Agricultural Outlook Board. During drought, this data is used to advise the Secretary of Agriculture on which counties should be declared disasters.

The information is used by the owners and operators of the 32,000,000 irrigated acres in the mountain states and the far west. The data is also used in the regulation of hundreds of small and large reservoirs for irrigation, flood control, power generation, recreation, industry, and municipal supplies. Cooperators include other federal agencies, state agencies, municipalities, other irrigation districts and water associations, and private utilities.

Information is available to the general public.

2. U. S. Department of Interior

2.1 Bureau of Reclamation

2.1.1 Irrigation Systems Rehabilitation and Betterment (R&B Program) - OMBl5.502

The purpose of this program is to rehabilitate and improve small irrigation facilities on projects governed by reclamation law or constructed under the authority of the Small Reclamation Projects Act of 1956. Assistance ranges from $9,000 to $64,833,000, with an average of $2,279,500.

Funds may be used for rehabilitation of existing irrigation systems, including those constructed under the Distribution System Loans Act of July 4, 1995 (P.L. 840130,69 Stat. 244) on reclamation projects only in the 17 western most contiguous states and on project facilities constructed under the Small Reclamation Projects Act in the 17 western states and Hawaii. Funds cannot be used to initiate new construction. Funds for rehabilitation and betterment work are interest-free, except for certain interest-bearing project functions constructed under the Small Reclamation Projects Act. All funds are repaid by the contracting entity in annual installments pursuant to the water users ability to pay as determined by the Secretary of the Interior, taking into account the outstanding obligations of the organization.

Any water users organization whose facilities were constructed by the BOR or with a Distribution System Loans Act loan, and to which the U.S. holds title, is eligible. In addition, any water users organization on non-federal projects constructed under the authority of the Small Reclamation Projects act of 1956 is eligible as well.

2.1.2 Small Reclamation Projects (Small Project Loans) - OMB 15.503

This program provides federal loans and some grants to public non-federal organizations for the rehabilitation and improvement or construction of water resource development projects. Assistance ranges between $1,906,000 and $26,700,000, with an average of $13,775,000. Loans and/or grants for calendar year 1989 were available for up to $29,600,000 for individual projects whose total cost did not exceed $44,500,000. Projects can be single-purpose irrigation or drainage, or multipurpose, including municipal and industrial water supplies, flood control, fish and wildlife, recreation development, and hydroelectric power. Construction grants can be made for a portion of the costs allocated to flood control, fish and wildlife enhancement, and recreation development, if such development is of general public benefit. Loan application report, water rights, and rights-of-way costs must be contributed by applicant.

Cities, counties, irrigation or water districts, or other entities organized under state law and eligible to contract with the federal government, and who can demonstrate engineering and financial feasibility, are eligible. Private individuals are not eligible.

2.1.3 Distribution System Loans OMB 15.501

This program provides reimbursable federal loans to organized irrigation districts with land included within congressionally authorized reclamation projects to plan, design, and construct irrigation and municipal and industrial water distribution or drainage systems in

lieu of federal construction.

The program is only for construction of irrigation, drainage, and associated municipal and industrial water supply systems. Projects must have been previously authorized for construction under reclamation law and located in the 17 western most contiguous states. Loan amounts are not limited, unless specified in the authorizing act. All project-required rights-of-way and other item costs up to 10 percent must be contributed. Costs allocated to irrigation and irrigation drainage are interest-free. Costs allocated to municipal and industrial water supply are interest bearing.

Irrigation districts organized under state law, eligible to contract with the United States and possessing a water supply contract with the BOR, are eligible.

2.2 Geological Survey

2.2.1 National Water Research Program - OMB 15.806

The purpose of this program is to support needed research into any aspect of water resource related problems deemed to be in the national interest. At least 50 percent of the research cost must be met by the applicant. Assistance ranges between $4,000 and $200,000, with an average of $50,000.

Applications must be for scientific research projects, which are within the USGS area of responsibility. Conferences and symposia will be supported only if it is clear that equivalent results cannot be obtained at regular meetings of professional societies. Cost sharing is encouraged.

Colleges, universities, profit-making and nonprofit organizations, and state and local governments, having named a principal investigator, are eligible.

3. Department of Defense, Department of Army

3.1 Office of the Chief of Engineers

3.1.1 Planning Assistance to States

This program provides for cooperation with states in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources of drainage basins located within the boundaries of that state.

The state must have a planning program for the development, utilization, or conservation of the water and related land resources underway or laid out in sufficient detail. All U.S. Corps of Engineers input must be an integral part of the state program. The input from the Corps is to be on an effort or service-sharing basis in lieu of an outright grant basis. The program is limited to $6,000,000 annually, and not more than $300,000 shall be expended in any one year in one state.

3.1.2 Emergency Advance Measures for Flood Prevention - OMB 12.111

In addition to allowing the Army Corps of Engineers to perform activities to protect life and property prior to or during flooding, this program allows the Corps to construct wells and transport water to farmers, ranchers, and political subdivisions in drought-distressed areas. The water is provided for human and livestock consumption only. The cost of well drilling under this program is paid by the applicant. Federal drilling equipment must be used. The transportation of water by vehicle, small diameter pipeline, or other means will be at 100% federal cost. The applicant, however, is responsible for the purchase, loading, unloading, and storage costs.

Authorized assistance for mitigating drought conditions includes transporting water and well drilling. This is a program of last resort and all other options must be exhausted before it will be implemented.

COE assistance for emergency water supplies will be provided only when: (1) the applicant lives in an area determined to be "drought-stricken" and a request is made by the governor of the state for assistance; (2) a clearly definable need will exist in the foreseeable future despite state and local actions for reasons other than lack of financial resources; (3) drought conditions are causing or are likely to cause a substantial threat to public health and welfare in the area; (4) all other local, state, and federal resources and options for securing necessary water supplies have been exhausted, including assistance and support from federal agencies such as FmHA, SBA, ASCS, and EDA; and (5) a long-term solution to the problem is being put in place so that the problem will not be recurring.

3.1.3 Emergency Water Supplies

The Secretary of the Army, acting through the Chief of Engineers, has the authority to drill wells or transport water for farmers, ranchers, and political subdivisions in an area determined by the Secretary of the Army to be drought-distressed. The water is provided for human or livestock consumption only. Both types of assistance are only provided after it is determined that the applicant cannot obtain the water (for reasons other than lack of financial resources) from the private sector within a reasonable time. The cost of well drilling will be paid by the applicant. If the applicant cannot obtain financing from commercial or other sources, the applicant may pay the reasonable cost over a number of years, not to exceed 30, and at an interest rate, which would apply pursuant to Section 7(b) (2) of the Small Business Act (PL 85-536). Reasonable cost is the lesser of the cost to the Corps of Engineers to construct the well or the cost of a private business to construct the well. The transportation of water by vehicle, small-diameter pipeline, or other means will be at 100 percent federal cost. The purchase, loading, unloading, and storage of the water will be at the applicant's expense. The Corps of Engineers has also developed policy and guidance for the preparation of drought contingency plans as an integral part of the overall water-control management system for Corps operated and maintained projects. Technical expertise and guidance on specific water and related land-resource problems may be available from the nearest district engineer.

4. Federal Emergency Management Agency (FEMA)

4.1 State and Local Programs and Support

4.1.1 Disaster Assistance - OMB 83.516

The purpose of this program is to provide supplemental assistance to states, local governments, certain private nonprofit organizations, and individuals in alleviating suffering and hardship resulting from presidential declared emergencies or disasters, including drought. There has never been a presidential disaster declaration for drought and it is not envisioned that there will ever be one. It is felt that Congress has sufficiently expanded the programs of other federal agencies, primarily those of the USDA. However, should a drought be severe enough to warrant presidential declaration, the following program would apply. Public assistance in the form of cost-sharing grants is available following a presidential declaration of emergency or disaster. Without a presidential declaration, grants may be made to states for the suppression of forest and grassland fires, which threaten to become major disasters. Individual housing, counseling, and legal and financial assistance are also available to families adversely impacted by declared disasters.

State and local governments, federally recognized Indian tribal governments, U.S. territories and possessions, and certain private nonprofit organizations in designated emergency or disaster areas are eligible for public assistance. Only states are eligible for fire suppression grants. Assistance is also available for individuals or families whose needs are not met by other programs.

5. Small Business Administration (58A)

5.1 Disaster Loan Assistance

Under the authorities of SBA, the administrator may declare an area available for SBA disaster loan assistance. While "drought" is not included in SBA's definition of a disaster, there are three circumstances in which the agency will provide loan assistance for drought related situations to eligible applicants:

- When the Secretary of Agriculture declares a natural disaster for farms; the SBA's Economic Injury Disaster Loan (EIDL) program is available to eligible applicants. Therefore, SBA will lend to agriculturally dependent businesses, but not to farmers. In addition, SBA loans are available to those suffering economic losses as a result of the effect of droughts on farmers and ranchers, i.e., SBA will provide loan assistance to farm equipment dealers that do not have a market because farmers are unable to continue farming. Therefore, for example, the agency would not provide the assistance to hydro-businesses or producers of canoes.
- Nurseries are eligible to apply for EIDL's due to drought.
- Presidential declarations for individual assistance - The difference between a presidential and Secretary of Agriculture declaration is that in cases where the president has made a declaration, EIDL is available to all applicants. The restriction that the business must be directly affected by the drought on farms and ranches is

removed.

6. American Red Cross (ARC)

6.1 Disaster Services Water Shortage

The disaster services of the Red Cross during a drought or water shortage will be in support of, and in cooperation with, general community based response efforts initiated to reduce suffering or meet basic human needs. Depending on a community's need, Red Cross activities may include:

- Providing technical consultation and guidance to local and state government agencies or officials when planning for the distribution of water from central sites to community residents,
- Establishing and staffing first-aid stations at community sites designated for the distribution of water to residents,
- Coordinating voluntary agency activities designed to support local community response efforts,
- Providing voluntary personnel to assist local government response actions.

The Red Cross does not provide assistance to commercial, industrial, or agricultural corporations with drought or water-shortage caused losses.

ANNEX D

STATE DROUGHT RELATED ASSISTANCE PROGRAMS

The Governor has authority to declare an emergency, effective for 30 days. Any extension must be approved by the Legislature. The Governor's emergency powers include the purchase or lease of necessary materials. Food and other items are specifically mentioned, including lands, but not water. However, water rights are similar to the property interest in land, and arguably the Governor could expropriate and reallocate water. Appropriate compensation would be required and determined under eminent domain statutes.

The state now has a revolving "emergency fund" of $250,000 which can be used to respond to any type of emergency provided the Governor issues a "State of Emergency" proclamation.

1. Department of Public Safety

1.1 Division of Emergency Services and Homeland Security (DES).

1.1.1 Utah Emergency Act of 1981

This act authorized DES to coordinate disaster mitigation, preparedness, response, and recovery covering "natural phenomenon," which specifically includes drought. Drought response therefore falls under the general State Emergency Response Plan. Within policies established by the Governor and the Legislature, the division is to prepare, implement, and maintain programs and plans for: (1) disaster prevention and mitigation; (2) prompt and effective response and recovery; (3) identification of particularly vulnerable areas; (4) coordinating preventive and preparedness measures; (5) coordinating federal, state, and local emergency activities; and (6) all necessary, incidental, and appropriate measures.

2. Department of Natural Resources

2.1 Division of Water Resources

The state of Utah, through the Board of Water Resources, operates three revolving construction fund programs for the purpose of providing technical and financial assistance in the development of the state's water resources. Over the years these programs have been used not only for water development purposes but to provide assistance during times of drought and flooding. These self-help programs require the sponsor of the project to repay the financial assistance provided by the state at 0% or low-interest rates. In addition, the sponsor is usually required to provide 25 percent of the estimated construction cost in cash or in-kind service.

2.1.1 Revolving Construction Fund (RCF)

The Revolving Construction Fund was established in 1947 to provide technical and financial assistance to nonprofit irrigation companies and water companies. Board funding is provided at 0% interest, which has been used to construct many small conservation projects. During the 1977 drought, funding was provided through this program to assist irrigation companies and individuals experiencing water shortages. This program provides the best opportunity for the state to provide assistance to irrigation companies experiencing problems during the drought.

2.1.2 Cities Water Loan Fund (CWLF)

The Cities Water Loan Fund is used to provide funding to political subdivisions of the state for upgrading and/or replacing their municipal water systems. Under this program, the board purchases general obligation or water revenue bonds from the municipality as security for the financial assistance being provided. The sponsors of these projects are also expected to repay the financing provided by the state. During the 1977 drought, several communities received funding through this program to help drill wells.

2.1.3 Conservation and Development Fund (C&D)

The Conservation and Development Fund was created in 1978 to help finance large water development projects beyond the funding limits of the RCF & CWLF. The Board of Water Resources either purchases a bond or enters into a purchase sales agreement with the sponsoring entity.

2.2 Division of Water Rights

With respect to water rights administration, permanent water rights transfers in Utah involve the usual notice and hearing requirements. After the filing of an application for permanent change in the point of diversion, or place or nature of use, the law requires advertising the change once a week for two consecutive weeks, followed by a 20-day protest period. If there is a protest, generally a hearing will be held. During the 1977 drought, every effort was made to keep the time required to process change applications as short as possible. Also of note, the State Engineer has authority to permit drilling of a water well after an application has been filed, but before final approval. However, the applicant assumes any risk of the change being rejected. The State Engineer may also approve temporary transfers or appropriations for a period not to exceed one year. While public notice may be required, the processing time is shorter. These provisions are not restricted to use during drought, and are contingent on the usual findings regarding water availability, non-interference with senior rights, engineering feasibility, financial ability, non-speculation, and the public interest in recreation and the natural stream environment.

While Utah law follows the prior appropriation doctrine of “first in time, first in right,” it also provides: “In times of scarcity, while priority of appropriation shall give the better right as between those using water for the same purpose, use for domestic purposes, without unnecessary waste, shall have preference over use for all other purposes, and use for agricultural purposes shall have preference over use for any other purpose except domestic use.” Thus, under drought conditions, special attention and consideration would be given community and domestic water systems.

3. Department of Community and Economic Development

3.1 Division of Community Development

3.1.1 Community Impact Fund Board Program

Though this program is not a drought response program, projects can be funded which have the effect of mitigating the impacts of a water shortage or drought. In areas impacted by natural resources Development, the Community Impact Board (CIB) makes loans and grants for a wide variety of projects deemed to be in the public interest. Included are drainage projects, drinking water and wastewater projects and secondary irrigation systems.

4. Utah Soil Conservation Commission Programs

4.1 Utah Agriculture Resource Development Loan (ARDL) Program

In 1976, the Utah Legislature provided $250,000 to create the Rangeland Development Fund. Over the next several years, this fund provided low-interest loans to applicants for range improvements.

In 1983, this fund was expanded to include cropland conservation measures. Funding was initialed at $42.48 million. There is now over $15 million in the revolving account. This fund is under direction of the SCC, and staff support is provided by the Utah Department of Agriculture. The Natural Resources Conservation Service provides technical assistance for the implementation of conservation measures under direction of the local soil conservation districts (SCDs).

The loans are available to all farmers and ranchers for use on private and state lands. Loans are made at 3% interest and carry a one-time 4% administrative fee. The maximum life of a loan is 12 years. Conservation practices must be maintained.

4.2 Priority Watershed Program

The ARDL Program includes the Watershed Subprogram, established to meet special conservation needs in priority areas. Priority watershed projects are intended to develop a coordinated interagency approach to problem area improvement. Watershed funds set aside by the SCC are used exclusively in designated areas. To meet technical assistance needs, watershed grant funds may be used.

The priority watersheds are identified jointly by the Utah Department of Environmental Quality, and Utah Department of Agriculture, the U.S. Natural Resources Conservation Service, and other interested local, state, and federal agencies. These priority watersheds are ranked by the SCC based on resource problems and local desire to reduce water pollution, soil erosion, and floodwater damage.

5. Department of Environmental Quality

5.1 Safe Drinking Water Board Financial Assistance Program

The Drinking Water Board's financial assistance program was created by the Legislature in 1983 with $10 million. Another $2.5 million was appropriated by the Legislature for a security account, which could only be used for credit enhancement purposes. Since then, approximately $9.9 million has been loaned to 18 applicants. The loans were used for drinking water facilities such as water storage tanks, pipelines, and wells. The repayments on these loans, along with interest, were to be deposited into the security account.

Amendments to the act in 1985 let the security account funds be used for direct project loans with variable interest rates, credit enhancement, or interest buy-down. Thus, a revolving loan system was established. Principal and interest repayments from previous loans are revolving into the security account. It is estimated that for each of the next 10 years, approximately $900,000 will enter the security account from this source.

5.1.2 Water Quality Board Wastewater Treatment

Facilities Financial Assistance Program, the Water Pollution Quality board and its staff, the Division of Water Quality, encourages communities to plan and finance all needed wastewater facilities. But for some communities, it may not be possible for residents alone to afford the full cost. For this reason, two assistance programs are administered by the Water Quality Board.

5.1.2.1 The State Wastewater Project Financial Assistance Program

In 1983, the Utah Legislature created a wastewater loan program and appropriated $20 million for the Water Pollution Control Committee to construct needed wastewater projects. In addition, $5 million was made available for credit enhancement agreements. Credit enhancement agreements are generally zero interest loans for the purchase of municipal bond insurance. The insurance improved ratings and financing on locally issued bonds. There is a large need for adequate wastewater systems, which will continue into the future due to growing populations and the natural deterioration of existing systems.

5~~.1~~.2.2 The present Federal Wastewater Treatment Construction Grants program has been in existence since 1972 when the Water Pollution Control Act was passed by Congress. The program is currently administered by the Division of Water Quality through a program delegation agreement with the U.S. Environmental Protection Agency (EPA).

Since 1972, the grants program has been used by 23 separate communities with raw sewage discharges or widespread failing individual wastewater disposal systems. During the same period, 76 other communities received grants for various stages of projects, which range from planning and design to major upgrading of existing plants or

replacement of inadequate facilities. This successful record has been accomplished with $186 million in federal funds, which stimulated a total of $248 million in wastewater facilities construction.

6. Disaster Relief Board

6.1 Utah Disaster Relief Board (DRB)

The Utah Disaster Relief Board (DRI) was created by the Legislature in 1983 to help local governments repair flood damage. DRB funds help applicants repair, restore, reconstruct, or replace public facilities damaged or destroyed by flooding or mudslides. Included may be the following county or municipal facilities: flood control public power, sewage treatment and collection, waterways, water supply and distribution, and watershed development. Some highway facilities and public buildings are also eligible.

The Permanent Community Impact Board (see Section 8.6) acts as the Disaster Relief Board. Personnel in the Division of Community Development act as staff for the board.

All financial assistance provided by the DRB is in the form of grants. Obviously, this funding is only appropriate for emergency repair situations and is only available when mandated by the Legislature and Governor. Routine water resources development is not eligible.

ANNEX E

Extract From Emergency Operations Handbook

CHAPTER 14 - NATURAL DISASTER RESPONSIBILITIES OF STATE AND LOCAL FOOD AND AGRICULTURAL COUNCILS, EMERGENCY PERSONNEL

SECTION 1-OPERATING RELATIONSHIPS

14101 OPERATING RELATIONSHIPS

A Local FAC Chairpersons, Emergency Programs, and State FAC Vice Chairpersons, Emergency Programs, are responsible for:

1 Reporting:

a Natural disaster information in accordance with Exhibits 24 and 25.

b Conditions such as droughts or unusually heavy rains, which threaten to develop into natural disaster situations.

2 Coordinating: USDA natural disaster activities to assure efficiency and effectiveness, without becoming directly involved in natural disaster assistance operations of individual USDA agencies.

3 Maintaining liaison with:

a. Appropriate representatives of State and local governments.

b. Representatives of the Federal Emergency Management Agency (FEMA), when a natural disaster occurs in only one state. If a natural disaster such as a flood or hurricane occurs in two or more states, the USDA Emergency Programs Staff, Departmental Administration, will provide for liaison with FEMA.

B Agency representatives serving on the Local FACs and State FACs. Emergency Programs are responsible for informing their Chairpersons of progress made by their respective agencies in providing natural disaster assistance.

C USDA agencies are responsible for:

1 Natural disaster assistance programs outlined in the current USDA Program Aid 1328, Natural Disaster Assistance Available from the U.S. Department of Agriculture.

2 Conducting their respective natural disaster assistance programs.

14102 MEETING NATURAL DISASTER SITUATIONS

Both the Local FAC Chairperson, Emergency Programs, and State FAC Vice Chairperson, Emergency Programs, will take the following actions:

A Call a meeting of their respective FAC, Emergency Personnel, as soon as practicable, if a natural disaster SIGNIFICANTLY affects rural areas:

1 The Local FAC Chairperson. Emergency Programs. will invite the local governing body or its appropriate representative, Local Emergency Programs Director, and other appropriate officials. When possible, without endangering lives of FAC Emergency Personnel, a physical on-site inspection should be conducted.

B Consult with as many FAC, Emergency personnel, as feasible, either in person or by telephone, when a meeting is impracticable.

C In the meeting

1 Arrange as necessary, for obtaining damage assessment information for preparation of Exhibit 25, USDA Potential Natural Disaster Damage Assessment Report:

2 Coordinate FAC Emergency Program activities to:

a. Avoid duplication of efforts in obtaining needed information.

b. Assure common use of information obtained.

c. Avoid providing conflicting information to the public and others.

3 Request that Local and State FAC, Emergency Personnel, keep their respective Chairpersons informed of progress in carrying out the emergency programs of their respective agencies.

D. Maintain liaison with appropriate local, State or Federal representatives.

SECTION 2 - REPORTS

142Cl1 REPORTING NATURAL DISASTERS

A. Local FAC Chairperson. Emergency Programs. Submit the following reports in accordance with exhibit instructions:

1. USDA Flash Situation Report (Exhibit 24) - A report will be made as soon as possible, but within 24 hours of the occurrence of a natural disaster.

2. USDA Potential Natural Disaster Damage Assessment Report (Exhibit 25). - When requested by the State FAC Vice Chairperson, Emergency Programs.

3 Concurrence. Obtain and indicate concurrence of the assessment of damage from Local FAC Emergency Personnel involved in reviewing and editing the report.

4 Signatures. The Damage Assessment Report must be signed and dated by the Local FAC Chairperson, Emergency Programs.

B State FAC Vice Chairperson. Emergency Programs:

1 USDA Flash Situation Report (Exhibit 24). Edit report if required, and make prompt distribution in accordance with exhibit instructions.

2 USDA Potential Natural Disaster Damage Assessment Report (Exhibit 25). Request Damage Assessment Report from the Local FAC Chairperson, Emergency Programs, if requested by the Governor's office, Indian Tribal Council, the FEMA Regional Director, or the national headquarters.

a In requesting Damage Assessment Report from the Local FAC Chairperson. Emergency Programs. provide:

(1) Submission Time. Consult with FmHA, NASS, and other State FAC, Emergency Personnel, as appropriate, in addition to the FEMA representative, in determining when the Local FAC Chairperson, Emergency Programs, should send the Damage Assessment Report to the State FAC Vice Chairperson, Emergency Programs.

(2) Price Information on Crops and Livestock.. Consult with the NASS member of the State FAC, Emergency Personnel, to determine unit prices on livestock and average yield of crops when required. The value of farm facilities will be determined locally by the Local FAC, Emergency Personnel, in estimating dollar losses of these items.

(3) Aquaculture Information. consult with:

(a) FmHA representative on the State FAC Emergency Personnel, concerning aquaculture enterprises eligible for emergency loans, and advise Local FAC Chairperson, Emergency Programs, of eligibility.

(b) Appropriate State government specialists and Federal Government specialists to obtain information to assist the local FAC Emergency Personnel, in estimating unit and dollar losses to aquaculture operations.

b Review of Damage Assessment Report from the Local FAC Chairperson, Emergency Programs:

(1) Review and Editing. ASCS, CES, FmHA, NASS and SCS, along with other State FAC, Emergency Personnel, whose agency emergency programs would be impacted as a result of the natural disaster, will review and edit the Damage Assessment report.

(2) Concurrence. Obtain and indicate concurrence of the assessment of damage from State FAC Emergency Personnel involved in reviewing and editing the report.

(3) Signatures. The Damage Assessment Report must be signed and dated by the State FAC Vice Chairperson, Emergency Programs, and the Local FAC Chairperson, Emergency Programs.

(4) Distribution. In accordance with Exhibit 25 instructions.

SECTION 3-LIAISON

14301 STAFFING FEMA DISASTER ASSISTANCE CENTERS

If FEMA establishes disaster assistance centers in the disaster area, the State FAC Vice Chairperson, Emergency Programs, will confer with other State FAC Emergency Personnel and:

A qualified USDA personnel to represent USDA at each established disaster assistance center.

B selected personnel on all current USDA disaster assistance programs.

C FEMA representative that a USDA representative is available at each of the disaster assistance centers.

SECTION 4- SECRETARIAL DETERMINATIONS AND

ADMINISTRATOR, FmHA NOTIFICATIONS

14401 CRITERIA

When severe loss and damage has occurred as the result of a natural disaster(s) to the agricultural segment of an area (county), FmHA EM loans may be made available as follows:

A By the Secretary of Agriculture - when it is determined that farmers, ranchers, and/or aquaculture operators have suffered severe physical and/or production losses. as a result of the natural disaster.

B By the Administrator. FmHA - when it is determined that farmers, ranchers, and/or aquaculture operators have suffered severe physical losses only. as a result of the natural disaster.

14402 REQUESTS

A All Secretarial Determinations must be initiated by a written request to the Secretary of Agriculture from a State Governor or Indian Tribal Council within 3 months of the last day of the natural disaster.

B All Administrator. FmHA Notifications must be initiated by an FmHA County Supervisor and recommended by the FmHA State Director to the Administrator, FmHA, within 3 months of the last day of the natural disaster. This process is an FmHA in-house procedure and does not involve any action on the part of other government agencies or political subdivision officials. DARs are not to be submitted.

SECTIONS-PRESIDENTIAL DECLARATIONS

(By Executive Authority)

14501 CRITERIA

A request for a Presidential declaration must be initiated by a State Governor making a written request to the President. FEMA makes a survey of damage and loss, and determines which areas (counties) have been affected, and which Federal programs are to be made available, except that FmHA emergency (EM) loans will be made available to qualified applicants in areas declared by the President and named by FEMA.

A. Major disaster. Any disaster in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant unusual assistance above and beyond normal emergency services available from State and Federal Governments. Major disaster assistance makes several Federal disaster programs available automatically, and is intended to supplement the efforts and available resources

to states, Local governments and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused by disasters.

B. Presidential emergency. Any disaster in any part of the United States which is of such magnitude that the President makes a declaration requiring certain Federal emergency programs to be implemented as a supplement to State and local efforts as a means of saving lives and protecting property, preserving public health and safety, and/or lessening the threat of a more severe disaster.

EOH
USDA POTENTIAL NATURAL DISASTER DAMAGE ASSESSMENT REPORT

1 Local FAC Chairperson. Emergency Programs:

A When requested by the State FAC Vice Chairperson, Emergency Programs, the Local FAC Chairperson, Emergency Programs, will schedule a meeting of the Local FAC Emergency Personnel, and make arrangements to assess the extent of the damage and submit the report to the state FAC Vice Chairperson, Emergency Programs, on the USDA Potential Natural disaster Damage ASSESSMENT Report (DAR) form.

B Reproduce the DAR form locally, as needed.

C Use term "farm" or "farmers" to cover farms, ranches, farmers, ranchers, or aquaculture operations

D Report losses to aquaculture operations separately, completing applicable items of the form.

E Complete specific items on the DAR as follows:

1 Self-explanatory.

2 Self-explanatory.

3 Number of farmers doing business as an owner-operator or tenant-operator in the disaster year.

4 Actual date (i.e., August 12,1986), or dates (i.e., June 15 through August 20, 1986), on which natural disaster began and ended. These dates are necessary in establishing the disaster incident period.

5 Type of natural disaster. EXAMPLES:

a Blizzard, drought, excessive rain, excessive snow, flash flooding, flooding, freeze, frost, hail, high winds, hurricane, lightning or tornado.

b If a major ANIMAL or PLANT DISEASE results from a natural disaster, state in an attachment, how abnormal weather contributed to spread of disease to epidemic stages.

c If a major INSECT OUTBREAK results from a natural disaster, state in an attachment, how abnormal weather contributed to the spreading and flourishing of the insects.

6 Number of Local FAC Emergency Personnel concurring with the information set forth in the DAR. Number of Local FAC Emergency Personnel not concurring with the information set forth in the DAR.

7 List all crops, including hay and pasture normally planted/growing in the order of their importance to the county's agricultural economy, regardless of whether or not they were damaged by the natural disaster. This information will be provided by the NASS member of the State FAC Emergency Personnel.

8 List acres normally planted/growing for crops shown in item 7. This information will be provided by the NASS member of the State FAC Emergency Personnel, and will be the average of the five years immediately preceding the disaster year.

9 List total acres planted/growing in county in the disaster year for crops shown in item 7.

10 Show disaster year yields per acre, i.e., bushels, pounds, or tons, etc., per acre for the county in the disaster year. These yields will be estimated realistically when DARs are requested prior to the completion of harvest. Take into consideration any probable recovery of the crops. If a reasonable assessment cannot be made, the DAR should reflect such a decision by the Local FAC Emergency Personnel.

11 List acres normally planted that were not planted to any crop during the disaster year. Those acres not planted must be due to the natural disaster.

12 & 13 Self-explanatory.
NOTE:The DARs will not be reviewed by the Secretary of Agriculture unless they are properly signed and dated and copies of the respective minutes are attached.

14 Self-explanatory.

15 Self-explanatory.

16 Use the average monthly market price for each type of livestock for the 36-month period preceding the calendar year in which the natural disaster occurred. This information will be provided by the NASS member of the State FAC Emergency Personnel.

17 Use the value of farm facilities, i.e., farm dwellings, including mobile homes, and service buildings, farm structures, farm machinery and equipment, and land damages, as determined by the Local FAC, Emergency Personnel, in estimating dollar losses. NOTE: Include damage and losses to fences, timberland, drainage outlets' and irrigation systems, etc., under "other" and note in Item 18. "Remarks" to which it applies.

18 Self-explanatory List alternate crops that, as estimated by the Local FAC Emergency Personnel may be planted to replace crops destroyed by the natural disaster.

F Submit the completed DAR and minutes of the Local FAC, Emergency Personnel meeting to the State FAC Vice Chairperson, Emergency Programs, with copies to:

1 Appropriate local government representatives.

2 Local FAC Emergency Personnel.

3 State FAC Vice Chairperson. Emergency Programs.

A The State FAC Vice Chairperson, Emergency Programs, will upon receiving all of the DARs requested from the Local FAC Chairperson, Emergency Programs, schedule a meeting of the State FAC Emergency Personnel for the purpose of reviewing the DARs.

B Review each DAR in cooperation with other State FAC Emergency Personnel, and in Item 6 indicate number of State FAC Emergency Personnel concurring and NOT concurring with the information set forth on the DARs. If DARs are not acceptable, return to the Local FAC Chairperson, Emergency Programs, for necessary additions or revisions.

C The State FAC Vice Chairperson, Emergency Programs, must sign and date the DAR in Item 13. The DARs will not be reviewed by the Secretary of Agriculture unless they are properly signed and dated and copies of the respective minutes are attached.

D FAX each DAR and respective minutes from Local FAC Emergency Personnel meetings within two work days after completion of State FAC Emergency Personnel review, unless returned to the Local FAC Emergency Personnel for revision. FAX to the ASCS Area Director, ATTENTION: EOLPD, with copies to:

1 The governor's Emergency Coordinator and the Head of the State Department of Agriculture.

2 All State FAC Emergency Personnel.

3 FEMA Regional Director (upon request).

4 National Weather Service, NOAA State representative

5 FmHA State Director

The FmHA State Director will send to the Administrator, FmHA, a copy of each DAR and respective minutes of the State and Local FAC Emergency Personnel meetings.

NOTE: The new flash situation and DAR forms will be used for reporting all natural disasters beginning on or after October 1, 1986.

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Utah State of the State
Drought Assessment and Mitigation Report

Abstract

Utah is an arid place. Drought it is a climatic factor that, depending on its duration, can cause extreme economic, social, and environmental impacts, but it is not the norm in Utah. Drought is generally impossible to predict and hard to detect until the signs of its presence are impossible to miss. Utah has been gripped by a drought, for at least five years, that by some standards is potentially even more devastating than the drought of the fifties or even the "dust bowl." All parts of the state have been hit, including the public lands that make up a significant part of the state. All uses that occur on public land have been impacted by this drought cycle. Impacts include severe plant mortality on some sites, record low flows in rivers, streams, and springs, and mortality and poor reproduction in some big game species. There is an increased fire danger and potential for catastrophic fires that could threaten homes and habitat, and the possibility for increased invasion by opportunistic weedy species, annual grasses, and insects. Because environmental impacts have crossed all jurisdictional and ownership boundaries there are significant collateral impacts from actions on any of these lands on surrounding lands, direct impacts to rural economies, and increases in social issues like out-migration from failed farms into urban areas.

But the impacts of future drought can be at least partially mitigated by cooperative partnerships between public land management agencies, state agencies, tribes, public land users, and the Governors office. This can be accomplished by forming multi-agency and multi-disciplinary teams to identify and implement early detection and early intervention strategies. These instruments use Land Use Plans as a base to launch mitigations early in a drought cycle and lay out a systematic approach for insuring that the critical recovery phase is factored into land use decisions. In addition they can identify "survival tools and education" opportunities that help private landowners and public land users plan for changes in use during drought cycles.

Drought is a normal but unpredictable part of the climate in Utah. Drought impacts have been exacerbated by changes in populations, demographics, and shifts in public land use paradigms. But these changes have also opened the window of opportunity for the development and deployment of new tools that will help multi-agency; multi-disciplinary mitigation teams detect drought earlier and start the mitigation process early in the cycle.

The purpose of this report is to compile a multi-agency overview of drought related impacts and issues primarily on public lands in Utah. It is not all-inclusive and only represents a snapshot in time of fall 2002. The State of the State Report is the cornerstone for future multi-agency cooperation, coordination, and statewide planning for the early detection, early intervention, and the mitigation of drought related impacts.

Key Words: Drought, Climate, Social Impacts, Economic Impacts, Environmental Impacts, Cooperative Partnerships, Multi-agency. Multi-disciplinary Teams, Mitigation, Monitoring, Planning for Drought, Land Use Planning, Early Detection Strategy, Early Intervention Strategy, Recovery, Science, Science of Recovery.

The First Drought of the New Millennium

One of the driest Januarys (2003) on record has ushered in the fifth year of an extended drought in Utah that has not only had impacts across the state but one that has also been pervasive across the west. This dry cycle has straddled the transition from the twentieth to the twenty-first century. This is the first drought of the new millennium. Several drought cycles were recorded in the previous century, the most notable being the drought in the fifties that, in Utah, was probably more devastating than the Dust Bowl in the thirties. Scientific and anecdotal evidence suggests that these cycles were responsible for significant environmental, economic, and even social impacts.

Each community in Utah has its own set of stories and histories about these impacts. Without a doubt these cycles caused farms and businesses to fail. There was some out-migration from hard hit rural communities into the urban areas along the Wasatch front. There are stories of severe environmental impacts as well: excessive erosion, historically dependable water sources failed, grass became dormant or suffered high mortality, and the condition of public, private, and state resources declined dramatically.

The first drought of the new millennium has had the same environmental impacts, but by some reports the social and economic impacts have been exacerbated by a dramatic increase in population (since the fifties), changes in demographics, and changes in uses and user paradigms on public lands.

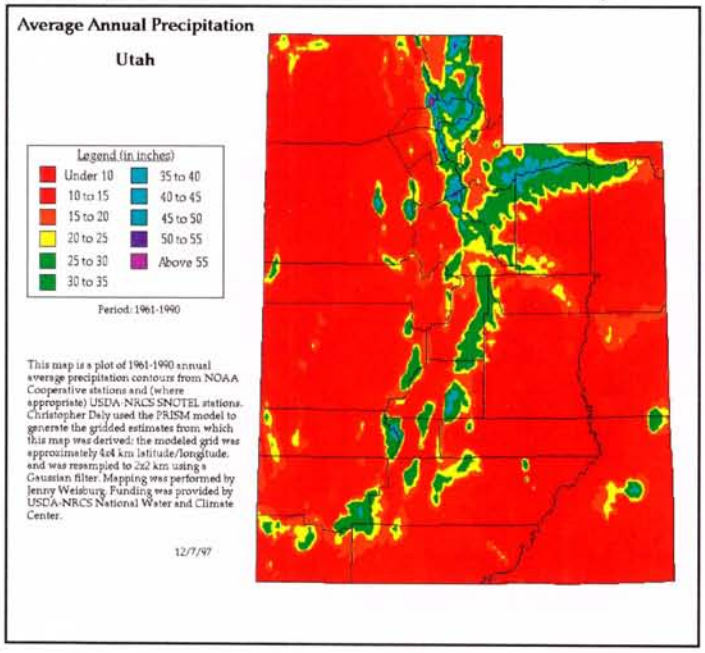
The Governor appointed a drought task force early in 2002 primarily to look at the impacts of drought on critical water storage and uses. State and federal agencies likewise appointed a drought task force in 2002 to look at economic, social, and environmental impacts on state, private, and federal land statewide. Both measure impacts and identify mitigation strategies. Both use this drought to plan for better survival during the next cycle.

Utah is an Arid Place

Drought is not the normal climatic condition in Utah but it is a normally reoccurring part of the climatic cycle. Two of the four true deserts found in the United States--the Great Basin desert which covers almost half of the state and the Mojave which extends into Utah around St George—are located on the west side of the Wasatch Divide. Almost the entire eastern half of the State, except the High Uintas, is within the colorful Colorado Plateau bio-geographic region. While this vast area has desert sites within its boundary, it is not a true desert, but it is arid.

While not all of the state is desert, all of Utah is arid, very arid. Annual precipitation varies across the state from Alta where 400" of snow (56.19" precipitation) is not uncommon and in the southeast at Hite Marina where snow seldom falls (5.31" precipitation). The average across the state is 11.83 inches per year.[i] In comparison to the Northwest this precipitation total is meager—for example it is less than one third of the total precipitation in Washington State. Utah is not the driest state in the country but it is ranked second behind Nevada that receives 9.46 inches per year.

With some planning and a history of diligence and creativity, the citizens of Utah have adapted to living in an arid environment. The state successfully maintains a large agricultural industry, growing urban centers, a vast and diverse recreational industry, and a high quality of life.



Utah's population continues to grow rapidly. Much of this growth has occurred since the last major drought in the 50's. In recent decades newer uses of water have been introduced such as considerations for populations of endangered species, the expectations of water sport recreationalist, changes in rural/urban demographics, in-migration of new families, and subsequent urban growth.

Utah agricultural water use has slightly declined over the last twenty years, but public supply and total water use in Utah has increased.[ii] The source for most of this water is found in the uplands managed by the State, the Bureau of Land Management, and the U.S. Forest Service. This water, in the form of winter snow and rain storms fills reservoirs—the storage source of precious culinary and agricultural water—and provides millions of recreation hours per year for boaters, rafters, and fishermen.

But public lands provide more than water for creeks and reservoirs. Utah public lands also provide timber, woodland products, habitat for wildlife, wild horses and burros, forage for livestock, thousands of miles of foot and OHV trails, oil and gas, and minerals, millions of acres of wilderness and proposed wilderness, and some of the most vast and colorful landscapes in the world. Most of these lands receive less than 15 inches

of annual precipitation and all of them regardless of altitude are susceptible to drought: seasonal, site specific, widespread, or like this cycle, pervasive across the State.

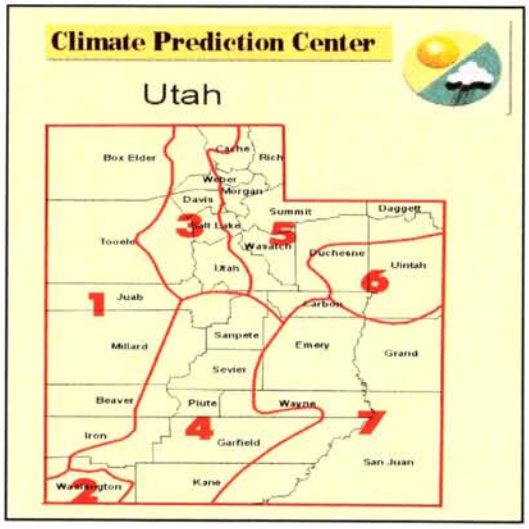
Drought is not the norm in Utah nor is it a stranger to our arid climate. It sneaks up on us and causes serious social, economic, and environmental impacts. But with teamwork and prior planning we can mitigate most of the issues related to drought.

History of Drought Cycles in Utah

Drought cycles come and go in Utah. Some cycles last one season, (i.e.. a monsoon season with low precipitation) some, like the current one, last for several years. Drought is situational, can be seasonal or site specific, and affects different parts of the society, environment, and economy differently depending on its duration and location.

While climatologists may disagree about the duration of this drought cycle and about when it might end, most agree that Utah has not experienced a drought as intense since the drought in the fifties. Our state was impacted by the "Dust Bowl" drought in the thirties but did not experience it as pervasively as the mid-west where giant dust storms rode high, hot winds across the Great Plains, forcing thousands of people to relocate. Many of our senior citizens not only have memories of caravans of destitute farmers crossing the state, but also share vivid personal stories

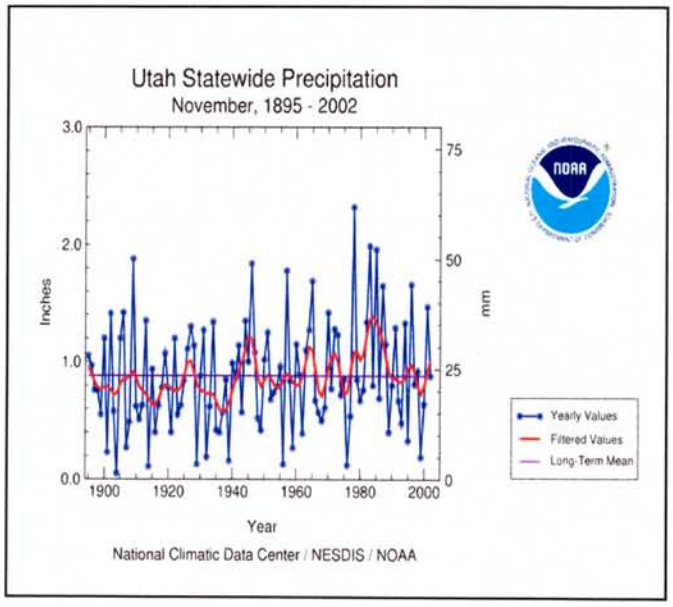
A considerable quantity of weather data is available for the state such as precipitation records from as early as 1895. State climatologists collect data in the seven climatic Divisions identified in the Palmer Drought Severity Index. (Figure at left) Those data (Appendix B) suggest that the only predictable part of the climate cycle is that drought is generally site and season specific. For example in 1950 a drought started in all of Utah except Division 3. While precipitation in the rest of the state was well below normal for a couple of years, in Division 3 it was slightly above normal until about mid-summer of 1952. The drought broke in the winter of 1951/52 but the record shows that the state and particularly Division 3 probably did not get normal late summer showers. Drought came back to Utah in 1953. In Division 1 the drought lasted until mid-summer of 1956 but the drought was generally pervasive across the state, until 1962, with some Divisions reporting short periods of above normal moisture scattered throughout the drought cycle. (Appendix B)



There are very few climotologists who will risk vocalizing that they can predict the frequency or intensity of drought cycles, or for that matter, any climatic pattern. While some climatogists claim progress has been made in computer-assisted predictions, most choose to limit their prognostications to the immediate short term.

In Utah, there is considerable debate about the frequency of drought. David Grider, USFS[iii], reported in a presentation that eastern Utah experiences drought about 71% of the time and western Utah about 51%. Mark Eubank[iv], in an interview about drought said: "Utah actually experiences a little more above normal precipitation than drought: about 2.1 wet years per 10 years and 1.7 below normal years per 10 years."

Regardless of the debate about frequency, predictability, or duration, drought is a frequent visitor to Utah. (Utah Statewide Precipitation graph below) Sometimes it stays for one season, sometimes it hits only one season for several years in a row, and sometimes, like this cycle, drought stays and impacts the entire state for several years. Each drought cycle brings with it impacts that can be measured immediately and others that are felt for years.



Each drought cycle in Utah's history has impacted a portion of the economy, had short and long-term environmental impacts, and has had impacts on our social relationships. These are predictable and within certain parameters can be mitigated to lessen impacts from future drought cycles.

The return to "normal" precipitation is a communal sigh of relief. Storage levels in reservoirs, especially those that provide water to urban areas, visibly fill during the spring snow-melt and winter snows and spring rains bring a flush of green to a landscape that may have looked burned and absent of plant life. It is easy to rush judgment, to assume that one good winter has eased or even eliminated the impacts from the past drought. Drought is not only insidious in its inception but also in the manner that some impacts are hidden. For example, some soils, heavily depleted during an extended drought, may not have recovered even a small part of normal soil moisture for any number of reasons such as: soil crusting, elimination of ground litter, and a reduction in above surface vegetative biomass that all impact percolation of precipitation. This impacts plant recovery (vigor and biomass) and in the long-term impacts replenishment of aquifers. Impacts spread from this simple source until humans realize, through economic measurements, that the drought continues to impact society and the environment.

Studies[v] indicate that many plants that have survived the drought recover fairly rapidly. The studies also show that if recovery is measured in total biomass that some sites may take longer to recover. The recovery period is not the same for all species of plants or soil types. Generally, the longer the drought the longer the recovery period, primarily because of a reduction in total biomass, reduction in surface litter, and poor seedling establishment.[vi] Recovery from a drought cycle in Utah will take patience, partnerships, and pre-planning.

A Multi-disciplinary, Multi-agency Team Approach
For Drought Assessment and Mitigation

By mid-summer, 2002, most of Utah had been experiencing moderate to severe drought for up to four years. Reports were coming into the Utah BLM State Office about the deteriorating condition of vegetation and the increased deficit in soil moisture on public lands. Questions were being asked not only about how to manage the current situation but also if the State Office had guidance concerning drought management. A quick inventory showed that the Bureau had a significant amount of information for the management of various resources including vegetation in the form of Standard and Guides and in the Code of Federal Regulations. But the agency had little information about early detection, early intervention, or planning for drought in any form including existing Washington Office Guidance, Technical Manuals and Land Use Plans, the document on which the agency makes area specific land use decisions. This absence in itself did not threaten the integrity of these LUP's as changing land uses for a variety of programs were inherent in the plans.

A meeting of the Resources Division of the State Office was held to brainstorm drought related issues, mitigations, and possible Best Management Practices. After a follow-up meeting it became clear that the Bureau needed to address drought and other climatic variances at least in Utah. State Office staff quickly canvassed their counter-parts in the Field Offices requesting information, photos, and opinions about drought management.

A trend began to assert itself:

1. Early detection and early intervention techniques and/or processes, if they existed, were not applied across jurisdictional boundaries.
2. The extent of this drought cycle and the social, economic, and environmental impacts were generally being mitigated, if at all, within each agency's jurisdictional boundaries.
3. While there is a fair amount of science concerning drought management and mitigation, much of it was not readily available to either agency personnel or public land users.

The Utah State Office team recognized the need to identify a list of drought indicators and to implement a process for early detection of drought in a timely manner. The agency needed to create and implement a process of early intervention to mitigate social, economic, and environmental impacts of drought and we needed to incorporate early detection and early intervention into our Land Use Plans. It became even clearer that BLM should not attempt to manage drought in a vacuum; we needed to have partners because any decisions BLM made to manage drought impacted other public and state lands, and private landowners. The BLM team recognized that the process should be multi-agency, multi-disciplinary, and public.

Utah Partners for Conservation and Development

Members:

USDI Bureau of Reclamation
USDA Farm Service Agency
Utah RC&D Councils
Utah Association of Conservation Districts
Utah Department of Natural Resources
USDA Natural Resource Conservation Service
Utah Department of Environmental Quality
Utah State University Extension
Utah Department of Agriculture
USDA Forest Service
USDI Bureau of Land Management

Part of the intra-office exercise was to identify existing partnerships that BLM could work with to accomplish these goals. Because BLM was a member of the Utah Partners for Conservation and Development it was decided to present a proposal to the Partnership Action Team, the heavy lifting arm of the Utah Partners group. By the end of July a team had been formed and a date set for a tour of the state to do:

- a rapid assessment of impacts from the current drought cycle on both private and public land; assess impacts to all public land programs i.e.: grazing, oil/gas, wildlife, recreation, etc.;
- provide short and long-term recommendations to land managers and public land users;
- prepare a State of the State report;
- develop strategies for incorporation of early detection, early intervention, and public participation processes into LUPs.

The Drought Assessment and Mitigation Team (DA&MT), understanding that there were several definitions of drought, agreed, at least in the short term, to a definition that came from the Bureau of Land Management Utah State Office as illustrated.

DA&MT Working Definition of Drought

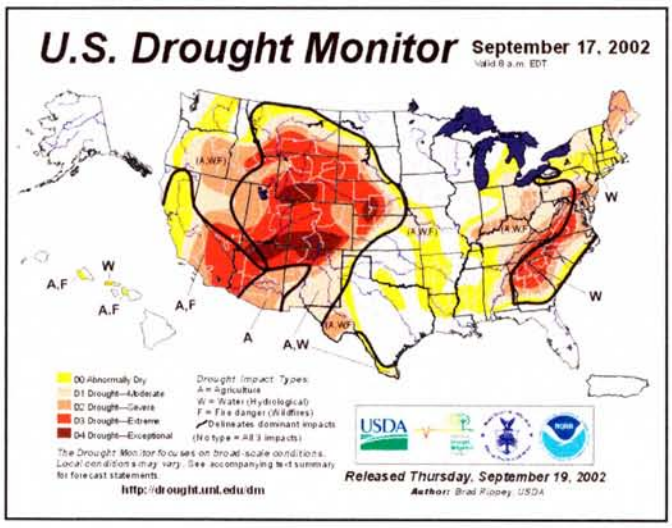
Drought is a negative deviation from normally arid public land conditions that results in:

- Significant volume decreases in surface and sub-surface water sources
- Moderate to severe economic and social impacts
- Potential conflict between competitive uses
- Short and long-term environmental impacts and damage to public and private land resources

This definition is fluid but it seems to fit all four kinds of drought and the conditions and impacts from this drought cycle. The DA&MT suggests that rather than debating the various definitions of drought that government agencies and partners focus on identifying drought indicators, drought assessment and mitigation strategies, and drought planning to mitigate various impacts that result from the four types of drought.

Assessment of the Current Condition

In mid-September, 2002 a team comprised of: Randy Parker-Utah Department of Agriculture, David Grider—U.S. Forest Service, Dr. Roger Banner—Utah State University Extension, Larry Ellicott and Lisa Coverdale—Natural Resource Conservation Service, and Larry Lichthardt and A.J. Martinez—BLM, toured most of the state. Sites visited: BLM administered Lands: Moab, Montecello, Hanksville, GSENM, Cedar City, Richfield, and Fillmore Field Office areas.
USFS: Uinta (drive through), Manti La Sal, Dixie, and Fishlake National Forests
NPS: Glen Canyon National Recreation Area, Capitol Reef NP (drive through)
State Parks: Green River, Otter Creek, and Yuba Reservoir. Drought conditions across the state and the west, for that trip, are shown in the U.S. Drought Monitor September 17, 2002 figure above.



The Multi-agency tour of Southern Utah provided participants the opportunity to see conditions and drought impacts first hand and visit with land managers, Extension agents, and members of the public. The tour provided visits to representative geographic areas to get a sense of the broader impacts. In addition, the team met with community leaders and elected officials for reports on broader economic impacts. It is important to note that the team was not conducting scientific observations nor gathering scientific data to make specific recommendations. Even though the team visited specific sites and the team was comprised of subject specific experts, the following observations are general in nature.

Environmental Impacts—Vegetation:

Utah has been in a prolonged drought with Southern Utah particularly hard hit in 2001-02. Limited moisture in both the winter and summer months meant broad adverse impacts on plant growth across the region. In many of the areas visited, vegetation (several species) exhibited severe stress. Many of the grasses had not received enough moisture to break dormancy. Plant mortality was observed in many of the areas the team visited. The lack of moisture and prolonged dormancy has also meant there is limited seed production to generate new plants.

There has been little forage re-growth after the previous year's grazing season. The rain that had been received two weeks prior to the team visit was the first moisture of the entire season in many areas. Some crested wheatgrass and other species broke dormancy and produced 2-3 inches of

growth and then returned to dormancy. Moisture, that provided for late season green-up, created optimism among livestock producers however, it created additional concerns for resource managers who understand the rancher's need for forage but are also responsible for maintaining or improving range health. Other vegetative impacts included severe mortality in stands of Big Sage, Rabbit Brush, and Bitter Brush, which, in these areas will critically impact wintering deer.

Across the four-corners states there continues to be a significant infestation of Pinyon Pine by the pine beetle Ips confusus. When the trees have normal moisture reserves they can usually successfully cast out swarming beetles, however, after a few years of declining precipitation and increased competition for less moisture, the trees become weakened and cannot protect themselves from invasion. Some stands on Cedar Mesa and around Boulder, Utah have as much as 40-60% mortality (estimates only). Clearly in the first years after die-off and before needles have been shed these stands are prime fuel for wildfire. Before or after a wildfire there is an increased risk of invasion by Juniper and exotic plant species, however, if not invaded, these stands have the potential of recovering (native species) through natural succession.

Environmental Impacts—Water Resources: Many reservoirs in the state were at the lowest levels they had been, many since they were built. For example at least three feet of the intake ring in Yuba reservoir was showing, indicating that the remaining conservation pool was dangerously low. Lake Powell had an extreme drop in elevation (storage) of almost 90 feet from normal pool levels. In the period between April and July, inflow was about 14% of average.

Many of the State's rivers and streams were running at 10% of normal. In some extreme cases, anecdotal reports from southern Utah suggested that some streams were below 1%. While the team has not gathered data on mortality in these depleted streams and lakes, there certainly has been some impact to riparian habitat and dependant species and fisheries. Limited water resources have put added pressure on some riparian areas from livestock and wildlife. Animals have tended to congregate where water was available. Where water was made available in a more dispersed area through hauling and development, there was less damage and broader use of forage.

Environmental Impacts—Wildlife

Wildlife populations have been hard hit by the drought. Buffalo and elk herds, in southern Utah, seem not to be as hard hit as other species, although both species were targets of concern in regards to competition with livestock and depredation on private lands. However, in the northeastern region of Utah, DWR reported that elk were in direct competition with deer for browse species normally not utilized by elk. It appeared that the hardest hit big game species in the region were antelope and mule deer. Many of the deer herds the team observed had less than two fawns per ten females. Many females were in poor condition, which will probably impact conception percentages. Some fawns carried spots in mid-September, which indicated late births (a carry-over drought impact from the previous year) and probable high mortality. Fawns were almost non-existent in antelope herds. Note: These are very limited observations and do not represent actual percentages which may vary or not be as pessimistic. All of the team members expressed concern about the coming winter and wildlife populations. They predicted severe wildlife losses, even if the winter is light, and increased competition for scarse vegetation. With a heavy winter, the wildlife losses are projected to be much more severe. (Appendix G)

Environmental Impacts—Wild Horses:

The team did not observe wild horses but resource managers reported that wild horses populations in the region had suffered some mortality even though the BLM conducted emergency gathers (about 1400 animals removed [vii]) to reduce impacts both to remaining animals and water and vegetative resources. Wild horses are highly competitive with other livestock and wildlife, often driving other species away from available water. Few foals were born in 2002. (Ibid) Going into the winter the animals are in poor condition that could result in additional mortality.

Environmental Impacts—Fire

Summer wild fires, in 2002, were fueled by some of the driest conditions on record. The most ominous fires were in the four-corner states. With relative humidity and fuel moisture in single digits and high, hot winds, fire behavior was at the least extreme. The fire in the Book Cliffs in the summer of 2002 was one of the largest in recent Utah history. Extreme weather, steep and dangerous terrain and remoteness hampered fire-fighting efforts. But probably the single largest influence were the extremely low fuel and soil moistures caused by this extended drought cycle.

Environmental Impacts—Soils

Soil moisture is as low as it can possibly be in many sites across Utah. As a result it is highly susebtiible to disturbances of all types inlcuding impacts from hooved animals, cross-country travel by Off Highway Vehicles (OHV), and irnonically, from high intensity rains. For example, in the Circle Cliffs area of the Grand Staircase Escalante National Monument, intense fall rains caused extreme head-cutting and sheet erosion because the soil moistures were so low that soils on that site could not resist movement. The unusually high winds of the spring of 2002 removed an unknown amount of soil all across the southwest in blinding dust storms.

Economic Impacts—Grazing:

Livestock producers have been faced with liquidating herds or trucking livestock to out-of-state pastures due to one of the region's worst droughts in memory[viii]. Cattle producers have been hit by a combination of drought and low prices. The severity of the drought has lead to a liquidation of cattle across much of the Western United States. The volume has forced cattle prices lower. The drought and associated lack of forage and water has dictated the need to reduce numbers, however, the lower market prices--as much as 40 percent less (Ibid) for cows and calves--has made it a more difficult decision. Exacerbating the situation is the limited hay production and high prices in the region. The lack of grazing resources, low cattle prices and high priced hay, producers are in an increasingly problematic situation.

There are a couple of concerns associated with the current liquidation of cattle. First, the genetics that have been developed have been developed to address geography and environment while allowing for an economical cattle grazing operation. Utilizing the private/public land mix has been a paramount consideration in developing genetics that can survive and in average conditions, even thrive. Conditions this year have required reductions through slaughter or relocation that will adversely affect livestock numbers and ranches in the region for the foreseeable future.

Public lands – BLM, Forest, Parks, Monuments, State Parks, etc,-- dominate Southern Utah's landscape. Many rural communities and some livestock producers are heavily dependent upon multiple-use of the public lands. Livestock grazing is an economic contributor to rural areas and the statewide economy. Liquidation of livestock and ranching operations will be felt in these communities. The following is an opinion by Randy Parker, Utah Department of Agriculture economist, based on his research and observations from the DA&MT tour.

> From a micro point of view, it is important to recognize the impact of displacing or liquidating even a single livestock (cattle) operation. If an average sized cow-calf operation with 500 mother cows goes out of business due to the drought, there is a direct loss to the local economy of over $200,000 in farm gate sales. This is based on a ninety percent calf crop and 500 pound feeder calves marketed at $.95/pound. The multiplier effect of an average cattle operation is 3-4, especially in an agriculture dependant area, providing an annual economic loss of around $750,000. The 2002 Utah Agricultural Statistics reports 71,000 cattle in southern and southeastern Utah, thus a forty percent reduction (28,400) in cattle inventory in the region based on the above presented scenario, would create a loss of economic activity of over $42 million. Similarly, the loss of an average sheep operation of 3,000 ewes would mean a $300,000 loss in one-time

farm gate sales. This is based on an assumption of 100 percent lamb crop on 125 pound market lambs sold at $.80/pound. Using the same 3-4 economic multiplier, there would be an estimated annual loss to the rural Utah economy approaching $1 million. The 2002 Utah Agricultural Statistics reports 78,000 sheep in southern and southeastern Utah. Therefore a forty- percent reduction (31,200) in sheep inventory in the region based on the above-presented scenario would create a loss of economic activity approaching $10 million.

Based on livestock numbers being sold at auction or transported out of state in search of forage, higher numbers of open cows, and projected reductions being anticipated by the land management agencies in some allotments, an estimate of forty percent reduction in livestock numbers could be considered conservative with an economic loss to the economy approaching $50 million.[ix]

Economic Impacts—Tourism:

The state's southern region has in recent years become more dependent upon tourism. Visitor numbers are down. The lack of water in the rivers and the threat of large fires seem to have reduced visitor numbers and economic activity. It has been reported backpacker groups and commercial recreation businesses have cancelled visits due to heat and lack of water. For example, the annual Friendship Cruise, on the Green River, was cancelled, for only the second time in its history. Low water levels in late July and August contributed to a loss in visitors in Huntington, Deer Creek, and Gunlock State Parks, because they were unable to launch boats. Utah State Parks reports an 8.3% decline in visitation to State run reservoirs.[x] Some like Otter Creek directly impact the economy of Antimony and that area of southern Utah. The manager of the Green River State Park reported to the DA&MT that he had not observed either private or commercial boats floating the river since July 2002. Therefore, rural, travel/tourism-dependant economies, adjacent to these parks, are acutely impacted.

Environmental, Economic, and Social Conflicts

The team identified several existing conflicts. All have a base in environmental impacts, which translate into economic impacts, and if they go unresolved they synthesize as social issues.

- Drought exacerbates the impacts of wildfire but the **exclusion of fire** from fire dependant ecological sites exacerbates the impacts of long-term drought cycles. For almost one hundred years the management of natural resources has included immediate suppression of all wildfires on public lands. As a consequence these sites have built-up higher fuel loads and are now at a high risk for catostrophic fire and invasions by insects such as pine beetles.
- **Heavy competition for depleted resources** between livestock, wild horses & burros, and wildlife, specifically elk on both private and public lands. There seem to be conflicting agendas between the agencies for the allocation of resources for these species. Livestock numbers can be reduced immediately if necessary. Wild horses and burros can be removed within a relatively short period of time given an increased capability of holding facilities to accommodate these extra animals and of course budget. Big game species are problematic in that the Utah Department of Wildlife Resources utilizes natural mortality and adjusted hunting permit numbers to thin herds. In addition this segment of resource management has a

well organized and powerful lobby that resists changes in herd numbers across the state.

- **Stand conversions** e.g. cool season to warm season species and invasion by weeds and exotic plants or conversion of dominant over story in P/J sites from Pinyon to Juniper or an invasion of weeds and exotic plants. Drought impacts sites are highly suseptible to invasion by opportunistic insects and annual grasses and weeds.
- **Communication gaps** between jurisdiction managers, and with users. Several contacts noted that the land management agencies were not coordinating and communicating, about drought, with each other or with public land users.
- **Rushing past Recovery**—There is an understandable impulse to want to utilize resources before they have recovered sufficiently. Vegetation and soils will need more than one "normal" precipitation cycle to recover.

Strategies for Management—Short term

Strategies for management—seamless management:

The land management agencies, in cooperation with other member partners of the Utah Partners for Conservation and Development, should develop and implement a strategy for seamless management. This does not imply that each agency must abdicate their organic legislation, rules, regulations, and procedures in the name of consensus and cooperation.

"You guys need to talk to us and to each other at the same time." Del LeFevre, Garfield County Commissioner and rancher told the DA&MT during the tour.

He went on to tell the team that often he felt it was up to him to mitigate any differences in yearly scheduling between the Forest Service and BLM. Instead, he suggested that it might make more sense to have both agencies call him in at the same time to discuss the grazing year. This would include other permittees that shared his allotments managed by both agencies.[xi] Seamless management, as defined by the team, is nothing more than cooperative communication between all agencies before a decision is made. This allows the agencies and the permittee an opportunity to suggest or explore a number of options or at the least prepare the permittee for temporary use reductions. In addition the permittee can look at options for herd and ranch management before his finances reach critical mass.

Seamless management is simply looking for common ground in assessment guidelines, assessment tools, and options for management of public lands. Examples include: the development and management of public and private resource reserves, seamless databases, and seamless Land Use Planning (this does not imply one inter-agency LUP but rather complimentary and mutually supportive planning that should include other plans in the same geography such as other federal agencies, State, and County plans).

Strategies for management—Assessment Guidelines

Drought is normally site or area specific; however, the current drought cycle in Utah has been pervasive over much of the State for at least 4 years. [NOTE: the term "site" has several uses. For purposes of this document it refers to areas within an allotment.] Some areas of the State, during this protracted drought, have seen improved precipitation conditions, such as in 2002 in northwestern Box Elder County and spring 2001 in the Kanab and St. George areas. But in general, drought conditions in the State have been widespread and resulted in reduced plant vigor, root pruning, mortality, and possible long-term changes in plant composition. Current drought conditions have affected both soils and surface water. Soil erosion has increased, as would normally occur with severe drought conditions, and surface water quantity and quality have declined.

While there is a "mild El Nino" event forecast for this winter (2002/2003) it is doubtful that it will offer more than temporary relief. The impacts of the drought will be longer term and will take time and several years of average or above average precipitation to mitigate the impacts of. At least one more below normal precipitation year (2003) is predicted as well as the continuation of a long-term drying trend.

It is important to recognize that drought conditions need to be assessed on a site specific and proposed use basis. Even as statewide as this drought is, conditions vary

across the State and within Field and Ranger District Offices. The ability of the rangelands to sustain themselves and provide livestock forage or to support other uses is affected by the type of vegetation, proposed season-of-use, the growing season dates, timing of precipitation events, vegetation conditions, and the kind of livestock being proposed for use. An analysis of these factors will determine what level of use, if any, is appropriate for a specific site.

The following are recommended "common-ground" range land specific assessment guidelines that public land managers and intra and inter-agency teams can use to assess range readiness under any climatic condition including drought. Furthermore they can be shared with public land users so that they are looking at range resources from the "same page."

Site Specific Assessment Guidelines—Short Term

The most important and immediate step is to visit with public land users as soon as possible to discuss the drought, possible ramifications, and potential future actions. All permitted public land users should be contacted before a formal letter outlining proposed actions is sent. Permittees that graze USFS and BLM allotments probably are the most immediate and highest priority.

The following items (assessment questions) should be considered when determining if livestock grazing should be permitted in the short term. **These assessment criteria should not be viewed as a checklist but rather as a general guide to facilitate the team process.** Other tools or additional information, including Utah BLM Standards and Guides, can be found in Appendix E. **It is highly recommended that a multi-agency, multi-disciplinary team approach be used when making an assessment for any program, activity, or use.**

Assessment criteria for evaluating condition

1. Will the proposed use provide for the recovery of plant vigor? (Grazing Management Guidelines, Tech Notes, Range 34, Appendix E)
   - Analysis of these factors will help determine needs for relief
     - Type of vegetation
     - Season of use
     - Growing season dates
     - Timing of precipitation (normal year)
     - Range condition (residual growth, litter)
     - Class of livestock
2. Is root development adequate to maintain plant growth with the proposed livestock use? (Grazing Management Guidelines, Tech Notes, Range 35, Appendix E)
   - Precipitation record (recent climate history) for that site if available or an average of records from similar sites. (How many years of continuous drought?)
   - Has precipitation returned to normal? Compared to previous deficits?
3. Has plant mortality affected the amount of forage available?
   - Physical evidence of plant carcasses in relationship to live plants.
   - Utilize trend studies or other site-specific data and information.

- Identify and use research about rangeland recovery.

4. Is adequate forage available, in suitable areas, to support the proposed livestock use while providing for improved watershed conditions and wildlife use or other consumptive uses like Wild Horse and Burros?
   - Is the grazing unit in a pasture system? Are there residual feed sources on rested units?
   - Does the grazing unit have unused areas that may be utilized by prescribing special terms and conditions?

Assessment criteria for evaluating potential management actions

1. What is the proposed season-of-use? (Extended livestock use during the growing season could further stress plants and reduce plant vigor.)
   - History of season of use. Have there been temporary reductions in use in past years? If so, what time of the year? Duration? Environmental results?
   - Are there unused forage reserves or allotments within the jurisdiction?
2. What additional monitoring will be required to assure that the scheduled use can be accommodated and how will it be accomplished
   - Does the office have the staffing to support additional monitoring?
   - What will the office have to give up (units of accomplishments) to conduct additional monitoring?
   - Are there other options for staffing a short term monitoring program? (i.e.: "Borrowing" vegetative experts from other agencies, grad students, etc.)
3. What is an appropriate level of use before livestock should be removed?
   - Stubble height (Grazing Management Guidelines, Tech Notes, Range 34, Appendix E)
   - Measure litter against open surface. Is there adequate litter (% based on soil inventories for that site) to protect soil moisture?
4. Is adequate water available for the livestock or will they congregate on a few watering areas?
   - Are there water sources in areas not traditionally grazed?
   - Is there road access to accommodate water hauling?
   - What is the [permittee] maintenance record for maintaining water systems and dirt tanks?
5. What is the track record and capability of the permittee to accommodate special permit terms and conditions? (water hauling, herding, etc.)
6. Encourage voluntary adjustments in livestock use, as it becomes apparent that normal grazing schedules would result in degradation of long-term resource productivity and subsequent economic impacts to the permittee.

While these assessment criteria (questions) are grazing program specific they can and should be modified as needed to assess the capability of public lands to sustain other uses, such as cross-country travel, special recreation permits, etc.

Site Specific Assessment Guidelines—Mid-Term (after spring and summer seasons 2003 through winter 2004)

Recovery will be slow even with average winter moisture. Water sources will continue to be limited and forage production and availability will be delayed as the key

forage species recover from the stress caused by the drought. Consider the following actions in preparing for future grazing activities:

- Consider competitive uses from horses and wildlife especially elk when allocating livestock use. Hold inter-agency and public meetings to identify issues and options for mitigation.
- Discuss future utilization levels and options with the permittee if utilization levels are met or exceeded in the short-term.
- Encourage voluntary adjustments in livestock use as it becomes apparent that normal grazing schedules would result in degradation of long-term resource productivity.
- Consider increased workloads or changes in priorities (FY 2003/2004) resulting from drought mitigation.
- Chart precipitation history. Have precipitation levels returned to normal or above for a long enough period to return to permitted levels of use?
- Use Standardized Precipitation Index, Palmer Drought Severity Index, and other tools list in Appendix E to determine climate trends.

Site Specific Assessment Guidelines—Long-term

Due to the extended nature and severity of the drought, changes in plant composition may occur or have occurred already. Changes are variable between sites and may include; conversion from cool to warm season grasses, increased or decreased shrub components, decreased grass production, increase in bare ground and the invasion of non-native plants. Depending on local conditions, changes in vegetation conditions may decrease the amount of forage available for livestock, wild horses or elk as well as other grazers and browsers. These changes would be long term and may require adjustments in future allocations. Field offices should be aware of this possibility and make changes as appropriate in their monitoring and assessment of these areas.

Strategies for Management—Outreach

The most immediate need is to visit with permittees prior to spring and summer use (2003). Ideally permittees who graze on both USFS and BLM would meet with USFS and BLM staff and leadership at the same time to discuss options.

Other permitted uses, such as outfitters and guide activities, cross-country OHV use, etc. should be evaluated for short-term impacts from drought. Agency staff and leadership should meet with Outfitters and Guides, etc. to discuss short and long-term drought impacts.

In late winter, the agencies should conduct joint meetings with grazing permittees to outline short-term actions.

The DA&MT recommends that public information meetings be held across the state (spring and summer) to identify issues and potential mitigations. Dr. Roger Banner--USU Extension, best describes the concept: "Plan for drought during the good years."

The team has identified a number of partnerships that could be utilized to conduct these meetings such as the RC&D Councils, The Utah Rural Economic Council, The Colorado Plateau Forum, and others.

There appears to be a conflict with wildlife, especially big game species. Resource managers and private landowners report that wildlife (primarily elk) have had

major impacts, especially in a drought, on rested pastures, resources reserves, private lands, and riparian areas. Therefore it is recommended that after the public information meetings that agency officials (Utah Partners for Conservation and Development) meet to resolve the wildlife/livestock public land issue. Furthermore we recommend that these agencies or a combination of affected partners meet with private landowners to identify issues, share science, and find potential mitigations to resolve the issue.

In those areas where wild horse herds are found, the agencies should hold public information meetings (mid-summer 2003) to discuss issues and possible mitigation.

There is a natural assumption to believe that a drought is over when "normal" precipitation averages return. And while the drought may indeed be broken, drought impacts, especially from a prolonged cycle, will not be immediately repaired. Given the duration of this cycle and its intensity, it is suggested that the Utah Partners for Conservation and Development plan and hold joint briefings with the following to discuss common positions:

- Utah Farm Bureau
- SITLA
- Utah Cattlemen's
- Utah Wool Growers
- Utah Association of Counties
- Utah Congressional Delegation
- Governor of Utah [NOTE: if the land management agencies enact either voluntary or other grazing reductions, it may be in the best interests of the State if an emergency drought designation is continued in Utah at least through 2003.]
- Joint news conferences
- NGO's with public land interests (e.g. OHV, wildlife, wilderness, etc.)
- Tribes

Recommendations—Long Term

The DA&MT suggests that a multi-agency, multi-disciplinary team be named immediately to gather climate data on a regular basis, at least yearly, to determine if drought is eminent.

One of the remaining tasks of the DA&MT is form sub-teams to develop strategies for the following in 2003.

A. Science: while there is a quantity of research that has been conducted on drought and drought impacts, most of this information is kept by the university that conducted the research. A compendium of known science and an annotated bibliography should be created for Utah. The science strategy would then focus on peer review of existing science, deployment of implementable research, and identifying science gaps and needs for future research. A joint funding strategy would be another product.

B. Early detection: there are a number of tools (Appendix E) that can be used for early detection of drought. In addition there are new methodologies, such as remote sensing, that could be applied. The strategy would also focus on identification of environmental triggers. Early intervention: because drought causes strife, it is important for the agencies to identify drought early and implement early "warning" meetings with public land users. The principles of ADR should be utilized. The strategy will identify these tools and develop a methodology for deployment.

C. Incorporation of multi-agency strategies in LUPs: this goes beyond the next section of this document. LUPs regardless of jurisdiction must be mutually supportive. A strategy for inclusion of these findings into existing land use plans and new plans is needed. Climate as a baseline component is missing from most LUP's. Some plans use climate to analyze alternatives and uses but climate must be an integral part of the process from beginning to end.

D. This multi-agency drought assessment and mitigation effort should be combined with the Governor's plan and with any other existing drought plans. In addition it is highly recommended that a statewide (multi-agency/entity) team be named to prepare a statewide drought assessment and mitigation plan. A suggested format for a statewide plan is included in Appendix F.

[i] Western Regional Climate Center

[ii] Solley, W.B., Pierce, R.R., & Perlman, H.A., 1993, Estimated use of water in the United States in 1990: USGS Circular 1081, 76p. and Solley, W.B., Pierce, R.R., & Perlman, H.A., 1998, Estimated use of water in the United States in 1995: USGS Circular 1200, 71p.

[iii] David Grider, Planning for Drought in Utah, Power Point Presentation December, 2002

[iv] "Radio West" Interview with Doug Fabrezzio, Utah in Drought July, 2002 NPR

[v] Rouse, G, Guinn, K, Madsen, C, August 1994, How Cool Season Grasses Grow and Plant Needs: Technical Notes, Range 35, USDA, Soil Conservation Service

[vi] Bowns, J., Dr, from a presentation on recovery, Feb. 2003, BLM Richfield, UT.

[vii] Warr G., Personal Conversation, August, 2002

[viii] , USU Extension agent, county, September, 2002

[ix] Randy Parker, unpublished document, Utah Department of Agriculture, 2002

[x] Jamie Dalton, unpublished report, Utah Department of Parks and Recreation, December, 2002

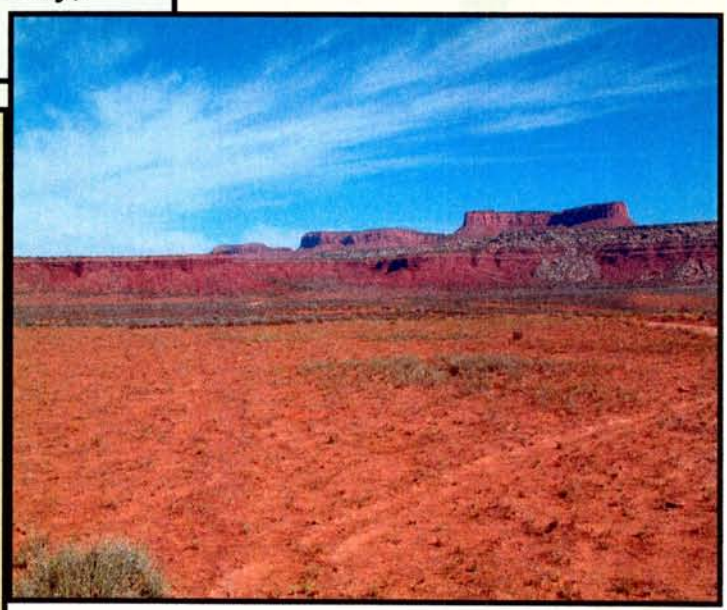
[xi] Del Lafevre, personal conversation with the DAMT, September, 2002

Utah Partners for Conservation and Development

DROUGHT ASSESSMENT AND MITIGATION
A STATE OF THE STATE REPORT
AN MULTI-AGENCY/MULTI-DISCIPLINARY TEAM APPROACH TO EARLY ASSESSMENT, EARLY INTERVENTION, AND PLANNING

EXECUTIVE SUMMARY

Drought is an insidious and recurring natural event that crosses all political boundaries and ownerships, impacting the land, the economy, and society.



Utah is an Arid Place

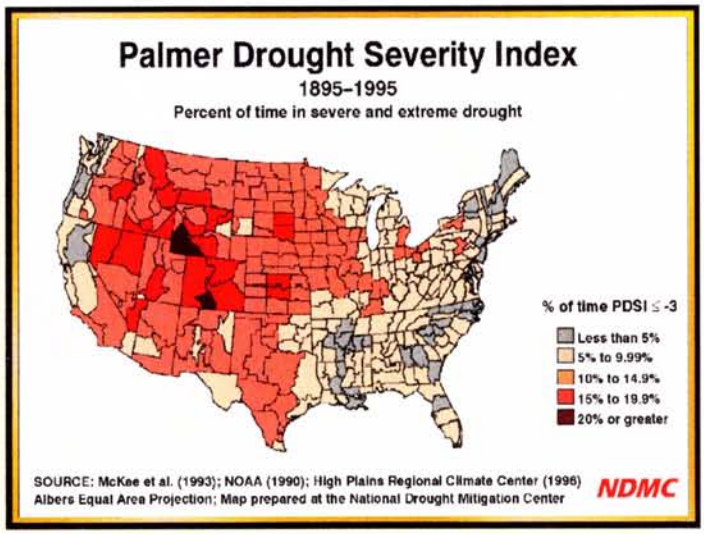
Drought is not the norm in Utah but it is a recurring climatic factor that, depending on its duration, can have extreme economic, social, and environmental impacts. Drought is generally impossible to predict and hard to detect until the signs of its presence are impossible to miss. The state of Utah is entering the fifth year (2003) of a drought that by some standards is potentially even more devastating than the drought of the fifties or even the "dust bowl." This is due in part to significant changes in population, demographics, and, on public lands, changes in uses and user preferences.

Drought on Public Lands 2002

All parts of the state have been hit by this drought cycle including public lands which make up a significant part of the state. All uses that occur on public lands have been impacted. Impacts include severe multi-species plant mortality on some sites, record low flows in rivers, streams, and springs, mortality and poor reproduction in some big game species, increased danger of catastrophic fires that threaten homes and habitat, and increased opportunities for invasion by opportunistic weedy species, annual grasses, and insects. The result: significant environmental issues on public lands, collateral impacts to private and state lands, and direct impacts to rural and statewide economies.

Cooperation is the Key to Drought Mitigation

The impacts of future drought cycles can be partially mitigated by cooperative partnerships between state and federal agencies, tribes, public land users, and the Governors Office. This can be accomplished by forming multi-agency, multi-disciplinary teams to identify and implement early detection and early intervention strategies. These instruments use a statewide drought mitigation plan and agency Land Use Plans as a base to launch mitigation early in a drought cycle. They lay out a systematic approach to insure that the critical recovery phase is factored into land use decisions. Teams will also identify survival tools and education opportunities that help private landowners and public land users plan for changes in use during drought cycles.



Next Steps

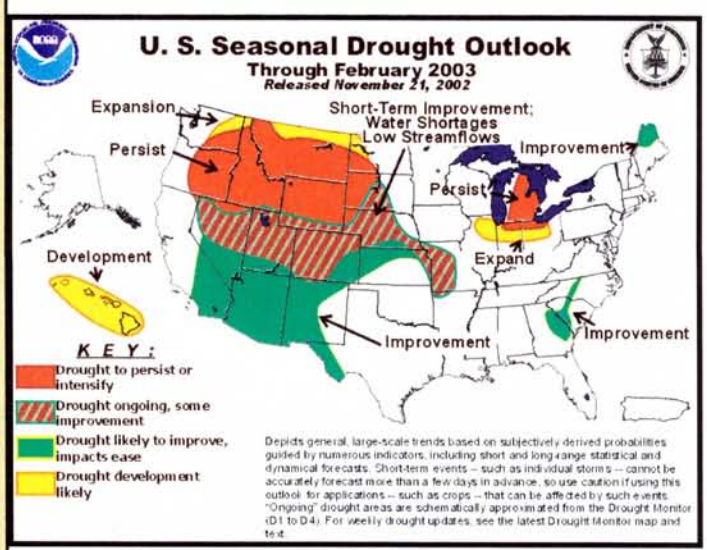
The federal and state partners in the Utah Partners for Conservation and Development have been working diligently to seek solutions that may help mitigate the impacts of drought. All have been in contact daily with various public land users. But tough and unpopular decisions have been and will continue to be made. These decisions will have impacts across the spectrum of public land programs and will resonate in regional economies. Strategies for developing a statewide drought plan, early detection triggers, and early intervention processes are being developed so that we can, collectively, start mitigating drought related issues sooner in a cycle. The team is identifying science and other tools that will help detect and alleviate the impacts of drought. The Utah Partners for Conservation and Development are committed to work cooperatively and keep the lines of communication open to all pubic land users to help reduce the impacts of drought on public land users.

The Science of Recovery

It is human nature to want to return to normal as quickly as possible. Therefore, after a prolonged drought, we look at a return to normal precipitation as the end of the drought. Some immediate indicators include green pastures and full reservoirs. But the real effects of drought on the economy and the environment can be hard to see. For example we do not see, after several years of drought, that even though a plant is green it lacks vigor and that the overall biomass of the site has been reduced, therefore, land use may have to continue at a reduced level for a while longer. In addition, soil moisture is so low that it does little to promote plant recovery, springs are slow to recover, and wildlife and livestock births are very low until they recover. Many public land users have taken reductions in use and will probably continue to do so, at least in the short term. The Partners are seeking and implementing the best science that can be found for making decisions. But the best tool has been one-on-one conversations with public land users discussing the recovery process and the possible ramifications and impacts.

Bottom Line

Recovery will not happen immediately following the first normal precipitation cycle. Both public land managers and public land users are faced with some tough decisions. It will take teamwork, science, and above all, time, patience, and communication to mitigate the economic, social, and environmental impacts of drought.



APPENDIX A

What is Drought?

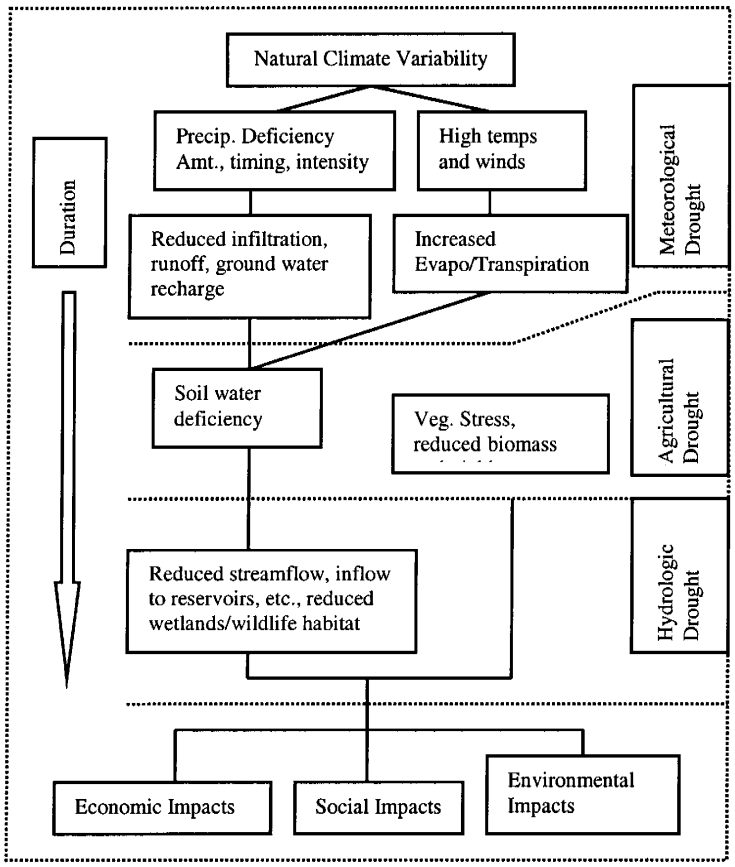
Drought is unique among natural hazards because it is not a clear event like a flood, earthquake, hurricane, or tornado. These events strike, leave their mark, and are gone. A drought, however, is insidious. It sneaks up disguised as several weeks of sunny days or a winter with little snow. Unlike a hurricane, we cannot follow its course on a map. Generally we are not sure when a drought began until it is already underway, and often we are unsure when it ends. Often we are fooled by the return of a "normal" or above normal winter, or in Utah, by summer "monsoon" rains that bring green to a parched landscape. However, any day when it doesn't rain or snow (which describes most days in Utah) could be the beginning of the next drought.

> "We have no good definition of drought. We may say truthfully that we scarcely know a drought when we see one. We welcome the first clear day after a rainy spell. Rainless days continue for a time and we are pleased to have a long spell of such fine weather. It keeps on and we are a little worried. A few days more and we are really in trouble. The first rainless day in a spell of fine weather contributes as much to the drought as the last, but no one knows how serious it will be until the last dry day is gone and the rains have come again... we are not sure about it until the crops have withered and died."[i]

Drought has often been referred to as a creeping disaster because the lack of sufficient moisture can lead to profound implications for the environment and all segments of society. However, drought may affect each segment differently and be highly variable in its severity and magnitude on each segment. The reason for this variability is the lack of a clear and concise definition of drought that is applicable to all disciplines.

A drought is a period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance (for example crop damage, water supply shortage, etc.) The severity of the drought depends upon the degree of moisture deficiency, the duration and the size of the affected area.

There are four main types of drought:



- Meteorological – is based on a specified time period with precipitation averaging below a critical threshold. Due to climatic differences what is considered a drought in one location may not be a drought in another location.
- Agricultural - refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.
- Hydrological - occurs when surface and subsurface water supplies are below normal.
- Societal or economic – a complex interaction of the natural phenomenon, environmental degradation, and human impact.

The wide variety of disciplines affected by drought, its diverse geographical and temporal distribution, and the many scales drought operates on make it difficult to develop both a definitions to describe drought and an index to measure it.

Common to all types of drought is the fact that they originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (say, a few weeks or a couple months), the drought is considered short-term. But if the weather or atmospheric circulation pattern becomes entrenched and the precipitation deficits last for several months to several years, the drought is considered to

be a long-term drought. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought. Many quantitative measures of drought have been developed in the United States, depending on the discipline affected, the region being considered, and the particular application.

Several indices developed by Wayne Palmer, as well as the Standardized Precipitation Index, are useful for describing the many scales of drought.
The Palmer Z Index measures short-term drought on a monthly scale. The Palmer Crop Moisture Index (CMI) measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.

The Palmer Drought Severity Index (PDSI) (known operationally as the Palmer Drought Index (PDI)) attempts to measure the duration and intensity of the long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during the current month is dependent on the current weather patterns plus the cumulative patterns of previous months. Since weather patterns can change almost literally overnight from a long-term drought pattern to a long-term wet pattern, the PDSI (PDI) can respond fairly rapidly.

The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The Palmer Hydrological Drought Index (PHDI), another long-term drought index, was developed to quantify these hydrological effects. The PHDI responds more slowly to changing conditions than the PDSI (PDI).

While Palmer's indices are water balance indices that consider water supply (precipitation), demand (Evapo-transpiration) and loss (runoff), the Standardized Precipitation Index (SPI) is a probability index that considers only precipitation.

The SPI is an index based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive

for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive. The SPI is computed by NCDC for several time scales, ranging from one month to 24 months, to capture the various scales of both short-term and long-term drought.

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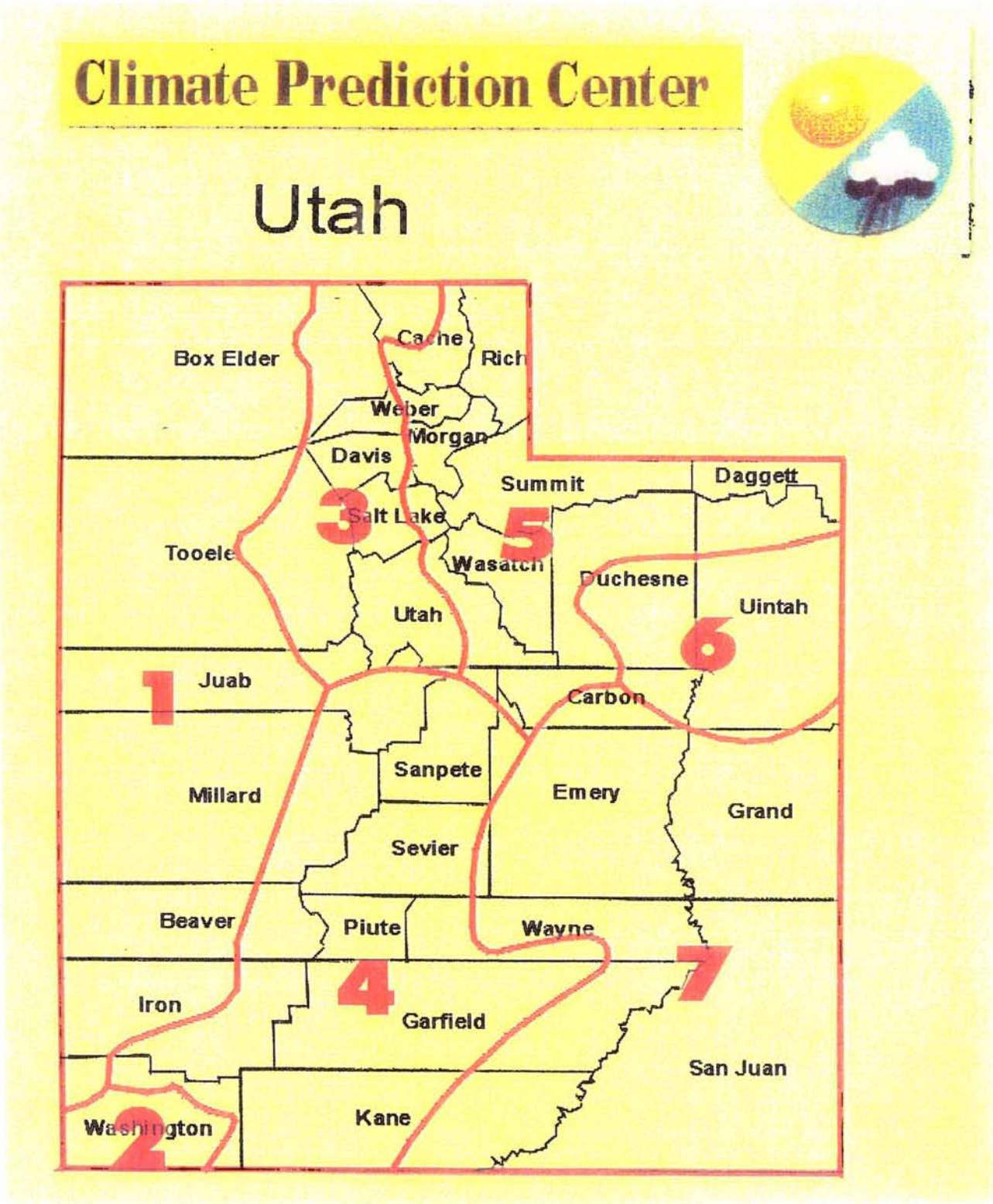
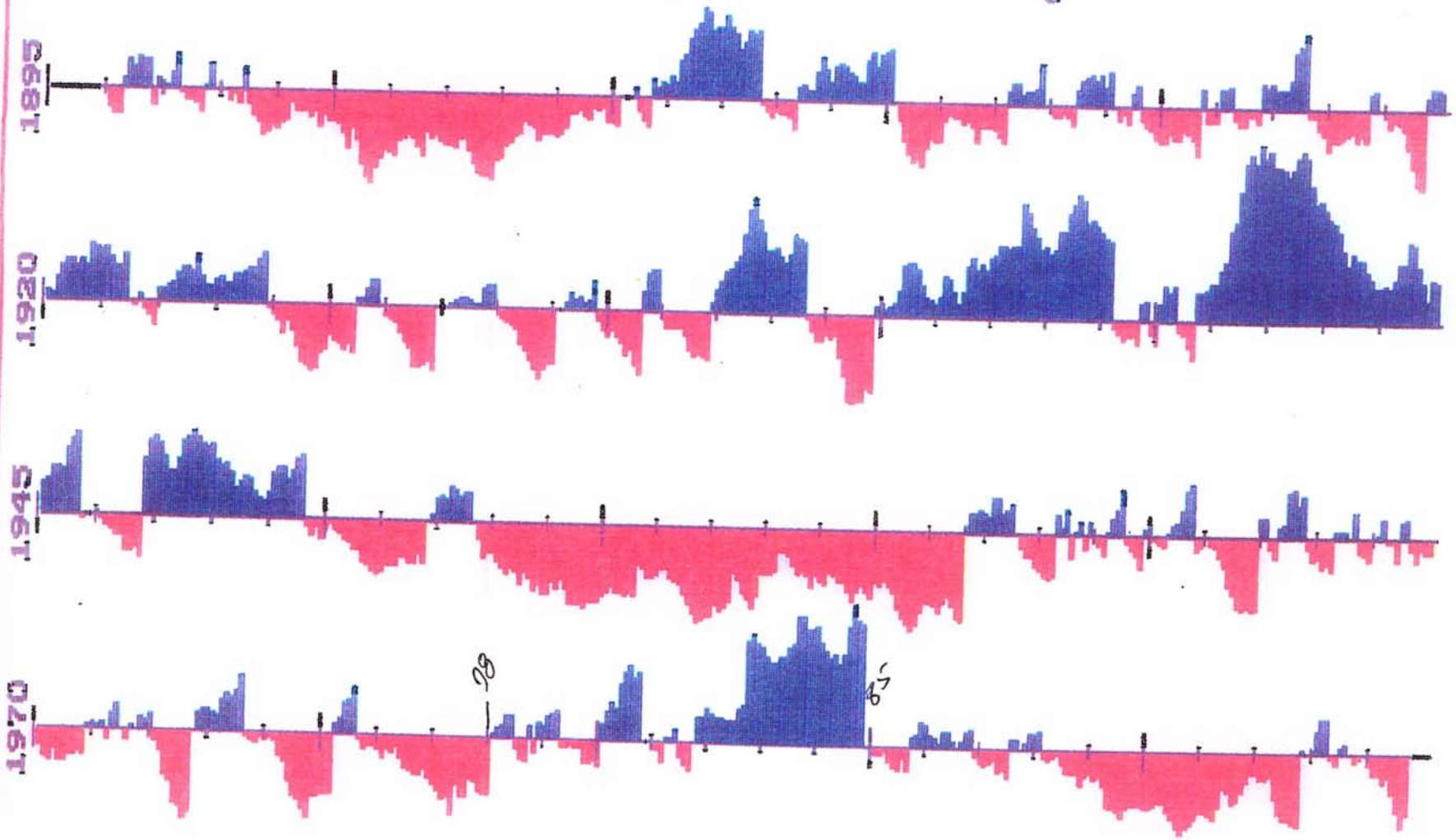
[i] Tannehill, Drought and Its Causes and Effects, (1947)

APPENDIX B
Historic Climate patterns in Utah
PALMER DROUGHT INDEX GRAPHS



Palmer Drought Severity Index



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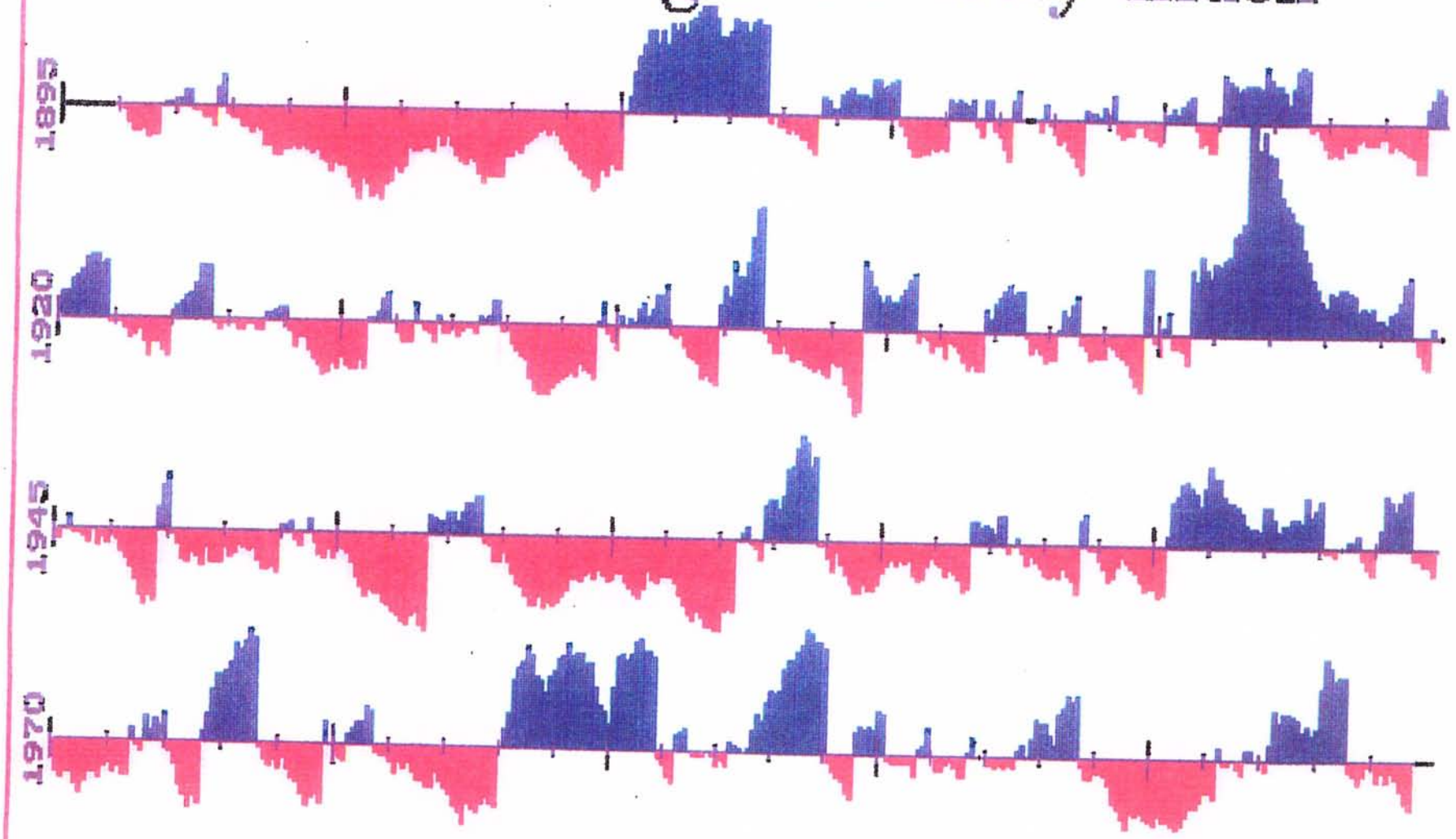

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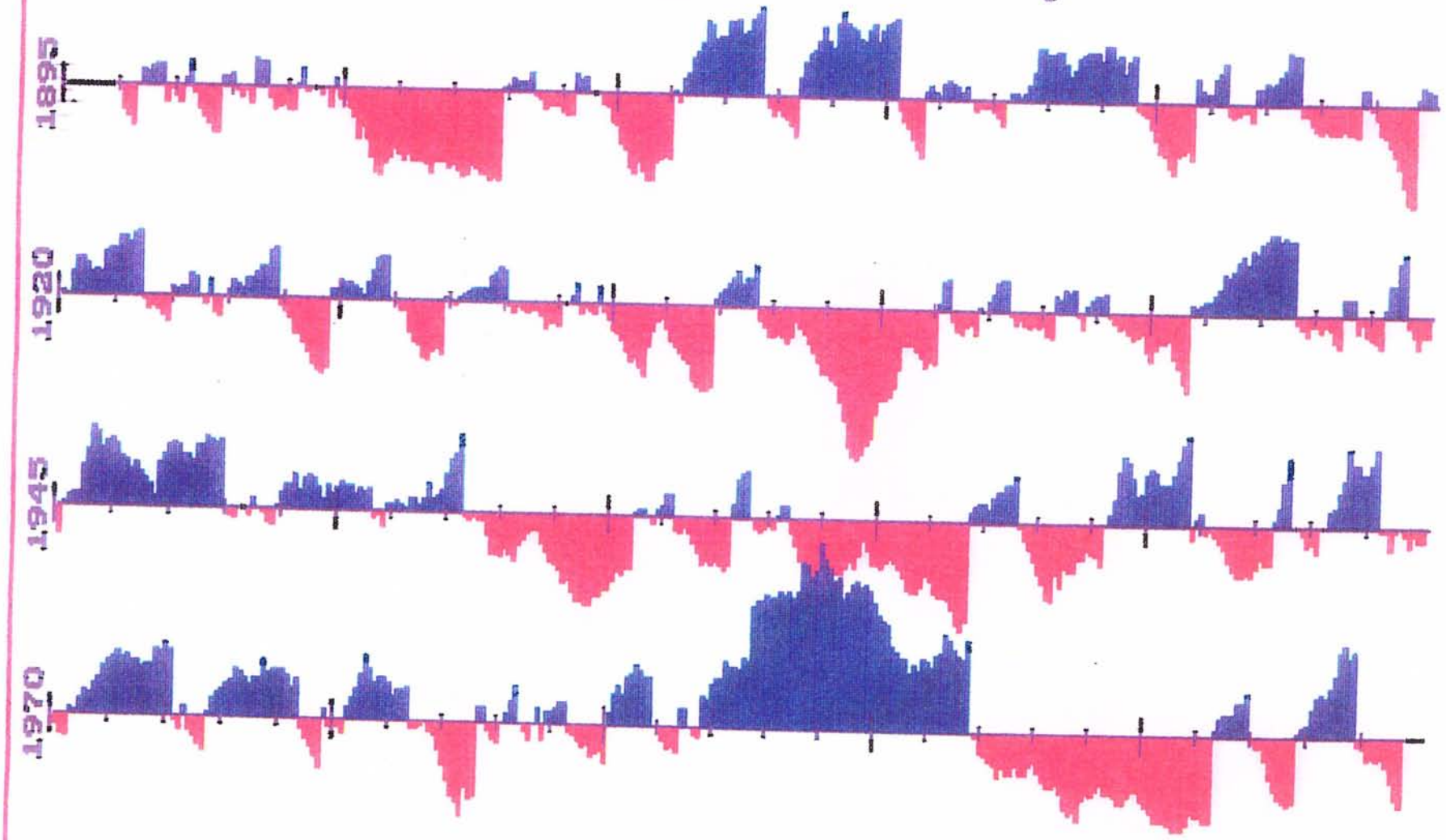

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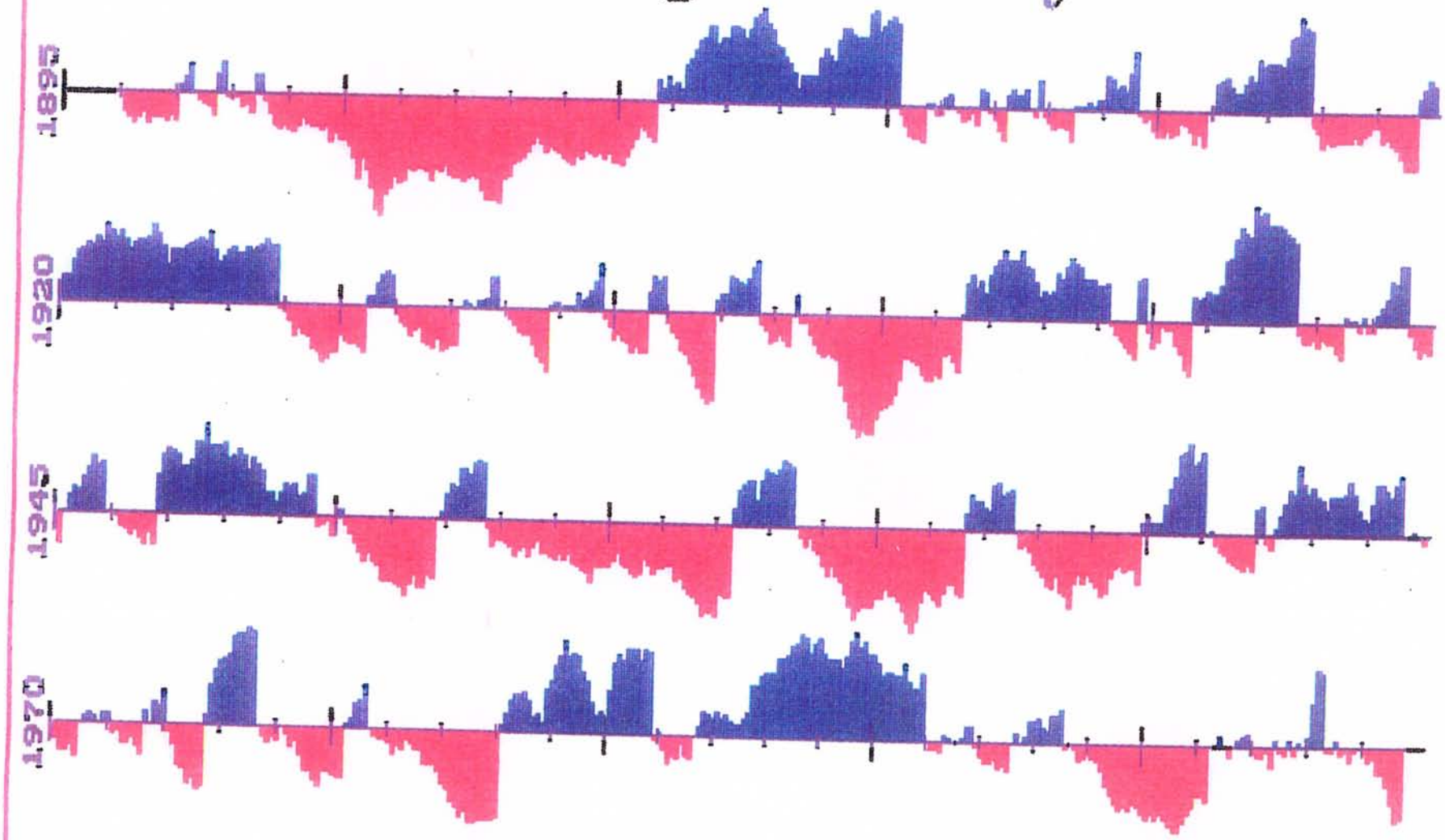

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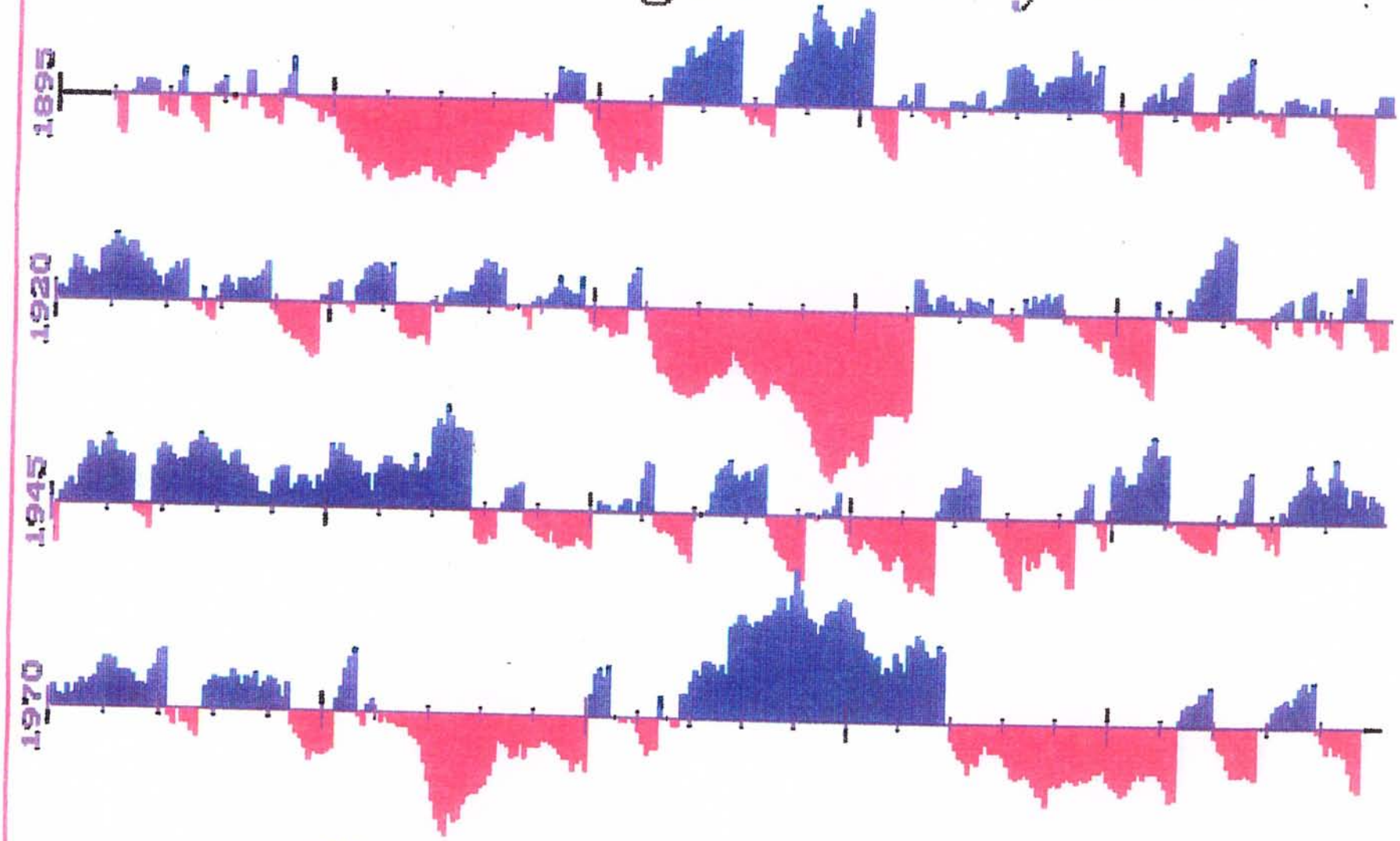

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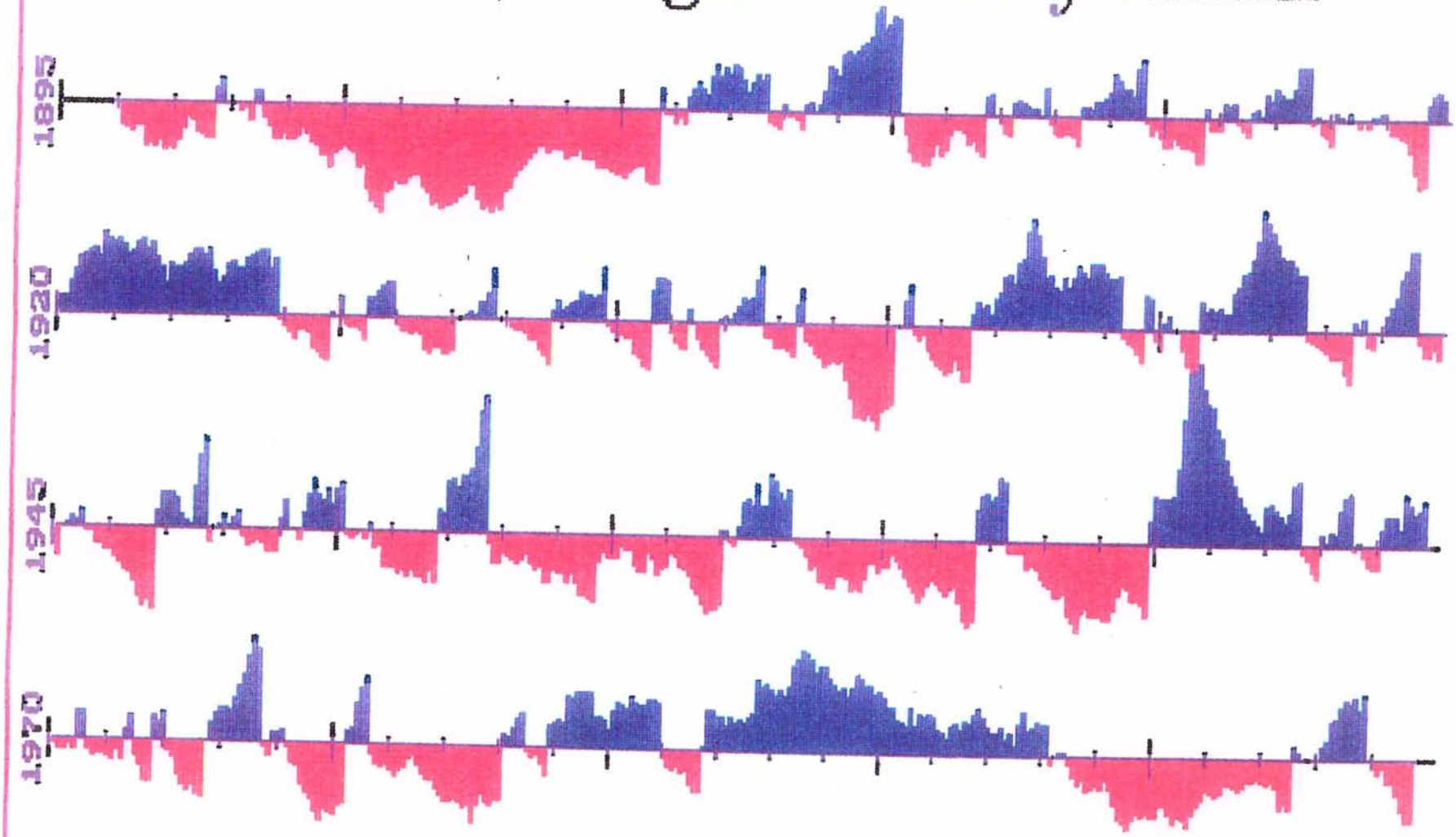

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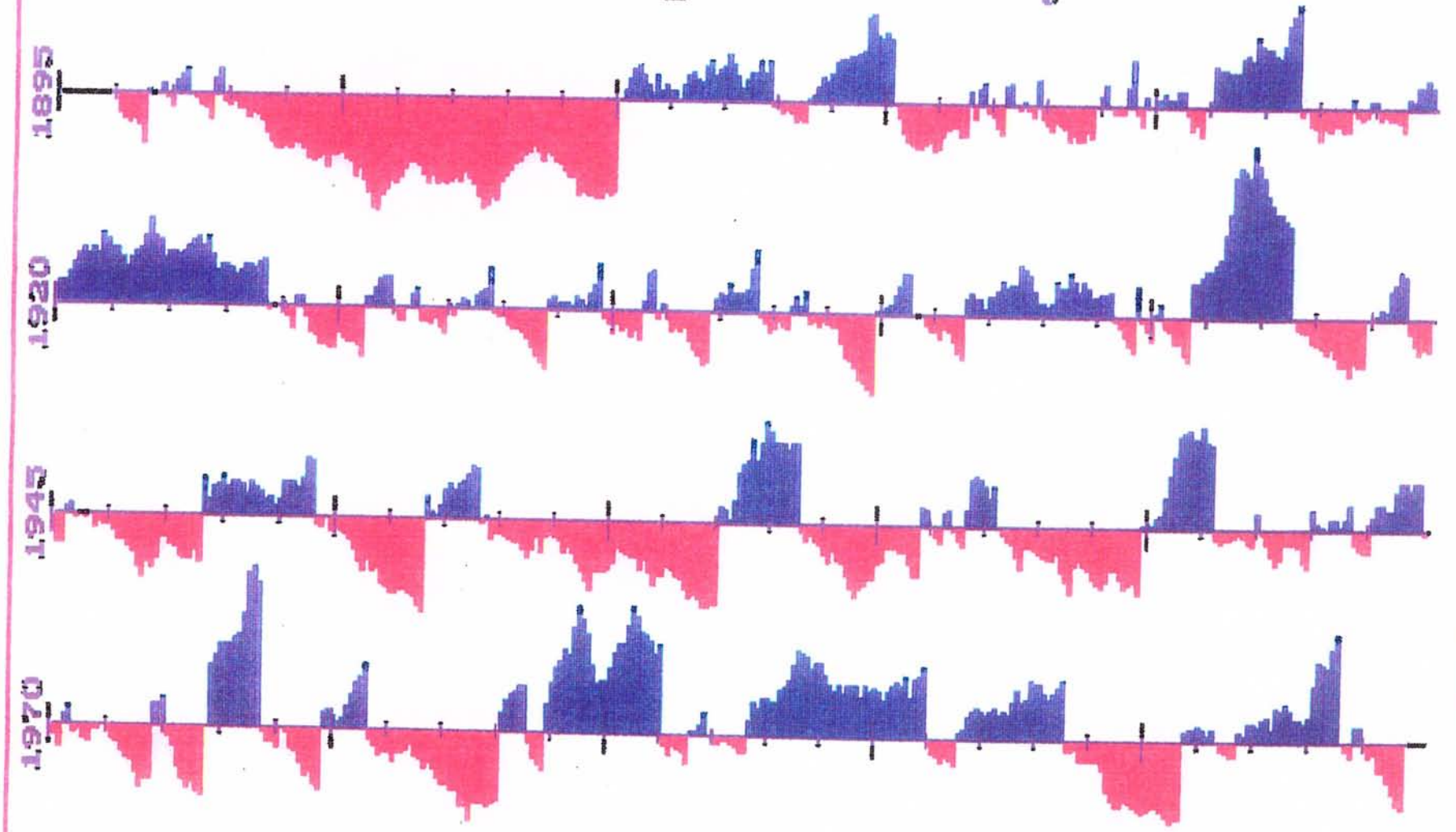

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Appendix C

Impacts of Drought

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs. Direct or primary impacts are usually biophysical. Conceptually speaking, the more removed the impact from the cause, the more complex the link to the cause. In fact, the web of impacts becomes so diffuse that it is very difficult to come up with financial estimates of damages. The impacts of drought can be categorized as economic, environmental, or social.

Not all impacts of drought are negative. Some agricultural producers outside the drought area or with surpluses benefit from higher prices, as do businesses that provide water-related services or alternatives to water-dependent services; these types of businesses were among the "winners" in the 1987–89 U.S. drought. Those producers in Utah who were able to grow hay in 2002 saw hay prices reach as high as $120 per ton. While clearly a positive impact to the hay producer, it hit livestock producers who were considering feeding hay very hard, further complicating already difficult decisions. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields both in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion.

Prolonged drought exacerbates issues with historic timber management regimes that have resulted in extra-ordinary fuel loads. These sites are easily stressed by drought, which makes them highly susceptible to insects and disease. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Hydropower production may also be curtailed significantly.

Impacts from Drought--Economic

Income loss is a crucial indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmer's face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region. Reduced water supply impairs the navigability of rivers and results in increased transportation costs because products must be transported by rail or truck. Utah does not have navigable rivers but when drought does impact rivers elsewhere, Utah citizens pay higher costs for rail and truck transportation.

The following are potential impacts that may or may not impact Utah.

Potential costs and losses to agricultural producers

- Annual and perennial crop losses
- Damage to crop quality
- Income loss for farmers due to reduced crop yields
- Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)
- Insect infestation and plant disease Wildlife damage to crops Increased irrigation costs
- Cost of new or supplemental water resource development (wells, dams, pipelines)

Costs and losses to livestock producers

- Reduced productivity of rangeland
- Reduced milk production
- Forced reduction of foundation stock (serious issue in Utah)
- Closure/limitation of public lands to grazing
- High cost/unavailability of water for livestock
- Cost of new or supplemental water resource development (wells, dams, pipelines)
- High cost/unavailability of feed for livestock
- Increased feed transportation costs
- High livestock mortality rates
- Disruption of reproduction cycles (delayed breeding, more miscarriages)
- Decreased stock weights (weaning weights)
- Increased predation
- Range fires (loss of additional habitat and forage)

Loss from timber and woodland production

- Wildland fires

- Tree disease
- Insect infestation (Ips confusus infestation in Four-corners—Pinyon)
- Impaired productivity of forest land
- Direct loss of trees, especially young ones (drought exacerbated mortality)

General economic effects

- Decreased land prices
- Loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, dairies, etc.)
- Unemployment from drought-related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
- Revenue losses to federal, state, and local governments (from reduced tax base)
- Reduction of economic development
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss
- Loss to recreation and tourism industry
- Loss to manufacturers and sellers of recreational equipment
- Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.

Energy-related effects

- Increased energy demand and reduced supply because of drought-related power curtailments
- Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power

Water Suppliers

- Revenue shortfalls and/or windfall profits
- Cost of water transport or transfer
- Cost of new or supplemental water resource development

Transportation Industry

- Decline in food production/disrupted food supply
- Increased importation of food (higher costs)

Impacts from Drought--Social

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster

relief. Most of the impacts specified as economic and environmental have social components as well. Globally, population out-migration is a significant problem in many countries, often stimulated by greater availability of food and water elsewhere. Migration is usually to urban areas within the stressed area or to regions outside the drought area; migration may even be too adjacent countries, creating refugee problems. In Utah, drought related farm and business failures also frequently lead to out-migration, usually to urban areas in the state and sometimes to other states. However, when the drought has abated, these persons (globally or in Utah) seldom return home, depriving rural areas of valuable human resources necessary for economic development. While little data about drought caused out-migration is available for Utah, it is recognized at least anecdotally.

"Our single largest export from Garfield County are our children followed by families who can't make a living wage."[i]

For the urban area to which they have immigrated, they place ever-increasing pressure on the social infrastructure, possibly leading to greater poverty and social unrest. Social impacts—some may or may not apply in Utah--include the following:

Health

- Mental and physical stress (e.g., anxiety, depression, loss of security, domestic violence)
- Health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced fire fighting capability, etc.)
- Reductions in nutrition (e.g., high-cost food limitations, stress-related dietary deficiencies)
- Loss of human life (e.g., from heat stress, suicides)
- Public safety from forest and range fires
- Increased respiratory ailments
- Increased disease caused by wildlife concentrations

Conflicts

- Water user conflicts (institutional restraints on water use)
- Political conflicts (public dissatisfaction with government drought response)
- Management conflicts (public dissatisfaction with government drought response)
- Other social conflicts (e.g., scientific, media-based)

Reduced quality of life, changes in lifestyle

- Increased poverty in general
- Population migrations (rural to urban areas)
- Loss of aesthetic values
- Reduction or modification of recreational activities

Miscellaneous

- Disruption of cultural belief systems (e.g., religious and scientific views of natural hazards)
- Reevaluation of social values (e.g., priorities, needs, rights)
- Perceptions of inequity in relief, possibly related to socioeconomic status, ethnicity, age, gender, seniority
- Loss of cultural sites
- Increased data/information needs, coordination of dissemination activities

Impacts from Drought--Environmental

Environmental losses are the result of damage to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Not all of the following impacts have occurred in Utah; however, the list may not include others that have.

Damage to animal species

- Reduction and degradation of fish and wildlife habitat (loss of fish and other aquatic organisms due to decreased flows)
- Lack of feed and drinking water
- Greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion
- Disease
- Increased vulnerability to predation (from species concentrated near water)
- Migration and concentration (loss of wildlife in some areas and too many wildlife in other areas)
- Increased stress to endangered species
- Loss of biodiversity

Hydrological effects

- Lower water levels in reservoirs, lakes, and ponds
- Reduced flow from springs
- Reduced streamflow
- Loss of wetlands
- Estuarine impacts (e.g., changes in salinity levels)

- Increased groundwater depletion, land subsidence, reduced recharge
- Water quality effects (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)

Damage to plant communities

- Loss of biodiversity
- Loss of trees from urban landscapes, shelterbelts, wooded conservation areas
- Loss of preferred stand density through plant mortality (lose not only forage production but also infiltration of water—impacts to aquifers)
- Conversion from cool season to warm season species (a probable consequence of diminished spring moisture—over several sequential years--and normal yearly summer monsoon precipitation)
- Composition changes through invasion by more aggressive and drought tolerant exotic species (grasses, forbs, shrubs, and trees)
- Increased number and severity of fires due to low fuel moisture caused by extended drought
- Wind and water erosion of soils, reduced soil quality
- Air quality effects (e.g., dust, pollutants)

- Visual and landscape quality (e.g., dust, vegetative cover, etc.)

This drought cycle, especially during 2002, has clearly impacted the state of Utah in a variety of ways. Some areas like the southeastern corner of the state have experienced more than perhaps the northwestern corner. Yet the cumulative impact from this cycle will be felt by Utahn's for years to come.

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[i] Louise Liston, Introductory remarks at NACo, 1997

Appendix D

Utah Bureau of Land Management Standards and Guidelines

A. Standard 1. Upland soils exhibit permeability and infiltration rates that sustain or improve site productivity, considering the soil type, climate, and landform. As indicated by:

a) Sufficient cover and litter to protect the soil surface from excessive water and wind erosion, promote infiltration, detain surface flow, and retard soil moisture loss by evaporation.

b) The absence of indicators of excessive erosion such as rills, soil pedestals, and actively eroding gullies.

c) The appropriate amount, type, and distribution of vegetation reflecting the presence of the Desired Plant Community [DPC], where identified in a land use plan, or where the DPC is not identified, a community that equally sustains the desired level of productivity and properly functioning ecological conditions.

B. Standard 2. Riparian and wetland areas are in properly functioning condition. Stream channel morphology and functions are appropriate to soil type, climate and landform.

As indicated by:

a) Streambank vegetation consisting of, or showing a trend toward, species with root masses capable of withstanding high streamflow events. Vegetative cover adequate to protect stream banks and dissipate streamflow energy associated with high- water flows, protect against accelerated erosion, capture sediment, and provide for groundwater recharge.

b) Vegetation reflecting: Desired Plant Community, maintenance of riparian and wetland soil moisture characteristics, diverse age structure and composition, high vigor, large woody debris when site potential allows, and providing food, cover and other habitat needs for dependent animal species.

c) Revegetating point bars; lateral stream movement associated with natural sinuosity; channel width, depth, pool frequency and roughness appropriate to landscape position.

d) Active floodplain.

C. Standard 3. Desired species, including native, threatened, endangered, and special-status species, are maintained at a level appropriate for the site and species

involved.

As indicated by:

a) Frequency, diversity, density, age classes, and productivity of desired native species necessary to ensure reproductive capability and survival.

b) Habitats connected at a level to enhance species survival.

c) Native species reoccupy habitat niches and voids caused by disturbances unless management objectives call for introduction or maintenance of nonnative species.

d) Appropriate amount, type, and distribution of vegetation reflecting the presence of (1) the Desired Plant Community [DPC], where identified in a land use plan conforming to these Standards, or (2) where the DPC is identified a community that equally sustains the desired level of productivity and properly functioning ecological processes.

D. Standard 4. BLM will apply and comply with water quality standards established by the State of Utah (R.317-2) and the Federal Clean Water and Safe Drinking Water Acts. Activities on BLM Lands will support the designated beneficial uses described in the Utah Water Quality Standards (R.317-2) for surface and groundwater. (1)

As indicated by:

a) Measurement of nutrient loads, total dissolved solids, chemical constituents, fecal coliform, water temperature and other water quality parameters.

b) Macro-invertebrate communities that indicate water quality meet aquatic objectives.

(1) BLM will continue to coordinate monitoring water quality activities with other Federal, State and technical agencies.

Utah Bureau of Land Management--Guidelines for Grazing Management

A. Grazing management practices will be implemented that:

a) Maintain sufficient residual vegetation and litter on both upland and riparian sites to protect the soil from wind and water erosion and support ecological functions;

b) Promote attainment or maintenance of proper functioning condition riparian/wetland areas, appropriate stream channel morphology, desired soil permeability and infiltration, and appropriate soil conditions and kinds and amounts of plants and animals to support the hydrologic cycle, nutrient cycle, and energy flow.

c) Meet the physiological requirements of desired plants and facilitate reproduction and maintenance of desired plants to the extent natural conditions allow;

d) Maintain viable and diverse populations of plants and animals appropriate for the site;

e) Provide or improve, within the limits of site potentials, habitat for Threatened or Endangered Species;

f) Avoid grazing management conflicts with other species that have the potential of becoming protected or special status species;

g) Encourage innovation, experimentation and the ultimate development of alternatives to improve rangeland management practices;

h) Give priority to rangeland improvement projects and land treatments that offer the best opportunity for achieving the Standards.

B. 2. Any spring or seep developments will be designed and constructed to protect ecological process and functions and improve livestock, wild horse and wildlife distribution.

C. New rangeland projects for grazing will be constructed in a manner consistent with the Standards. Considering economic circumstances and site limitations, existing rangeland projects and facilities that conflict with the achievement or maintenance of the Standards will be relocated and/or modified.

D. Livestock salt blocks and other nutritional supplements will be located away from riparian/wetland areas or other permanently located, or other natural water sources. It is recommended that the locations of these supplements be moved every year.

E. The use and perpetuation of native species will be emphasized. However, when restoring or rehabilitating disturbed or degraded rangelands non-intrusive, nonnative plant species are appropriate for use where native species (a) are not available, (b) are not economically feasible, can not achieve ecological objectives as well as nonnative species, and/or (d) cannot compete with already established native species.

F. When rangeland manipulations are necessary, the best management practices, including biological processes, fire and intensive grazing, will be utilized prior to the use of chemical or mechanical manipulations.

G. When establishing grazing practices and rangeland improvements, the quality of the outdoor recreation experience is to be considered. Aesthetic and scenic values, water, campsites and opportunities for solitude are among those considerations.

H. Feeding of hay and other harvested forage (which does not refer to miscellaneous salt, protein, and other supplements) for the purpose of substituting for inadequate natural forage will not be conducted on BLM lands other than in (a) emergency situations where no other resource exists and animal survival is in jeopardy, or (b) situations where the Authorized Officer determines such a practice will assist in meeting a Standard or attaining a management objective.

I. In order to eliminate, minimize, or limit the spread of noxious weeds, (a) only hay cubes, hay pellets, or certified weed-free hay will be fed on BLM lands, and (b) reasonable adjustments in grazing methods, methods of transport, and animal husbandry practices will be applied.

J. To avoid contamination of water sources and inadvertent damage to non-target species, aerial application of pesticides will not be allowed within 100 feet of a riparian/wetland area unless the product is registered for such use by the EPA.

K. On rangelands where a standard is not being met, and conditions are moving toward meeting the standard, grazing may be allowed to continue. On lands where a standard is not being met, conditions are not improving toward meeting the standard or other management objectives, and livestock grazing is deemed responsible, administrative action with regard to livestock will be taken by the Authorized Officer pursuant to CFR 4180.2(c).

L. Where it can be determined that more than one kind of grazing animal is responsible for failure to achieve a Standard, and adjustments in management are required, those adjustments will be made to each kind of animal, based on interagency cooperation as needed, in proportion to their degree of responsibility.

M. Rangelands that have been burned, reseeded or otherwise treated to alter vegetative composition will be closed to livestock grazing as follows: (1) burned rangelands, whether by wildfire or prescribed burning, will be ungrazed for a minimum of one complete growing season following the burn; and (2) rangelands that have been reseeded or otherwise chemically or mechanically treated will be ungrazed for a minimum of two complete growing seasons.

N. Conversions in kind of livestock (such as from sheep to cattle) will be analyzed in light of Rangeland Health Standards. Where such conversions are not adverse to achieving a Standard, or they are not in conflict with BLM land use plans, the conversion will be allowed.

Appendix E

Strategies for Management—Tools for Assessment of Condition and Management Options

1. Standardized Precipitation Index (http://www.wrcc.dri.edu/cgi-bin/spiFmap.pl?spi72) as a way of measuring drought that is different from the Palmer drought index (PDSI). Like the PDSI, this index is negative for drought, and positive for wet conditions. But the SPI is a probability index that considers only precipitation, while Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff). The SPI is an index based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive.

   The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero. Positive SPI values indicate greater than median precipitation, while negative values indicate less than median precipitation. A drought event occurs any time the SPI is continuously negative and reaches an intensity where the SPI is –1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and an intensity for each month that the event continues. The accumulated magnitude of drought can also be drought magnitude, and it is the positive sum of the SPI for all the months within a drought event.

   Since the SPI is standardized, both drought and wet spell conditions can be represented for all climate types. This index also determines criteria for the

Standardized Precipitation Index Value	
2.0 or More	Extremely Wet
1.5 to 1.99	Very Wet
1.0 to 1.49	Moderately Wet
0.99 to –0.99	Near Normal
-1.0 to –1.49	Moderately Dry
2.0 or More	Extremely Wet
1.5 to 1.99	Very Wet

   duration of a drought or wet spell event for any time scale. For example, the beginning of a drought is anytime when the SPI value is negative for a continuous period of time and gets to be equal to/less than a value of –1.0. This event would then end whenever the value became positive. If you want to find the total

magnitude of the drought event, all you need to do is take the absolute value of the sum of all SPI values for the months in which the event occurred.

There are some advantages to the SPI, one, which includes the fact that it is a much less complex index to determine than the Palmer Index. Another advantage is that is can provide early warnings of an on-coming drought and its possible severity. This early warning could give people and businesses time to prepare for the possible on-set of a long-term dry spell.

2. **Palmer Drought Severity Index.**
   (http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif)

The Palmer is a soil moisture algorithm calibrated for relatively homogeneous regions. Government agencies and states rely on the Palmer to trigger drought relief programs. Palmer values may lag emerging droughts by several months; less well suited for mountainous land or areas of frequent climatic extremes; complex, has an unspecified, built-in time scale that can be misleading. The only type of precipitation taken into consideration is rain. Things such as snowfall or frozen ground, things that can affect the moisture content of the ground a great deal, are not looked at. In regions where snowfall is a significant source of moisture, this index may become inaccurate. It also depends on how much snowfall the region gets as to how inaccurate the index would be.

Palmer Drought Severity Index Values	
4.0 or More	Extremely Wet
3.0 to 3.99	Very Wet
2.0 to 2.99	Moderately Wet
1.0 to 1.99	Slightly Wet
0.5 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-0.5 to -0.99	Incipient Dry Spell
-1.0 to -1.99	Mild Drought
-2.0 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 to -4.99	Extreme Drought

The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. From the inputs, all the basic terms of the water balance equation can be determined, including evapotranspiration, soil recharge, runoff, and moisture loss from the surface layer.

The palmer index is a very popular index that is typically calculated on a monthly basis, but weekly calculations (especially during the growing season) are also available. One reason the index is popular is due to the fact that it is the most effective in measuring impacts affected by soil conditions, such as agriculture. It is a good tool for monitoring droughts and is used to begin actions/plans dealing with areas affected by a significant drought. The palmer index also provides good

opportunities to take current soil conditions and compare them to periods of drought/wet spell in the past.

It is most effective measuring impacts sensitive to soil moisture conditions. It has also been useful as a drought-monitoring tool and has been used to trigger actions associated with drought contingency plans. Positive characteristics of the Palmer Index that contribute to its popularity: (1) it provides decision makers with a measurement of the abnormality of recent weather for a region; (2) it provides an opportunity to place current conditions in historical perspective; and (3) it provides spatial and temporal representations of historical droughts.

2. **Percent of Normal Precipitation.** (http://www.wcc.nrcs.usda.gov/water/snow/past_up2.pl?report=ut&year=2002&month=09&day=30) The Percent of Normal Precipitation is a simple calculation well suited to the needs of meteorologists and general audiences. It is quite effective for comparing a single region or season. The percent of normal precipitation is one of the simplest measurements of rainfall for a location. It is calculated by dividing actual precipitation by normal precipitation -- typically considered to be a 30-year mean -- and multiplying by 100%. This can be calculated for a variety of time scales. Normal precipitation for a specific location is considered to be 100%. One disadvantage of this index is the fact that it is easily misunderstood. This is a mathematically constructed value that doesn't always match up with what you would expect the weather to be. Another disadvantage is that the average precipitation is sometimes different than the median precipitation (meaning that it is a value exceeded by half of the precipitation events). Using this index is implying that the average and median values are the same, but monthly/seasonal scales of precipitation do not have normal distributions.

   Mountain data from NRCS SNOTEL Sites provide percent of normal precipitation data for each of the water basins in Utah. In addition, regional weekly percent of normal precipitation maps are available on the Climate Prediction Center's website: (www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/us_monthly_pct_precip.html)

3. **Climate Prediction Center's Drought Monitor Report** (http://www.drought.unl.edu/dm/monitor.html)

   On each Thursday, the CPC, together with the United States Department of Agriculture and the
   National Drought Mitigation Center in Lincoln, Nebraska, issues a weekly drought assessment
   called the United States Drought Monitor. The Monitor provides a consolidated depiction of
   national drought conditions based on a combination of drought indicators and field reports. The

Drought Monitor is intended to provide a general and up-to-date summary of current drought conditions across the 50 states, Puerto Rico, and the Pacific possessions. This national product is designed to provide the "big picture" so the general public, media, government officials, and others can see what is happening around the country. To keep the map from becoming too complex, the drought categories shown represent typical drought intensities, not every drought intensity, within the area. The map is not designed to depict local conditions or to replace drought warnings and watches issued by local or regional government entities.

D0-D4: The Drought Monitor summary map identifies general drought areas, labeling droughts by intensity, with D1 being the least intense and D4 being the most intense. D0, drought watch areas, are either drying out and possibly heading for drought, or are recovering from drought but not yet back to normal, suffering long-term impacts such as low reservoir levels. **A, W and F:** Since "drought" means a moisture deficit bad enough to have social, environmental or economic effects, a description of what the primary physical effects are generally included: **A** = agricultural effects, both crops and livestock; **W** = water supplies, rivers, groundwater and reservoirs; **F** = fire danger (wildfires)

Drought intensity categories are based on six key indicators and numerous supplementary indicators. The accompanying drought severity classification table shows the ranges for each indicator for each dryness level. Because the ranges of the various indicators often don't coincide, the final drought category tends to be based on what the majority of the indicators show. The analysts producing the map also weight the indices according to how well they perform in various parts of the country and at different times of the year. Also, additional indicators are often needed in the West, where winter snowfall has a strong bearing on water supplies.

Drought Severity Classification								
		RANGES						
Category	Description	Possible Impacts	Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Percent of Normal Precip	Standardized Precipitation Index (SPI)	Satellite Vegetation Health Index
D0	Abnormally Dry	Going into drought: short-term	-1.0 to -1.9	21-30	21-30	<75 % for 3	-0.5 to -0.7	36-45

		dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.				months		
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested	-2.0 to -2.9	11-20	11-20	<70 % for 3 months	-0.8 to -1.2	26-35
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common:	-3.0 to -3.9	6-10	6-10	<65 % for 6 months	-1.3 to -1.5	16-25

		water restrictions imposed						
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	<60 % for 6 months	-1.6 to -1.9	6-15
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies	-5.0 or less	0-2	0-2	<65 % for 12 months	-2.0 or less	1-5

4. **Biomass Stress Indices.** Modis (or Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the TERRA (EOS AM) and Aqua (EOS PM) satellites. Terra's orbit around the earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire earth's surface every 1 to 2 days (daily in the northern latitudes), acquiring data in 36 co-registered spectral bands, or groups of wavelengths at moderate spatial resolutions of 250, 500, and 1000 meters.

The bands used are 250-meter resolution. Indices are an indicator of the loss of biomass. To identify the areas of biomass stress, MODIS band 1 (visible red) and band 2 (infra red) are used in the equation **2/infra red. Stress indices values (5 ranges of color sets in each value, varying from dark green to dark red) of low, moderate, high, very high, and extreme are determined and mapped.

During 2002, satellite data was compiled at the USDA Forest Service (USFS) Remote Sensing Applications Center in cooperation with NASA Goddard Space Flight Center, and the University of Maryland. Region 4 USDA Forest Service then did biomass stress

processing. Imagery was collected by the Moderate Resolution Imaging Spectroradiometer (MODIS). Future availability of this drought-monitoring index is contingent upon USFS funding and staffing.

5. Vegetation Health Index. Since drought covers large areas, it is difficult to monitor them using conventional systems. In recent years, the National Oceanic and Atmospheric Administration (NOAA) has designed a new Advanced Very High Resolution Radiometer (AVHRR) based Vegetation Condition Index (VCI) and Temperature Condition Index (TCI), which have been useful in detecting and monitoring large-area drought-related vegetation stress. Vegetation is monitored from NOAA operational polar-orbiting satellites. The VCI and TCI are used to determine the water and temperature related vegetation stress occurring during drought.

The images are color-coded maps of vegetation condition (health) estimated by the Vegetation and Temperature Condition Index (VT). The VT is a numerical index, which changes from 0 to 100 characterizing change in vegetation conditions from extremely poor (0) to excellent (100). Fair conditions are coded by green color (50), which changes to brown and red when conditions deteriorate and to blue when they improve. The VT reflects indirectly a combination of chlorophyll and moisture content in the vegetation and also changes in thermal conditions at the surface. This new approach combines the visible, near infrared, and thermal radiances in a numerical index characterizing vegetation health. This approach is extremely useful in detecting and monitoring such complex and difficult-to-identify phenomenon as drought. The VT values below 35 are used for identifying vegetation stress, which is an indirect drought indicator. The VT is very useful for early drought detection, assessing drought area coverage, duration, and intensity, and for monitoring drought impacts on vegetation and agricultural crops.

Maps can be downloaded from NOAA/NESDIS (National Environmental Satellite Data and Information Service) website at http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci/usavhcd.html.
Maps are colored depicting levels of stress using a band of nine colors indicating stress, fair, or favorable conditions.

7. Visual Greenness. NOAA (National Climatic Data Center, Department of Commerce). Over the last 10 years a team from NOAA has been developing techniques and algorithms that process microwave imagery from the Special Sensor Microwave Imager into climate products that assess surface wetness, temperature, and snow cover around the world. This data set is unique and provides valuable insights on growing conditions around the world in near real time. Furthermore, since microwave emission penetrates through clouds, the satellite can observe surface conditions when Infrared and visible imagery are unavailable. In addition, they have based all the data on a 14-year base period, in order to allow the user to easily interpret the significance of the current conditions (relative to the previous years).

Vegetation Greenness Maps are derived weekly from Normalized Difference Vegetation Index (NDVI) data observed by satellites and provided by the EROS Data Center, U.S.

Geological Survey and the USDA Forest Service, Intermountain Research Station. These maps have a 1.1-kilometer (.6 mile) spatial resolution.

Visual Greenness (VG) - Indicates how green each pixel is in relation to a standard reference such as a highly green and densely vegetated agricultural field. An image is produced that portrays **vegetation greenness, as you would expect to see** if you were flying over the landscape. In this context, normally dry areas will look cured compared to fully vegetated areas.

Maps can be downloaded from www.agribiz.com/weather/visual.html. Maps are colored depicting levels of greenness (water content) using 11 colors ranging from deep red to blue in 10% increments, with 1-10% being deep red and over 100% being water.

Extension Service

OREGON STATE UNIVERSITY

Corvallis, Oregon 97331

THE GRAZIER

No. 314 November 2002

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COMING EVENTS

Listen to the Ripples: Working Together for Watershed Communities. Nov. 20-23, 2002, Deschutes County Fair and Expo Center, Redmond, OR. Joint Conference, 7th Biennial Oregon Watershed Enhancement Board and 53rd Annual Meeting Oregon Association of Conservation Districts. The program is described as broadly designed for soil and water conservation districts, watershed councils, federal and state agencies, landowners, academics, local officials, and others interested in their local natural resources. Register online at: www.oweb.state.or.us

Cows and Creeks Symposium Dec. 13, 2002, Meadow Lakes Golf Course, Prineville, OR. Speakers include Dr. Mike Borman (Rangeland Resources Extension Specialist, Dept. of Rangeland Resources, OSU) with an introduction on watershed considerations and a discussion of research results and implications from a water temperature research project in the Burnt River system; Dr. Rob Atwill (Univ. of California, Davis, Extension Veterinarian) speaking on "Livestock and Water Quality: How Do We Know That Livestock are the Problem?"; Dr. Larry Larson (Dept. of Rangeland Resources, OSU, and OSU Agriculture Program at Eastern Oregon University) speaking on the topic of "Nonuse and Changes in Riparian Areas"; Dr. Tim Delcurto (Eastern Oregon Agricultural Research Station, Union) on "Livestock Management and Behavior in Riparian Areas"; and Dr. Derek Bailey (Montana State University, Havre Research Station) on "Livestock Management and Behavior in Uplands." Registration includes lunch and handouts. Early registration by Dec. 2 is $10. Later registration is $15. The symposium is sponsored by the Crook County Extension Office and Crook County Soil & Water Conservation District with program support by Oregon Watershed Enhancement Board. For registration and program information, contact Tim Deboodt or Cory Parsons at 541-447-6228.

Society for Range Management 56th Annual Meeting. Feb. 1-7, 2003, Casper, WY. Meeting theme is "Rangelands – Diversity Through Time," and the primary focus of the technical sessions and symposia will be rangeland ecology, and multiple values associated with rangeland ecosystems. Currently planned sessions will be arranged around the following topics: Rangeland Ecology: Fire Ecology, Riparian Ecology, Drivers in Rangeland Ecosystems, Rangeland Bird Ecology, Endangered Species, Nutrient Dynamics; Rangeland Economics and Sociology: Conservation Easements and Grass Banks, Cooperative Management; Plant/Animal Relationships: Animal Behavior, Plant/Animal Interactions; Rangeland Management: Invasive Species, History – Pleistocene to Present, Interspecies Dynamics; Technology and Management: Rapid Assessment Techniques, GIS and Remote Sensing. Graduate Student competitions will be held for both papers and posters for both Ph.D. and M.S. students. Program and registration information is available on the SRM homepage at: http://www.rangelands.org

Agriculture, Family and Community Development, 4-H Youth, Forestry, Energy, and Extension Sea Grant programs. Oregon State University, United States Department of Agriculture, and Oregon counties cooperating. Oregon State University Extension Service offers educational programs, activities and materials without discrimination based on race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, or disabled veteran or Vietnam era veteran status. Oregon State University Extension service is an Equal Opportunity Employer.

Second Annual Northwest Stream Restoration Design Symposium. Feb. 4-7, 2003, Skamania Lodge, Stevenson, WA. The symposium provides a forum for stream restoration professionals to exchange ideas and compare lessons learned. The preliminary program is on the conference website: http://rrnw.org/Skamania2003/

Livestock Management for Fisheries Habitat: A collaborative approach. April 29-30, 2003, Prineville, OR. This workshop is intended to bring together fisheries biologists and rangeland managers to present fisheries and livestock needs, and management strategies that will provide habitat for both. The workshop is being jointly hosted by the Pacific Northwest Section, Society for Range Management and the Oregon Chapter, American Fisheries Society. Program details and registration information will be in the Piscatorial Press and the PNW Section SRM newsletter. The next *Grazier* will have additional information as well.

GRAZING MANAGEMENT GUIDELINES

(**Editor's Note**: Editor's Note: This is the (late) first issue of *The Grazier* for the 2002-03 academic year. I thought it might be useful to revisit some basics of range and pasture management. The following information was prepared by Kevin Guinn, Area Range Conservationist, Natural Resource Conservation Service, Ephrata, WA. It has been through technical review by Gerald Rouse (State Range Management Specialist, NRCS, Spokane, WA) and Dr. David Briske, Professor of Ecophysiology, Dept. of Rangeland Ecology and Management, Texas A&M University. I have modified the format to save space and I have edited a bit, but not much. Keep in mind that some of the numbers presented are generic. They represent rule-of-thumb guidelines if specific responses by specific grasses under specific conditions are not known.

- There is no such thing as Range Readiness for plants.
- The Critical Period is not early spring.
- Regrowth does not come from root carbohydrates. It does come from current photosynthate produced by existing leaf area.

I. Effects of Grazing

Every function of a plant is affected by grazing:
- Size of food factory (photosynthetic leaf area).
- Food Production.
- Root Growth.
- Water and nutrient availability.
- Carbohydrate storage in shoots.

The effect of grazing is dependent upon:
- Season of use and growth stage.
- Grazing intensity (remaining leaf area), which directly affects light interception.
- Frequency of grazing (regrowth grazed).
- Type of plant (warm season vs. cool season; forb, shrub, vs. grass).
- Availability of growing points and new tiller buds.
- Shoot carbohydrate reserves.
- Size of root system.
- Physical effects of grazing animals on plants and soil (trampling may be negative but nutrient cycling a positive response).

How grazing at different times of the year affects grasses:
(Note: The dates below are from Ephrata, WA at 1500 feet; Table 1).

►When grazing is relatively low risk: Summer 6/26-8/30, Fall 9/1-11/30, Winter 12/1-2/28
* Grazing has little effect on plant growth unless grazing is severe.
* The reduction of tillers under heavy grazing is due to higher over-winter mortality rather than an inadequate number of tillers emerging in the fall.
* *Fall green up is not free forage!* It is the basis for next year's production.
* Cured vegetation protects new tillers.
* Cured vegetation provides energy and green growth provides protein to animals.
* Wolf plants are not as likely to be avoided during this period.

►When grazing is somewhat higher risk: Early Spring 3/1-4/15
* Has little effect as long as no more than 50% of current growth is removed and duration and frequency are controlled.
* Plants are set for vegetative growth and able to rapidly replace lost leaves and stems, if growing conditions are favorable.

* Growing points are not elevated, and thus, protected.

Myth #1: Grazing after range readiness is best for bunchgrasses. This is WRONG! The range readiness concept is outdated.

* All you need is the soil to be firm enough to prevent soil compaction and enough growth for the livestock.
* Consider the effect of leaf area and air temperature on growth rate and the likelihood of the forage supply staying ahead of the livestock.
* You need enough old growth and magnesium blocks to avoid grass tetany.

►When grazing is highest risk (CRITICAL PERIOD): Late Spring 3/20-6/25
* The growing points are elevated, and thus, vulnerable.
* If growing points are removed, replacement tillers must come from axillary buds.
* Plants are committed to seed production.
* The ability to replace lost leaves and stems is low and declining.

Myth #2: The critical period is early spring. This is WRONG!
The critical period is when plants are trying to make seed (boot stage through soft dough stage).

* At Ephrata, WA from 1988-1994, the critical period came between 3/20 and 6/25. See the chart "Comparing the Years."
* Grazing annually during the critical period can have a severe impact and even kill bunchgrasses.

The effects of grazing depends upon what's removed.
- Leaf blades only- minimal if growing conditions are good.
- Leaf sheaths- regrowth will be delayed.
- Apical meristem- tiller will die; must be replaced by activation of an axillary bud.

How grazing affects roots: *(Numbers are based on a USDA report by Crider in 1955 in a greenhouse clipping study. Actual grazing may have different results.)*
- As long as no more than 50% of top-growth is removed, grazing has little effect on the roots.
- At 60% use, HALF of the roots stop growing for 12 days.
- At 80% use, ALL of the roots stop growing for 12 days.
- At 90% use, ALL of the roots stop growing for 18 days.
- The growing season at Ephrata is 90-140 days (K. Guinn study). 12-18 days relates to 10-20% of the growing season when the plants are not producing.
- Under progressively heavier grazing, roots will have fewer branches; become sparser, shorter, and more concentrated in the top portion of the soil profile.
- A balance between roots and top-growth will always occur.
- To minimize weed invasion, have plants with a large, healthy root system.
- This is why we should generally graze no more than 50% of the top-growth during the growing season.

How grazing affects plant growth.

- For sod-formers (non-jointed species):
  * Maintain leaves and growing points and the plant keeps producing.
  * Graze the leaf growing points and the plants are hurt.

- For bunchgrasses (jointed species):

  * As seedheads are elevated on the stem, they become vulnerable to removal.
  * Graze the growing points of stems, you not only kill the stems, but new growth must come from axillary buds which reduces next year's stems, and
  * Less than a 1:1 ratio of stem replacement for next year may reduce the stand.

Where does regrowth come from?

Myth #3: Root carbohydrate reserve is most important for regrowth following a severe grazing. This is WRONG!

- There is no indication that root carbohydrate reserves are mobilized for shoot growth.
- Most reserves are located in stem bases.
- Reserves in grass stem bases affect regrowth for only 2-7 days following grazing.

- Current photosynthesis is the most significant source of carbohydrates (88-99%).
- Severe grazing cannot be expected to increase production of native bunchgrasses, especially in dry environments.

- Bunchgrasses may be eliminated by intensive, long-term grazing.
- Decrease of basal areas of individual plants.
- Fragmentation of large plants into smaller plants.
- Plant basal areas are reduced below critical size and tiller numbers are reduced.

- Characteristics that provide resistance to grazing:
- Low growing points.
- Delayed elevation of growing points.
- Predominance of vegetative shoots over reproductive shoots.
- Deep and expansive root system or added drought tolerance and acquisition of minerals.

II. Grazing Management Guidelines

There are three types of grasses:
Match the type of grass with its appropriate grazing management strategy.

1. Non-jointed species (sod-formers).
2. Introduced jointed species (bunchgrasses).
3. Native jointed species (bunchgrasses).

Four criteria determine the susceptibility to grazing and the rate of recovery.

1. The amount of leaves and stems remaining after defoliation.
2. The susceptibility of growing point to damage or removal:
   * Growth form (bunch or sod-former).
   * Ratio of reproductive to vegetative tillers.
   * Height and location of growing point (time of year).
   * Time of grazing.
3. Ability of plants to produce new tillers.
4. Ability of plants to allocate resources to maintain a favorable shoot-root ratio.

Recovery by sod-formers (answers relate to four criteria above):
- Rancher decision to control intensity, duration, and timing of grazing.
- Growing points are protected.
- Easily produces new tillers.
- No problem with shoot-root ratio.

Recovery by bunchgrasses (answers relate to four criteria above):
- Rancher decision to control intensity, duration, and timing of grazing.
- Growing points can be vulnerable depending on growth stage.
- Ability to produce new tillers is quite limited.
- Maintenance of shoot-root ratio is variable among grass species.
  * The response difference between sod-formers and bunchgrasses is why they have different grazing management guidelines based on different amounts of biomass removed and/or remaining on these two growth forms.

Maintaining shoot-root ratio following defoliation.

- Crested Wheatgrass
  * Introduced from Asia; evolved with heavy grazing pressure.
  * Reduces root growth after defoliation.
  * Allocates more resources to shoot growth.
  * Quickly re-establishes a favorable root-shoot ratio.

- Bluebunch Wheatgrass
  * Native; evolved without *heavy* grazing pressure.
  * Roots grow at the same rate after defoliation.
  * Unable to re-allocate resources to grow additional leaves and stems.
  * Ratio between shoot and roots becomes very unbalanced.
  * In subsequent years:
    -Excessive root die off
    -Poor plant health
    -Plant death
  * The response difference between crested and bluebunch is why natives and introduced species have different grazing management guidelines. The response difference is related to rapid new tiller production in crested.

Management guidelines for non-jointed species:

Kentucky bluegrass	Regar brome
tall fescue	orchardgrass
pinegrass	perennial ryegrass
quackgrass	saltgrass (not a true sodformer)

* High number of vegetative to reproductive stems.
* Growing points remain close to the ground, usually too low to be grazed.
* Able to quickly regrow if growing points have not been removed.
* If growing points are removed, they can readily activate other growing points.
* Has ability to replace photosynthetic tissue quickly when soil moisture exists.

- Leave enough leaves and stems to keep plants producing.
  * Graze above apical meristems and growing points.
- Leave enough leaves and stems for site stability.
  * Two inches for site protection.
  * Cattle need four inches to effectively graze.
- Grazing systems that are appropriate.
  (1) Continuous but moderate use.
  (2) Rapid rotation started early to keep plants vegetative with a 21-25 day regrowth period for each rapid growth.
    -Short duration.
    -Savory grazing method.
  (3) Deferred rotation and rest rotation are overkill.
  (4) The key area is the heavily used area of the pasture.

Management guidelines for introduced jointed species:

smooth brome	reed canarygrass
creeping meadow foxtail	annual ryegrass
pubescent wheatgrass	crested wheatgrass
intermediate wheatgrass	timothy
Siberian wheatgrass	tall wheatgrass

- If growing point is not removed:
  * Reduces root growth after defoliation.
  * Allocates more resources to shoot growth.
  * Quickly re-establishes a favorable root-shoot ratio.

- Ability to regrow depends on the state of growth and the ability to reallocate resources:
  * For introduced species, if growing point is removed during the boot stage, the reallocation of energy goes to axillary buds for tiller recruitment, but moisture will most likely be limiting.
- Removal of topgrowth at or after soft dough stage results in plants going dormant.
  * Proper grazing use:
    - 50% of what there is during the growing season.
    - 60% when dormant.
  * Graze no field more than half the growing season.
  * Graze no field more than 2 out of 3 years during the critical period (boot through soft dough stage).
  * Grazing systems that are appropriate:
    (1) Rotation of grazing between critical and noncritical periods from one year to the next.
    (2) Deferred rotation, rest rotation and intensive deferred rotation are overkill.
    (3) Key area should reflect average use.

Management guidelines for native bunchgrasses (jointed species):

bluebunch wheatgrass	needle-and-thread
Idaho fescue	Thurber needlegrass
basin wildrye	big bluegrass
prairie Junegrass	

- If growing point is not removed.
  * Roots grow at the same rate after defoliation.
  * Unable to re-allocate resources to grow additional leaves and stems.
  * Ratio between shoot and roots becomes very unbalanced.

- Ability to regrow depends on the stage of growth and the ability to reallocate resources.
  * For native species, if growing point is removed during the boot stage, the reallocation of energy goes to roots; this throws the root:shoot ratio off resulting in a long term die-off of a portion of the plant.

- Removal of top-growth at or after soft dough stage results in plants going dormant.
  * Proper grazing use:
    - 50% of what there is during the growing season.
    - 60% when dormant.
  * Graze no field more than half the growing season.
  * Graze no field more than 1 out of 3 years during the critical period (boot through soft dough stage).
  * Defer each field 1 out of 3 years (growing season).

* Grazing systems that are appropriate:
(1) Deferred rotation.
(2) Rest rotation.
(3) Intensive deferred rotation.
(4) Short duration and Savory grazing method are not appropriate.
(5) Rotation of grazing between critical and non-critical periods from one year to the next when key areas are the heavily used areas of the pasture.

Management guidelines for forest grazing:
- If all grasses are native bunchgrasses, use the criteria above for native bunchgrasses.
- **If all grasses are non-jointed species (pinegrass, bluegrass), use the criteria above for sod-formers.**
- If the area has both sod-formers and native bunchgrasses:
* Fence separately and use separate criteria for each, or
* If cannot separate, use the criteria for native bunchgrasses.

Management guidelines for riparian areas:
- Fence out (at least until vegetation response is sufficient) when:
* Banks are not stable.
* Sediment is not being filtered.
* Riparian area is large enough to create a riparian pasture.
- Managing woody species:
* If being suppressed, install a temporary fence to jumpstart the plants.
* Defer summer and fall.
* Graze after spring runoff and let plants regrow for the next runoff event.
- Managing grasses and grass-like species:
* If grasses in riparian areas are sod-formers, use sod-formers criteria tempered with the woody criteria above.
* Most sedges will respond positively to management based on native bunchgrass criteria.

Management Guidelines for Annual Rangeland:
- In the rare cases where the plant communities are 100% annuals:
* Graze so as to leave enough plant cover to protect the site from erosion (at least 30% cover).
* Monitor trend (Range Health Indicator Worksheet is a useful tool).
- When the plant community still has perennials present:
* Manage for the perennials.
* Graze early spring and fall:
(1) In early spring, move the livestock when they switch their diet from annuals to perennials.
(2) In the fall, graze no more than 60% of the perennial bunchgrasses; maintain a stubble height so that 40% of the bunchgrasses are not eaten.

Conclusions on Grazing Management.
- Only two factors of plant growth are within our control:
(1) Leaf area remaining after grazing. (Intensity)
(2) Time of grazing. (Timing and Duration)
- Leaf area remaining after grazing and time of grazing should be the primary focus of ranchers' management.
- A cow is a management tool to manipulate and improve plant communities.
- Do not forget the two natural laws:
(1) If we keep down the shoot, we kill the root.
(2) Nature abhors empty space; abuse the good plants and undesirables will invade.
- Over-grazed grasses cannot remain healthy, vigorous, and productive any more than a steer can gain weight on a maintenance ration.
- Leave enough leaf area to ensure photosynthesis.
- For native bunchgrasses minimize the severity of grazing when grasses are more susceptible by:
* Grazing no field more than half the growing season.
* Grazing only 1 in 3 years during the critical period (2 out of 3 for introduced jointed).
* Deferring each field 1 out of every 3 years during the growing season.

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TABLE 1

PLANT PHENOLOGY
For
Bluebunch Wheatgrass

Ephrata, Washington
1500' Elevation

K. Guinn 1/94

GROWTH STAGE	1988	1989	1990	1991	1992	1993	1994	7-yr. Ave
7-8" Leaves	3/20	4/02	3/22	3/28	3/01	4/11	3/20	3/24
Boot	4/18	4/18	4/10	4/21	3/25	4/25	4/10	4/14
Seedheads Out	5/10	5/04	4/22	5/01	4/12	5/16	5/01	5/01
Anthesis	5/30	5/25	5/06	5/20	5/10	5/23	5/14	5/18
			5/27	6/02				
End Soft Dough	6/10	6/11	*6/01	*6/23	5/31	6/05		6/10
Seed Shatter	6/19	6/25	N/A	6/30	6/07	6/27		6/20
Critical Period								
	4/15	4/15	4/05	4/20	3/20	4/20	4/10	4/10
	6/15	6/15	6/05	6/25	6/05	6/20		6/15
Number Days	61	61	61	66	78	61		65
End of Deferment Period:								
	6/15	6/15	6/05	6/25	6/05	6/20		6/15

*No seed formation in 1990.

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TECHNICAL NOTES

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

RANGE 34

Spokane, Washington
August 1994

GRAZING MANAGEMENT GUIDELINES

by

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TECHNICAL REVIEW

by

Gerald B. Rouse
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and

Dr. Briske, Professor
Texas A and M
College Station, Texas

- THERE IS NO SUCH THING AS RANGE READINESS FOR PLANTS.
- THE CRITICAL PERIOD IS NOT EARLY SPRING.
- REGROWTH DOES NOT COME FROM ROOT CARBOHYDRATES; BUT, DOES COME FROM CURRENT PHOTOSYNTHATE OF EXISTING LEAF AREA.

A. Effects of Grazing

1. Every function of plants is affected by grazing:

   a. Size of food factory (photosynthetic leaf area).
   b. Food Production.
   c. Root growth.
   d. Water and nutrient availability.
   e. Carbohydrate storage in shoots.

2. The effect of grazing is dependent upon:

   a. Season of use and growth stage.
   b. Grazing intensity (remaining leaf area) which directly affects light interception.
   c. Frequency of grazing (regrowth grazed).
   d. Type of plant (warm season vs. cool season; forb, shrub, vs. grass).
   e. Availability of growing points and new tiller buds.
   f. Shoot carbohydrate reserves.
   g. Size of root system.
   h. Physical effects of grazing animals on plants and soil (trampling may be negative but nutrient cycling a positive response).

3. How grazing at different times of the year affects grasses.

(Note: The dates below are from Ephrata at 1500 feet; Table 1.)

a. When grazing is low risk:

Summer 6/16 - 8/30 Fall 9/1 - 11/30 Winter 12/1 - 2/28

* Grazing has little effect on plant growth unless grazing is severe.
* The reduction of tillers under heavy grazing is due to higher overwinter mortality rather than an inadequate number of tillers emerging in the fall.
* Fall green up is not free forage! It is the basis for next year's production.
* Cured vegetation protects new tillers.
* Cured vegetation provides energy and green growth provides protein to animals.
* Wolf plants are not as likely to be avoided during this period.

b. When grazing is high risk:

Early Spring 3/1 - 4/15

* Has little effect as long as no more than 50% of current growth is removed and duration and frequency is controlled.
* Plants are set for vegetative growth and able to rapidly replace lost leaves and stems, if growing conditions are favorable.
* Growing points are not elevated, and thus, protected.

* **Myth #1: Grazing after range readiness is best for bunchgrasses. This is WRONG! The range readiness concept is outdated.**

* All you need is the soil to be firm enough to prevent soil compaction and enough growth for the livestock.
* Consider the effect of leaf area and air temperature on growth rate and the likelihood of the forage supply staying ahead of the livestock.
* You need enough old growth and magnesium blocks to avoid grass tetany.

c. When grazing is very high risk (CRITICAL PERIOD):

Late Spring 3/20 - 6/25

* The growing points are elevated, and thus, vulnerable.
* If growing points are removed, replacement tillers must come from axillary buds.
* Plants are committed to seed production.
* The ability to replace lost leaves and stems is low and declining.

* **Myth #2: The critical period is early spring. This is WRONG!**

* **The critical period is when plants are trying to make seed (boot stage through soft dough stage).**

* At Ephrata, Washington from 1988 - 1994, the critical period came between 3/20 and 6/25. See the chart "Comparing the Years."
* Grazing during the critical period can have a severe impact and even kill bunchgrasses.

4. The effects of grazing depends upon what's removed.

   a. Leaf blades only - minimal if growing conditions are good.
   b. Leaf sheaths - regrowth will be delayed.
   c. Apical meristem-tiller will die; must be replaced by activation of an axillary bud.

5. How grazing affects roots (Figures 1 and 2):

   (Data a.-d. is from "Grass: The Stockman's Crop" which reports on a comprehensive test for different grasses.)

   a. As long as no more than 50% of topgrowth is removed, grazing has little effect on the roots.
   b. At 60% use, HALF of the roots stop growing for 12 days.
   c. At 80% use, ALL of the roots stop growing for 12 days.
   d. At 90% use, ALL of the roots stop growing for 18 days.
   e. The growing season at Ephrata is 90-140 days (K. Guinn study). 12-18 days relates to 10-20% of the growing season when the plants are not producing.
   f. Under progressively heavier grazing, roots will have fewer branches; become, sparser, shorter, and more concentrated in the top portion of the soil profile.
   g. A balance between roots and topgrowth will always occur.
   h. To minimize weed invasion, have plants with a large, healthy root system.
   i. This is why we should graze no more than 50% of the topgrowth during the growing season.

6. How grazing affects plant growth.

   a. For sodformers (non-jointed species):
      - Maintain leaves and growing points and the plant keeps producing.
      - Graze the leaf growing points and the plants are hurt.
   b. For bunchgrasses (jointed species):
      - As seedheads are elevated on the stem, they become vulnerable to removal.
      - Graze the growing points of stems, you not only kill the stems, but
      - New growth must come from axillary buds which reduces next years stems, and
      - Less than a 1:1 ratio of stem replacement for next year may reduce the stand.

7. Where does regrowth come from?

   a. **Myth #3: Root carbohydrate reserves is most important for regrowth following a severe grazing. This is WRONG!**

   b. There is no indication that root carbohydrate reserves are mobilized for shoot growth.
   c. Most reserves are located in stem bases.
   d. Reserves in grass stem bases affect regrowth for only 2-7 days following grazing.
   e. Current photosynthesis is the most significant source of carbohydrates (88-99%) (Figure 3).

8. Severe grazing cannot be expected to increase production of native bunchgrasses especially in dry environments.

9. Bunchgrasses may be eliminated by intensive, long-term grazing.

   a. Decrease of basal areas of individual plants.
   b. Fragmentation of large plants into smaller plants.
   c. Plant basal areas are reduced below critical size and tiller numbers are reduced.

10. Characteristics that provide resistance to grazing:

   a. Low growing points.
   b. Delayed elevation of growing points.
   c. Predominance of vegetative only shoots over reproductive shoots.
   d. Deep and expansive root system or added drought tolerance and acquisition of minerals.

B. Grazing Management Guidelines

1. There are three types of grasses:

   a. Non-jointed species (sodformers).
   b. Introduced jointed species (bunchgrasses).
   c. Native jointed species (bunchgrasses).
   d. Match the type of grass with its appropriate grazing management strategy.

2. Four criteria determine the susceptibility to grazing and the rate of recovery:

   a. The amount of leaves and stems remaining after defoliation.
   b. The susceptibility of growing point to damage or removal:

      * Growth form (bunch or sodformer).
      * Ratio of reproductive to vegetative tillers.
      * Height and location of growing point (time of year).
      * Time of grazing.

   c. Ability of plants to produce new tillers.
   d. Ability of plants to allocate resources to maintain a favorable shoot-root ratio.

3. Recovery by sodformers (answers relate to 2. a-d):

   a. Rancher decision to control intensity, duration, and timing of grazing.
   b. Growing points are protected.
   c. Easily produces new tillers.
   d. No problem with shoot-root ratio.

4. Recovery by bunchgrasses (Answers relate to 2. a-d):

   a. Rancher decision to control intensity, duration, and timing of grazing.
   b. Growing points are vulnerable depending on growth stage.
   c. Ability to produce new tillers is quite limited.
   d. Maintenance of shoot-root ratio is variable among grass species.

   * The response difference between sodformers and bunchgrasses is why they have different grazing management guidelines based on different amounts of biomass removed and/or remaining on these two growth forms.

5. Maintaining shoot-root ratio following defoliation:

   a. Crested Wheatgrass

      * Introduced from Asia; evolved with heavy grazing pressure.
      * Reduces root growth after defoliation.
      * Allocates more resources to shoot growth.
      * Quickly re-establishes a favorable shoot-root ratio.

   b. Bluebunch Wheatgrass

      * Native (Washington state grass); evolved without heavy grazing pressure.
      * Roots grow at the same rate after defoliation.
      * Unable to re-allocate resources to grow additional leaves and stems.
      * Ratio between shoot and roots becomes very unbalanced.
      * In subsequent years:

        - Excessive root die off
        - Poor plant health
        - Plant death

      * The response difference between crested and bluebunch is why natives and introduced species have different grazing management guidelines. The response difference is related to rapid new tiller production in crested.

6. Management guidelines for non-jointed species:

Kentucky bluegrass	Regar brome
tall fescue	orchardgrass
pinegrass	perennial ryegrass
saltgrass (not a true sodformer)	quackgrass

* High number of vegetative to reproductive stems.
* Growing points remain close to the ground, usually too low to be grazed.
* Able to quickly regrow if growing points have not been removed.
* If growing points are removed, they can readily activate other growing points.
* Has ability to replace photosynthetic tissue quickly when soil moisture exists.

a. Leave enough leaves and stems to keep plants producing.

* Graze above apical meristems and growing points.

b. Leave enough leaves and stems for site stability.

* Two inches for site protection.
* Cattle need four inches to effectively graze.

c. Grazing systems that are appropriate:

(1) Continuous but moderate use.
(2) Rapid rotation started early to keep plants vegetative with a 21-25 day regrowth period for each field during rapid growth.

- Short duration.
- Savory grazing method.

(3) Deferred rotation and rest rotation are overkill.
(4) The key area is the heavily used area of the pasture.

7. Management guidelines for introduced jointed species:

smooth brome	reed canarygrass
creeping meadow foxtail	annual ryegrass
timothy	crested wheatgrass
intermediate wheatgrass	pubescent wheatgrass
Siberian wheatgrass	tall wheatgrass

* If growing point is not removed:

* Reduces root growth after defoliation.
* Allocates more resources to shoot growth.
* Quickly re-establishes a favorable shoot-root ratio.

* Ability to regrow depends on the state of growth and the ability to reallocate resources:

* For introduced species, if growing point is removed during the boot stage, the reallocation of energy goes to axillary buds for tiller recruitment, but moisture will most likely be limiting.

* Removal of topgrowth at or after soft dough stage results in plants going dormant.

a. Proper grazing use:

* 50% of what is there during the growing season.
* 60% when dormant.

b. Graze no field more than half the growing season.
c. Graze no field more than 2 out of 3 years during the critical period (boot through soft dough stage).

d. Grazing systems that are appropriate:

(1) Rotation of grazing between critical and noncritical periods from one year to the next.
(2) Deferred rotation, rest rotation and intensive deferred rotation are overkill.
(3) Key area should reflect average use.

8. Management guidelines for native bunchgrasses (jointed species):

bluebunch wheatgrass	needle-and-thread
Idaho fescue	Thurber needlegrass
basin wildrye	big bluegrass
prairie Junegrass	

* If growing point is not removed

* Roots grow at the same rate after defoliation.
* Unable to re-allocate resources to grow additional leaves and stems.
* Ratio between shoot and roots becomes very unbalanced.

* Ability to regrow depends on the stage of growth and the ability to reallocate resources:

* For native species, if growing point is removed during the boot stage, the reallocation of energy goes to roots; this throws the root:shoot ratio off resulting in a long term die-off of a portion of the plant.

* Removal of topgrowth at or after soft dough stage results in plants going dormant.

a. Proper grazing use:

* 50% of what is there during the growing season.
* 60% when dormant.

b. Graze no field more than half the growing season.
c. Graze no field more than 1 out of 3 years during the critical period (boot through soft dough stage).
d. Defer each field 1 out of 3 years (growing season).
c. Grazing systems that are appropriate:

(1) Deferred rotation.
(2) Rest rotation.
(3) Intensive deferred rotation.
(4) Short duration and Savory grazing method are <u>not appropriate</u>.
(5) Rotation of grazing between critical and non-critical periods from one year to the next when key areas are the heavily used areas of the pasture.

9. Management guidelines for forest grazing:

a. If all grasses are native bunchgrasses, use the criteria above for native bunchgrasses.

b. If all grasses are jointed species (pinegrass, bluegrass), use the criteria above for sodformers.

c. If the area has both sodformers and native bunchgrasses:

* Fence separately and use separate criteria for each, or
* If cannot separate, use the criteria for native bunchgrasses.

10. Management guidelines for riparian areas **(key areas are the non-functional components of the system):**

a. Fence out when:

* Banks are not stable.
* Sediment is not being filtered.
* Riparian area is large enough to create a riparian pasture.

b. Managing woody species:

* To establish rest 2 years or install a temporary fence.
* Defer summer and fall.
* Graze after spring runoff and let plants regrow for the next runoff event.

c. Managing grasses and grass-like species:

* If grasses in riparian areas are sodformers, so use sodformers criteria tempered with the woody criteria above.
* Most sedges will respond positively to management based on native bunchgrass criteria.

11. Management Guidelines for Annual Rangeland:

a. In the <u>rare cases</u> where the plant communities are 100% annuals:

* Graze so as to leave enough plant cover to protect the site from erosion (at least 30% cover).
* Use the Range Health Indicator Worksheet to judge trend.

b. When the plant community still has perennials present:

* Manage for the perennials.
* Graze early spring and fall:

(1) In early spring move the livestock when they switch their diet from annuals to perennials.

(2) In the fall graze no more than 60% of the perennials bunchgrasses; maintain a stubble height so that 40% of the bunchgrasses are not eaten.

12. Conclusions on Grazing Management:

a. Only two factors of plant growth are within our control:

* Size of leave area remaining after grazing. (Intensity)
* Time of grazing. (Timing and Duration)

b. The size of leave area remaining after grazing and time of grazing should be the primary focus of ranchers management.

c. A cow is a management tool to manipulate and improve plant communities.

d. Do not forget the two natural laws:

* If we keep down the shoot, we kill the root.
* Nature abhors empty space; abuse the good plants and undesirables will invade.

e. Over-grazed grasses cannot remain healthy, vigorous and productive any more than a steer can gain weight on a maintenance ration.

f. Leave enough leaf area to ensure photosynthesis.

g. For native bunchgrasses minimize the severity of grazing when grasses are most susceptible by:

* Grazing no field more than half the growing season.
* Grazing only 1 in 3 years during the critical period (2 out of 3 for introduced jointed).
* Deferring each field 1 out of every 3 years during the growing season.

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TABLE 1

PLANT PHENOLOGY

For

Bluebunch Wheatgrass

Ephrata, Washington
1500' Elevation

K. Guinn 1/94

GROWTH STAGE	1988	1989	1990	1991	1992	1993	1994	7-YEAR Average
7-8" Leaves	3/20	4/02	3/22	3/28	3/01	4/11	3/20	3/24
Boot	4/18	4/18	4/10	4/21	3/25	4/25	4/10	4/14
Seedheads Out	5/10	5/04	4/22	5/01	4/12	5/16	5/01	5/01
Anthesis	5/30	5/25	5/06 5/27	5/20 6/02	5/10	5/23	5/14	5/18
End Soft Dough	6/10	6/11	*6/01	*6/23	5/31	6/05		6/10
Seed Shatter	6/19	6/25	N/A	6/30	6/07	6/27		6/20
Critical Period:								
	4/15	4/15	4/05	4/20	3/20	4/20	4/10	4/10
	6/15	6/15	6/05	6/25	6/05	6/20		6/15
Number Days	61	61	61	66	78	61		65
End of Deferment Period:								
	6/15	6/15	6/05	6/25	6/05	6/20		6/15

* No seed formation in 1990.

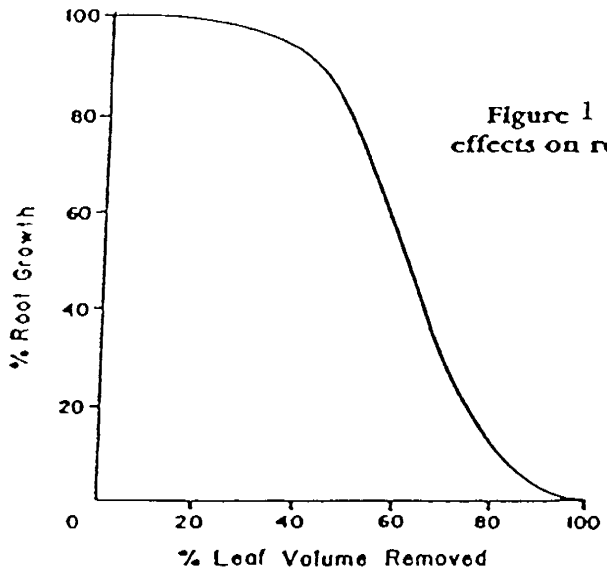

Figure 1 Defoliation effects on root growth.

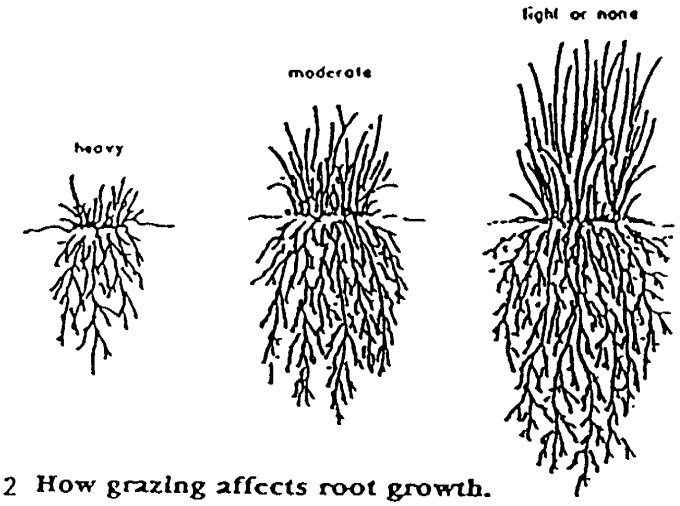

Figure 2 How grazing affects root growth.

A temporary lack of root growth following defoliation may not be entirely detrimental to a grass. Crested wheatgrass reduces root growth following defoliation whereas bluebunch wheatgrass does not. By reducing root growth, crested wheatgrass is able to allocate more resources to shoot regrowth, thus re-establishing the balance between the root and shoot systems (Richards 1984). Because carbohydrates necessary for

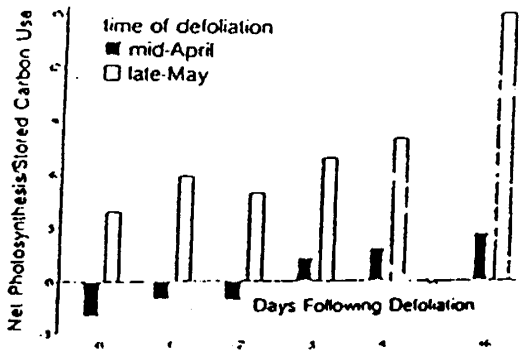

Figure 3 Carbon balance of bluebunch wheatgrass following a severe defoliation on day zero in April and late May. Adapted from Richards and Caldwell 1985.

TECHNICAL NOTES

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

RANGE 35

Spokane, Washington
August 1994

HOW COOL SEASON GRASSES GROW AND PLANT NEEDS

by

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A. Grass Parts (Figure 1)

1. Leaves (Flowers)
2. Stems (Rhizomes and Stolons)
3. Roots

B. Plants Must Have Adequate:

1. Space
   a. Soil depth.
      * Water holding capacity.
      * Fertility storage capacity.
   b. Sufficient sunlight to meet their needs.
   c. Plant numbers.
      * Too many may stunt growth.
      * Too few or inadequate top growth allows weed invasion.
2. Water and Nutrients
   a. Function of water - actively growing grasses are 75% to 90% water.
      * Necessary for photosynthesis.
      * Minerals must be dissolved in water before they are taken up by the roots.
      * Plant cooling agent.

* Water is the major limiting factor to rangeland plants.

* Adequate moisture during the last half of the growing season will not compensate for an inadequate moisture supply during the first half.

b. Nutrients

* From air: carbon dioxide.

* Carbon dioxide is second to water as a leading element for grass growth.

* Of the elements required for grass growth about 95% are taken from the air and only 5% from the soil (if water is not included).

* Plants use phosphorous, nitrogen, potash, calcium, magnesium, and sulfur in large quantities to manufacture their food. They use other minerals such as iron, copper, boron, manganese, molybdenum, and zinc in small quantities but must have them for good plant growth.

* Sources of nitrogen on rangeland:

- Rain
- Decomposition of grass roots and shoots
- Animal excretion
- Some legumes such as lupine and vetch

3. Root System

a. Functions of the older portion of root system:

* Anchors the plant.

* Binds the soil.

b. Functions of new portion of root system:

* Extracts mineral elements and water from soil particles.

* Replaces the older roots that become inactive.

c. Root Replacement

* Each year a portion of a grass plant's roots die and are replaced.

* Amount of annual replacement ranges from 20-50% of the total root system.

* Growing roots require food from the leaves and water from the soil.

4. Top Growth

a. The leaves and stems are where plants make their own food.

b. Stems are the support structure for the plant and transport water and nutrients to and from the above ground portion and the roots.

c. The amount of top growth directly affects the plants total water absorption and transpiration.

d. Nutrient storage.

5. Relationship between top growth and root system. (Figure 2)

   a. Vigorous top growth is essential in order to maintain a healthy root system which in turn results in a grass plant that produces abundant forage and is more tolerant of drought and other stresses.

   b. A small top growth can only support a small root system.

C. Plants Make Their Own Food Through A Process Called PHOTOSYNTHESIS. (Figure 3)

1. Photosynthesis is an energy-capturing process.

2. In the presence of sunlight, a simple sugar, glucose, is formed when water and carbon dioxide are fixed in chlorophyll, the green tissue of the plants (carbon fixation).

3. The sugars then combine with the minerals elements from the soil to make proteins, plant oils, and fats that the plant needs to grow and reproduce itself.

4. Photosynthesis is limited to periods when plants have green leaves, stems or both and favorable water and temperature conditions.

   a. Cool season plants.

   b. Warm season plants.

D. Food Storage

1. Location

   a. Lower stem bases for most grasses.

   b. Rhizomes (examples - saltgrass, smooth brome, reed canarygrass).

   c. Seeds for annuals (example - cheatgrass).

   d. Roots in forbs (example - legumes).

   e. Branches and roots (shrubs and trees).

2. Uses

   a. To support tiller recruitment and growth after defoliation when photosynthesis is low.

   b. To develop heat and cold resistance.

   c. To support metabolism during periods of dormancy.

   d. To promote flower and seed formation.

E. Tillers Are The Basic Unit Of Grasses (Figure 4)

1. Tillers and Bunchgrasses

   a. Tillers are composed of growing points, stems, leaves, nodes and dormant buds (Figures 5 and 6)

   b. Individual grass plants are composed of several tillers which originated from axillary buds of older parental tillers.

c. Each tiller establishes a shoot and root system to acquire resources.

d. A bunchgrass is a collection of individual tillers with some shared facilities. The analogy would be an apartment house of clones. A study by Olson and Richards (1988) showed that an ungrazed tiller does not enhance the growth potential of an unrelated heavily grazed tiller on the same plant. Food is not transferred through the root and crown system to needy tillers. A parent tiller will support a daughter tiller.

e. Generally tillers have: an emerging leaf, an immature leaf, a mature leaf and a senescing leaf.

2. Tiller Recruitment

a. Tiller recruitment occurs mostly in the spring and fall. Thus, the fall green up is not free forage but is the basis for next year's production. Fall recruitment of tillers only occurs if there is sufficient moisture available.

b. Fall or early spring initiated tillers provide the most production because they have a longer period for growth and development. The number of tillers in a plant determines the potential for the total production within the constraints of resource availability.

3. Intercalary Meristems

a. Intercalary meristems (areas of cell division or growth) are located at the base of the leaf blade and sheath, and at the internode.

b. Result in the growth of the leaf blades, sheath and internode.

c. The growth of the leaf blade and sheath stop when the ligule is fully developed.

d. The basal location of the intercalary meristem within the blade and sheath explain why leaf growth can occur following defoliation as long as the leaf has not matured.

e. Internode elongation is dependent upon species and phenology. Generally, it occurs as the apical meristem becomes reproductive but in some grasses it occurs in the vegetative stage of the plant. When internode elongation occurs it raises the apical meristem above ground level.

4. Axillary Buds

a. The apical meristem produces axillary buds at the nodes of the grass plant.

b. If the apical meristem is removed the axillary bud will produce a new tiller if there is adequate moisture.

5. Leaf Replacement Potential

a. The rate at which the leaf area is regrown following defoliation is a function of the number, source and location of meristems within the plant.

b. Growth will occur most rapidly from immature intercalary meristems (blade, sheath) and least rapidly from newly initiated axillary buds.

c. When the apical meristem becomes reproductive or is removed by grazing, leaf replacement must originate from axillary buds which require the greatest amount of time for regrowth. This is why grasses that have a high ratio of reproductive or culmed vegetative tillers (jointed grasses) are best suited to intermittent grazing.

F. Longevity Of Perennial Grasses Depend On The Successive Production Of Short Lived Tillers.

1. The dead centers of many perennial grasses are a natural development rather than a negative response to stress.
2. Tiller longevity in perennial grasses is usually less than 1 year.
3. Grasses must have more than a 1:1 ratio of tiller replacement to increase in size.
4. If tiller recruitment was stopped for the time equal to the life of the existing tillers, the plant would loose its growing points and die.
5. Changes in tiller density occurs when tiller recruitment lags behind or exceeds tiller mortality. (Figure 7)
6. Reproductive tiller development terminates with seed maturity; vegetative tiller mortality is the consequence of shading of smaller tillers, and less carbon allocation to young tillers from parental tillers may be more important. (Figure 8)

G. Axillary Buds And Growing Points Give Rise To and Regulate All Growth.

1. With the right conditions axillary buds start growth in the fall, although in spring also for many species.
2. Apical meristem (Figures 5, 6, and 8).
   a. Controls the growth of the tillers and all growth initially originates from the apical meristem.
   b. Continues to grow (produce intercalary meristems) as long as the apical meristem is in the vegetative state.
   c. The apical meristem produces the seedhead. (Figure 8)
   d. Once the apical meristem becomes reproductive (in the boot stage) the plant is committed to reproduction and its ability to produce new phytomers and leaves specifically is at a low level and declining. **This is the most critical period for the grass (boot stage through soft dough stage).**
   e. When the apical meristem becomes reproductive or is removed by defoliation - begetative growth can only occur from immature intercalary meristems (leaf blade and sheath) or from axillary buds. Axillary bud development is dependent on soil moisture so there may not be adequate soil moisture for regrowth.
   f. The type of grass determines when the apical meristem is elevated. Once the apical meristem is elevated it is susceptible to removal by grazing or mowing. If the growing point is removed, that tiller cannot grow and new growth must come from axillary buds which reduces next years crop.

H. Growth Cycle (Figures 9 and 10)

(Growth from inception to maturity is quite similar in all grasses.)

1. Fall/Winter

   a. If there is adequate moisture new tillers start in the fall from axillary buds.

   b. These tillers overwinter in the 1-3 leaf stage.

2. Spring Vegetative Growth

   a. Expanding young leaves use most of the carbohydrates they produce and also import some carbon from older leaves that are mature or draw on carbohydrate pools.

   b. Photosynthesis from fall initiated tillers is generally adequate to meet the needs of the plants for initiation of spring growth.

   c. Only a small portion of the stored carbohydrates is used for the start of spring growth.

   d. As spring growth begins, the apical meristem (growing point) is inside the stem, near the base of the plant. Whether or not the apical meristem is elevated during the growing season depends on the type of grass plant and stage of growth.

   e. The phenology (state of development) of a plant is primarily dependent upon air temperature which is expressed as growing degrees.

3. Late Spring/Summer Reproductive Growth

   a. Fall initiated tillers have the greatest chance of becoming reproductive, thus tillers initiated in the spring generally will not flower.

   b. Most cool-season grasses (almost all of the native range grasses in Eastern Washington), require tiller initiation in the fall and exposure to cold temperature for formation of reproductive structures.

   c. During stem elongation (reproductive growth) the apical meristem is already forming an inflorescence and elevates above the ground, becoming susceptible to removal.

4. Regrowth

   a. Within 3 days following defoliation, photosynthesis provides from 88% to 99% of the regrowth in bluebunch wheatgrass; the remainder is supplied from carbohydrate pools stored food). The carbohydrate pools should be considered small buffers for regrowth, not large reserves.

   b. The most critical factor affecting regrowth is the amount of green leaf and stem tissue remaining after defoliation. The more green leaf area remaining after a grazing period, the greater the potential for regrowth. Favorable growing conditions are required.

c. Under range conditions there may not be enough moisture for axillary buds; the quickest regrowth comes from leaves and stems on existing tillers; we just cannot expect a lot of regrowth under range conditions.

I. **Establishment of Seedlings**

1. Plants may reproduce by tillering, rhizomes and stolons, or seeds.

2. Reproduction by seed is the most common method among the higher plants and the only method of many perennials and all annuals.

3. The seedling depends on the rapid development of its own roots to supply it with moisture. In drought years, the seed may not germinate or the seedling may die before it can send its roots down to the moist subsoils. Annuals such as cheatgrass are serious competitors to young perennial plants because of its rapid root growth and the early initiation of growth.

4. Shrub or forb seeds can remain for a period of 5-10 years, some much longer, allowing the plant to survive prolonged drought periods or other disturbances.

5. Grass seeds are viable for only 1-2 years; there is not a soil bank of grass seeds; in good years grasses must produce seed and then the next year must germinate and recruit seedlings.

J. **Types of Grasses (Figure 12)**

1. Bunchgrasses or Jointed Grasses (bluebunch wheatgrass, Idaho Fescue, crested wheatgrass, etc.)

   a. Have a high ratio of reproductive or culmed vegetative tillers.

   b. Internode elongation elevates the apical meristem above the ground surface where it can be removed by defoliation.

2. Sodforming or non-jointed grasses (orchardgrass, tall fescue, Kentucky bluegrass, etc.

   a. Less than 10% of the stems are jointed and produce seedheads.

   b. The growing point on the other stems remain close to the ground during the growing season. The leaves and tillers can continue to elongate even though a portion of the leaves have been removed by grazing or mowing.

   c. Forage production comes from continued leaf growth at the junction of the blade and collar and base of sheath (intercalary meristem). If the intercalary meristem is not removed, the leaf will continue to grow as long as there is adequate moisture.

   d. If the intercalary meristem is allowed to grow too high it can be removed. Once the intercalary meristem is removed the growth stops because the source of regrowth is gone. New growth must come from axillary buds which take time to start growing.

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PARTS of GRASS PLANTS

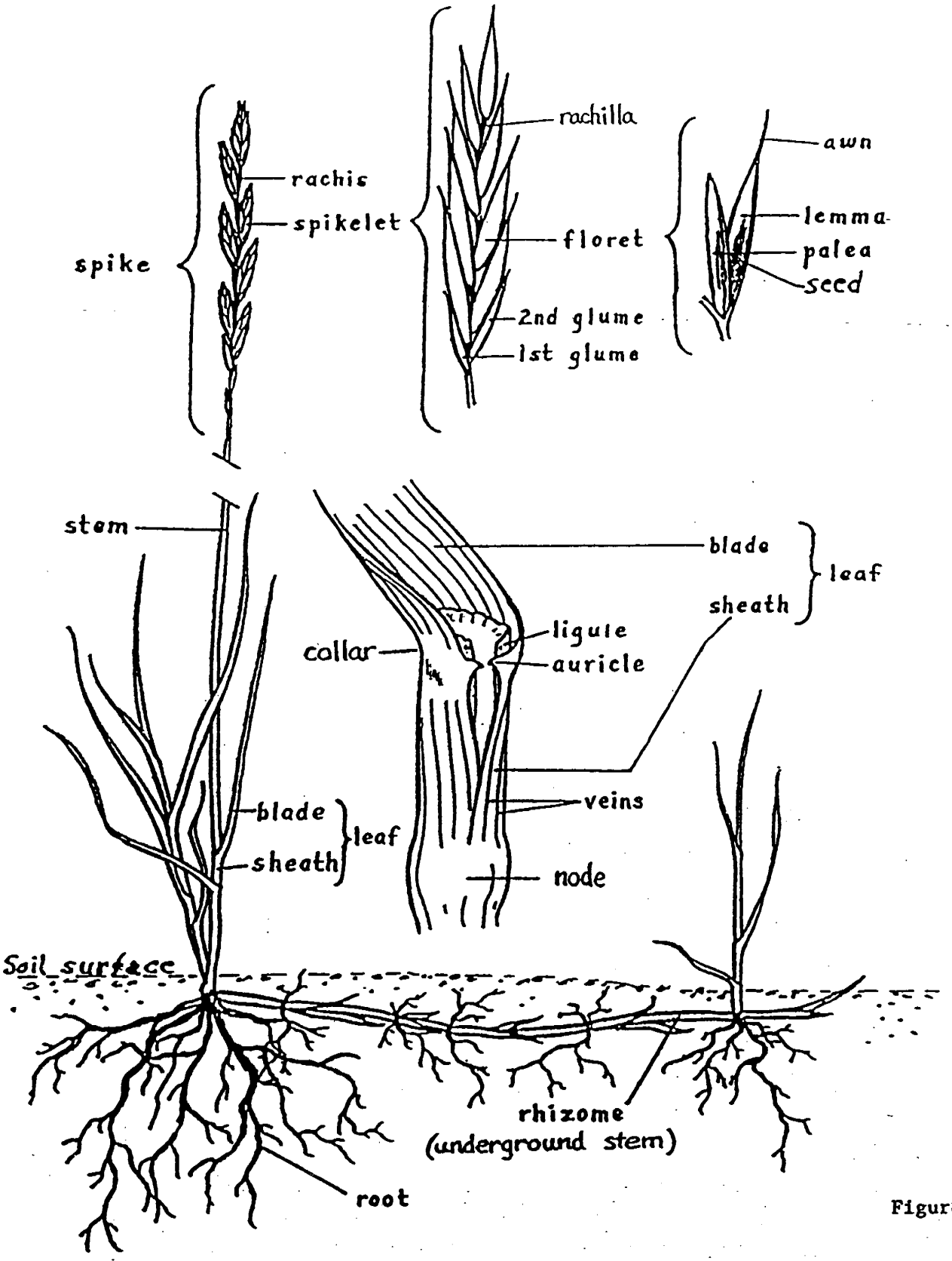
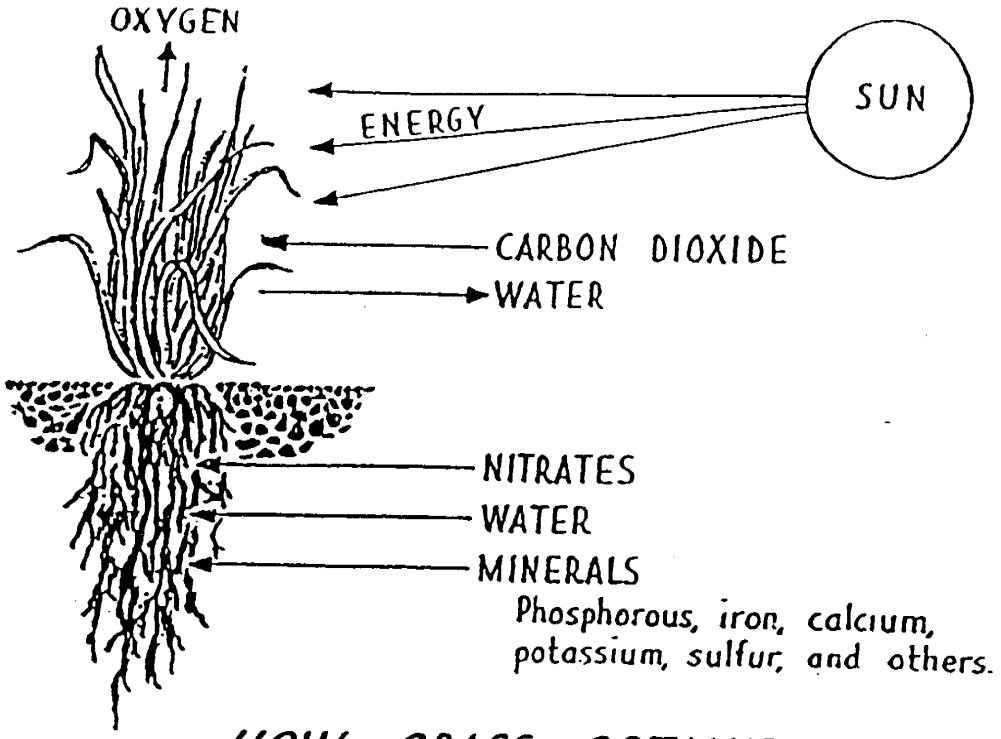


Figure 1



HOW GRASS OBTAINS MATERIALS FOR FOOD MANUFACTURE

Figure 2

A. Although you may think you see quite a bit of "daylight" between grass plants in even your best pastures, actually the plants are properly spaced. Notice how the roots intermingle and the leaf canopy prevents sunlight from reaching other plants such as weeds. B. Each year approximately 30 percent of each grass plant's root system must be replaced. What happens if you overgraze and the plant's root system not only can't expand, but can't replace that vital 30 percent natural loss? C. Weeds can take hold and grow where grass roots have been too severely weakened. Weedy pasture is less productive pasture.

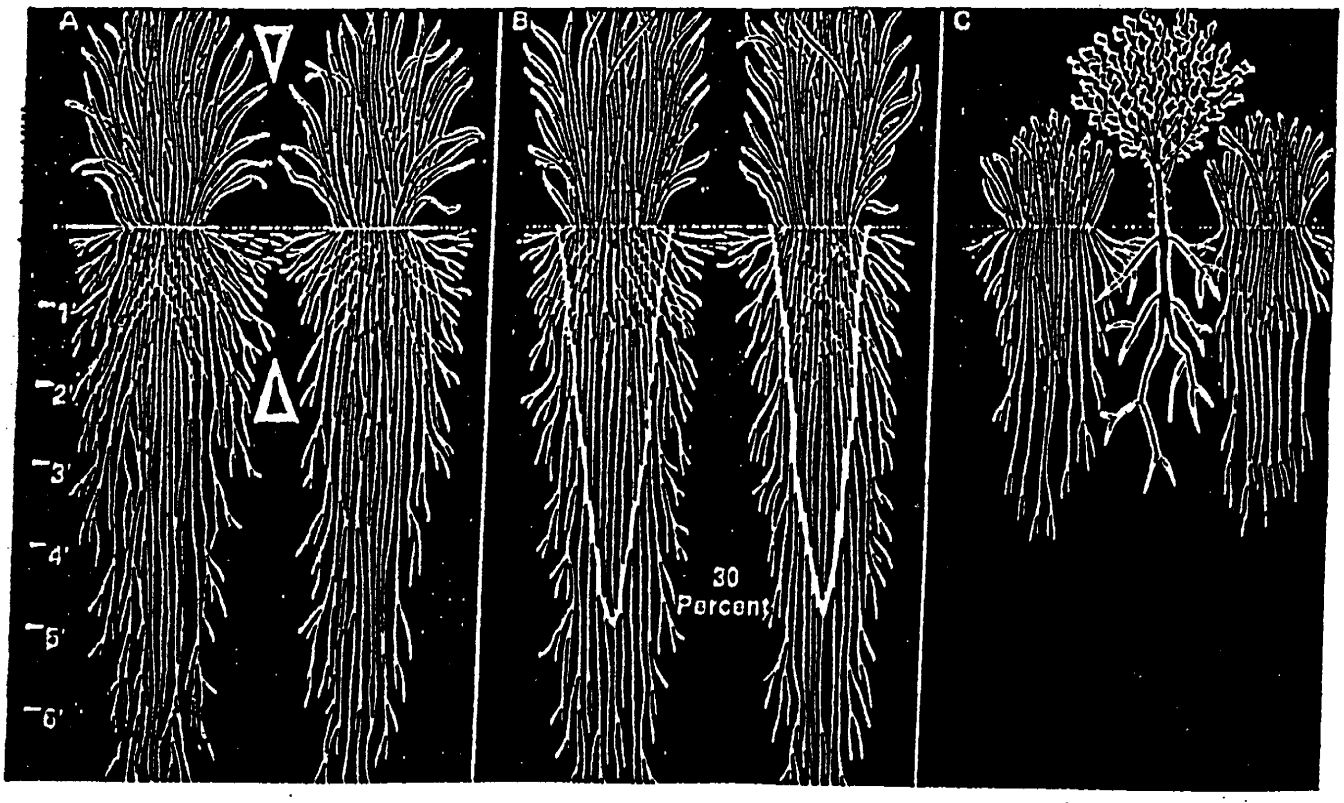


Figure 3

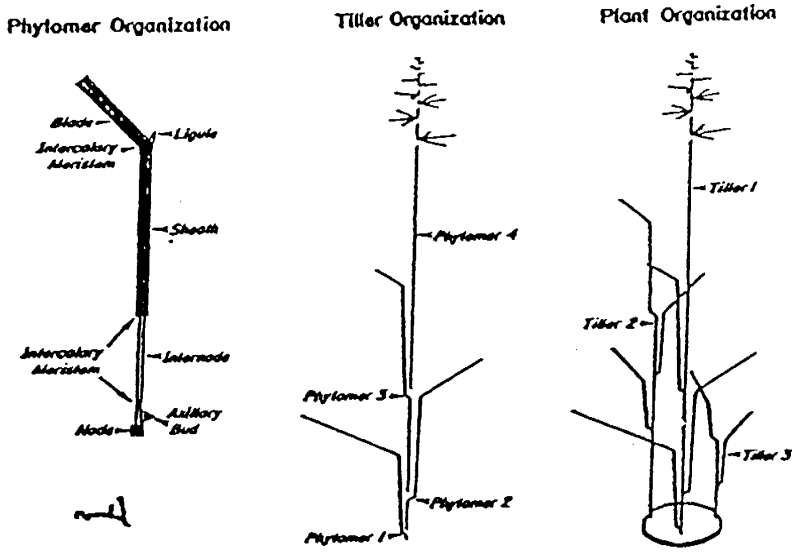


Figure 4

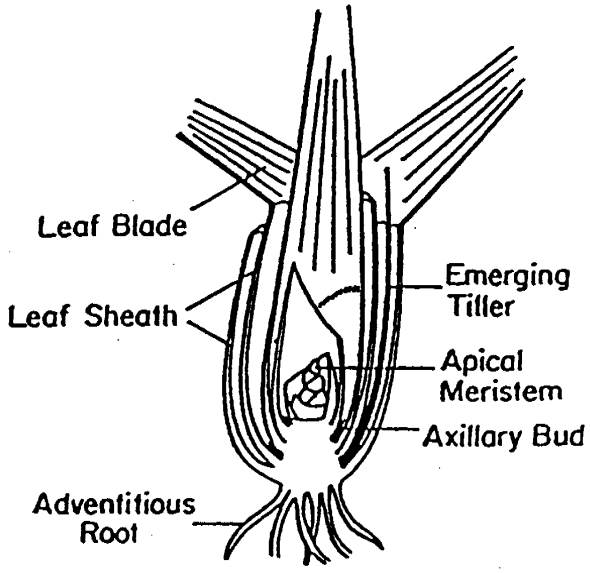
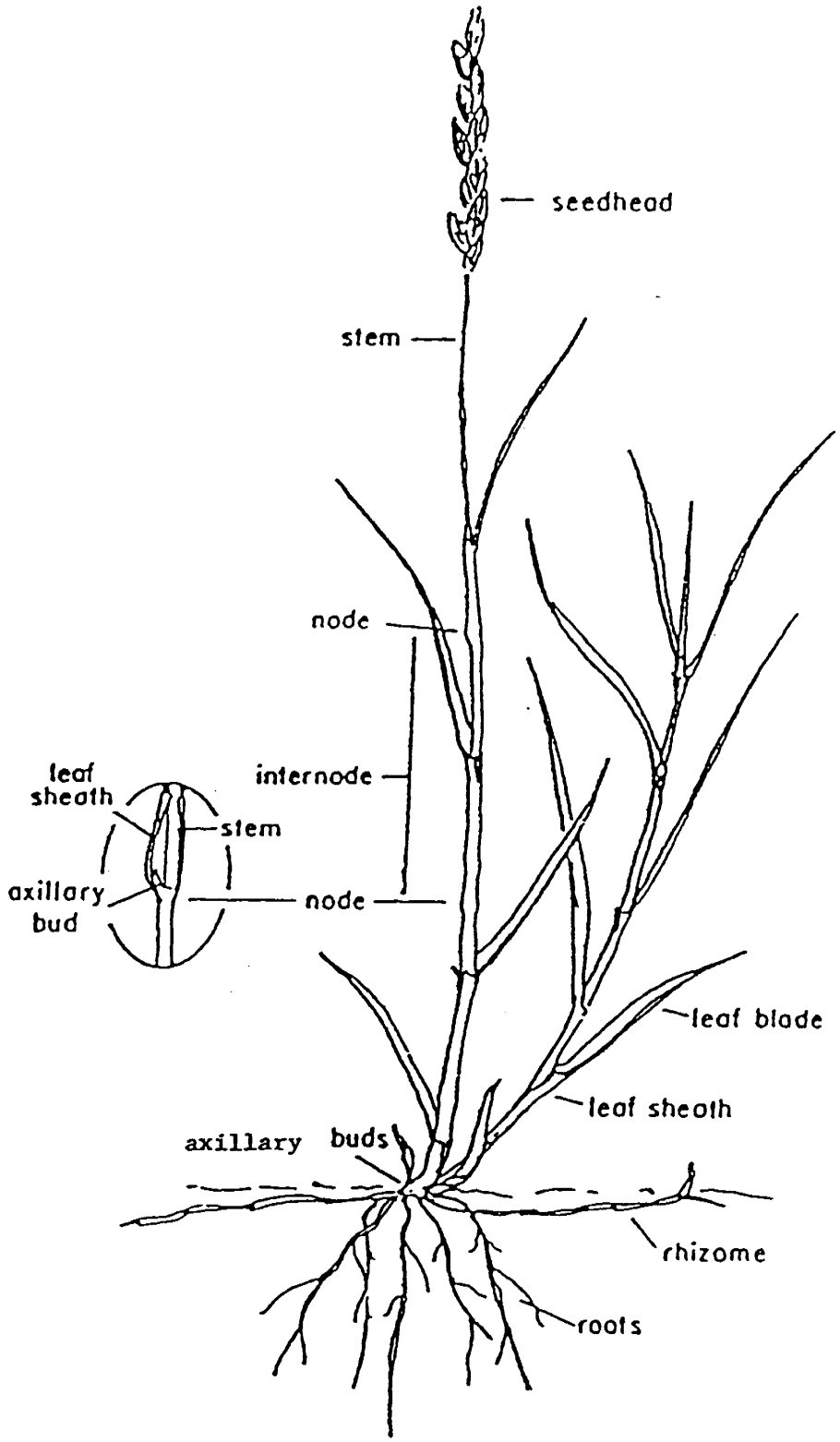


Figure 5 **Tiller initiation from axillary buds in the crown of a grass plant. Axillary buds contain single rudimentary apical meristems capable of differentiating a complete tiller (from Jewiss 1972).**



gure 6 Structure of the grass plant and location of buds at can grow into tillers. The main growing point has atured into a seed head.

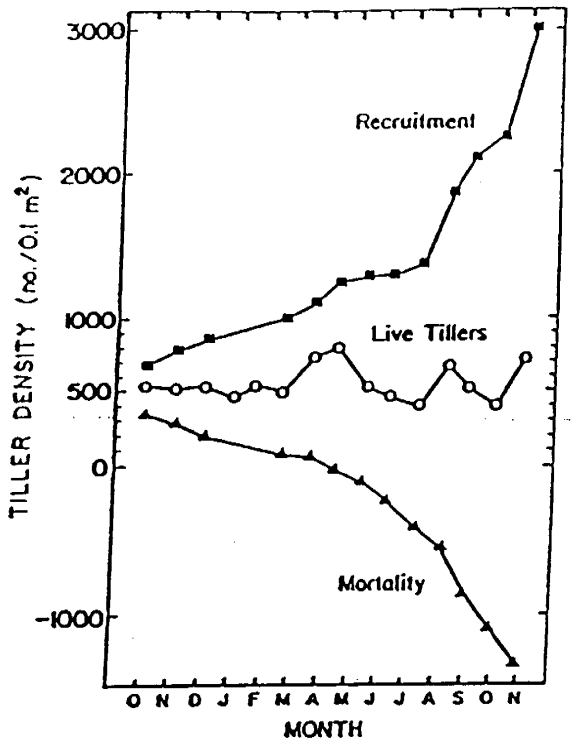


Figure 7 **Live tiller density as a consequence of tiller recruitment and mortality within a population. Tiller density increases when recruitment exceeds mortality and decreases when recruitment lags behind mortality (from White 1980).**

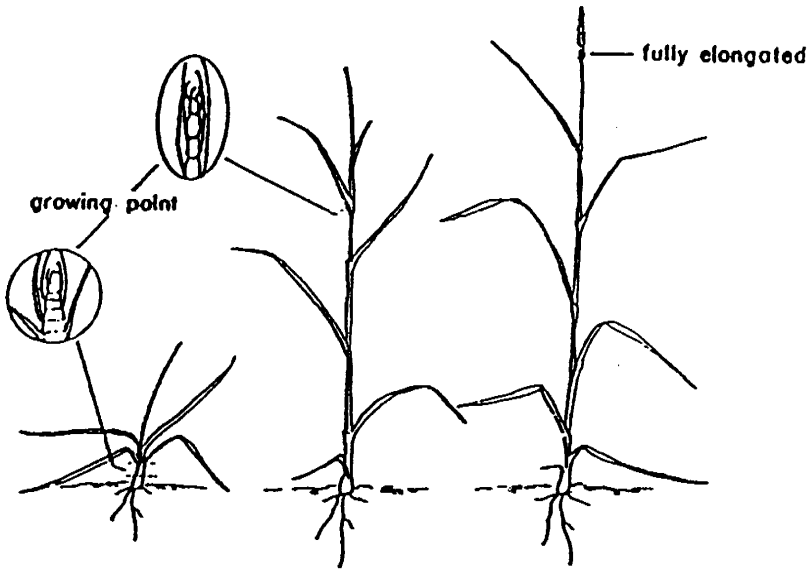


Figure 8 Developmental phases of a grass tiller.

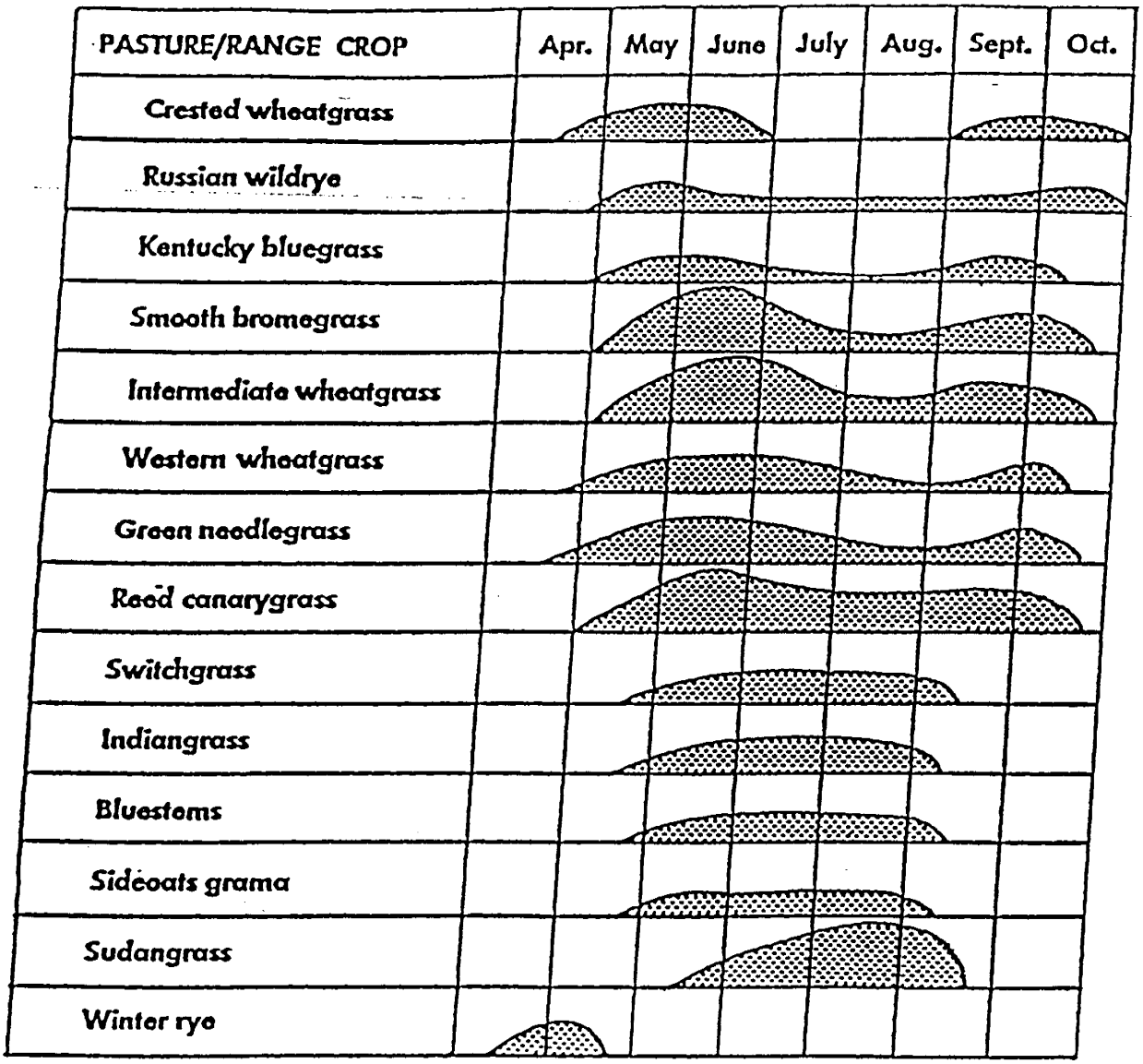

PASTURE/RANGE CROP
Apr.
May
June
July
Aug.
Sept.
Oct.
Crested wheatgrass
Russian wildrye
Kentucky bluegrass
Smooth bromegrass
Intermediate wheatgrass
Western wheatgrass
Green needlegrass
Reed canarygrass
Switchgrass
Indiangrass
Bluestems
Sideoats grama
Sudangrass
Winter rye

Figure 9

GROWTH CURVE OF BLUE BUNCH WHEATGRASS AT VARIOUS GROWTH STAGES

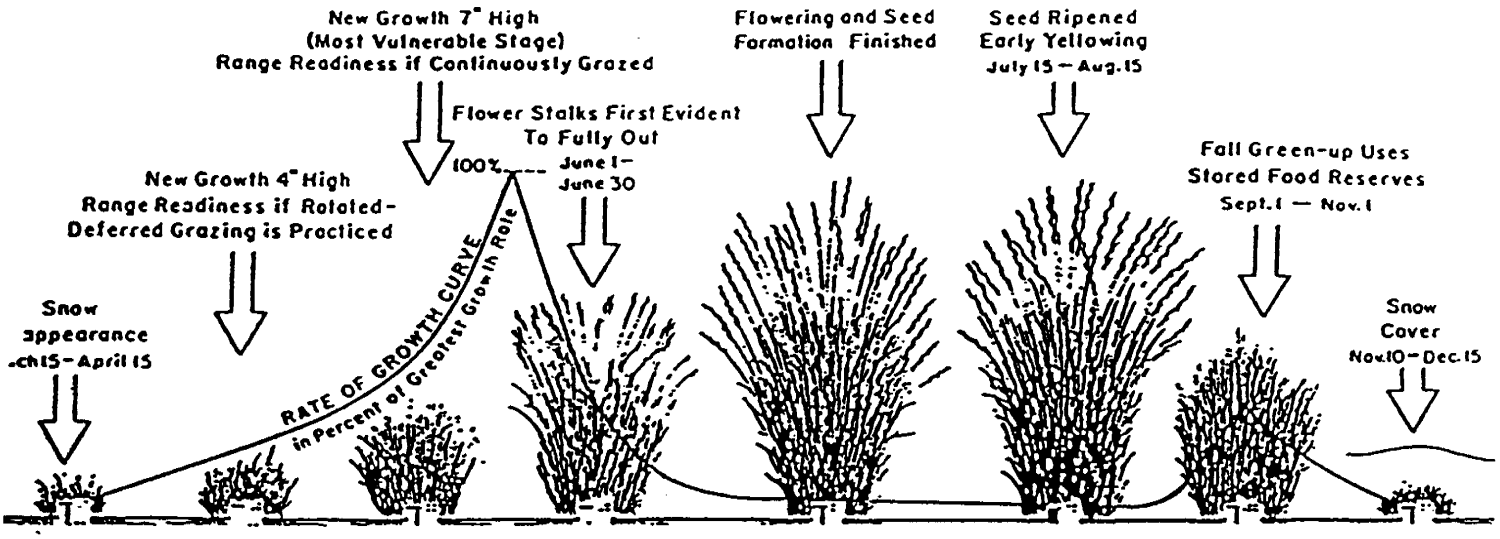


Figure 10

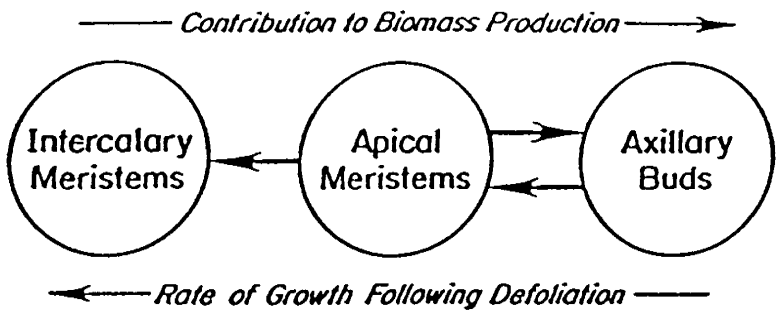


Figure 11 **Sources of meristematic activity in a grass plant. The relative growth rate from each source following defoliation is established by the extent to which tissue differentiation has previously occurred. Axillary buds confer perenniality to the plant while intercalary meristems are relatively short-lived (from Briske 1986).**

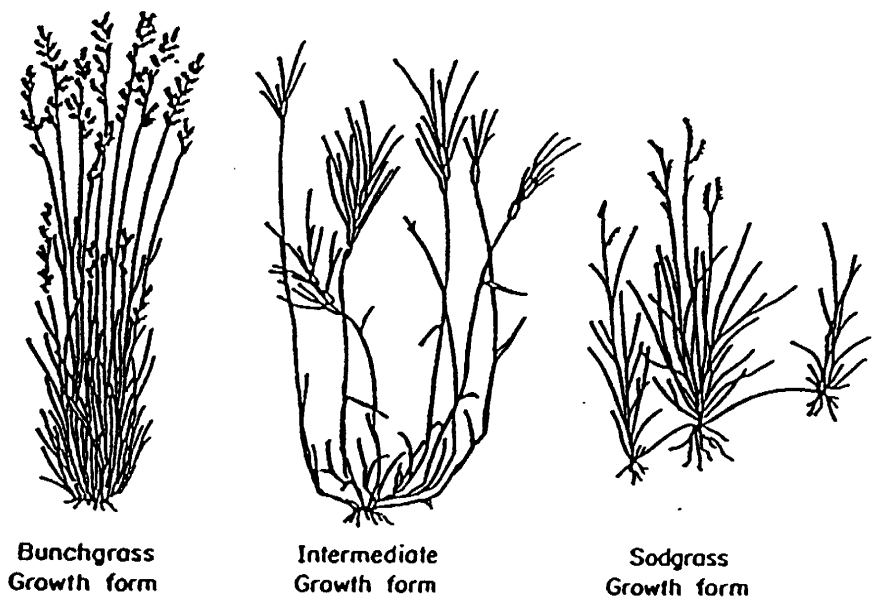


Figure 12 **Variation within the grass growth form originates from the pattern of tiller emergence expressed by various species groups. The bunchgrass growth form originates from intravaginal tiller development, while extravaginal tiller development contributes to a more diffuse tiller arrangement and serves as a prerequisite to the sodgrass growth form. Stolons or rhizomes further increase inter-tiller distances within plants.**

Appendix F

Planning for Drought

Planning for drought could consume time and resources, especially if a multi-agency approach is utilized. However, if each agency plans for drought independent of other agencies or state and private landowners the site-specific and collateral impacts from independent decisions made on these lands will probably cause long-term negative impacts on the economy and environment of Utah, which will certainly cause social change. Consequently, the DA&MT suggests that a statewide drought planning effort will pay positive long-term dividends from the investment of time and resources will be worth the short-term pain.

Step 1: Appoint a Drought Task Force

A drought planning process in Utah would be very successful if it followed the multi-agency/multi-disciplinary approach used in the Drought Assessment and Mitigation Team process and if the effort were initiated by the governor.

The task force has two purposes. First, the task force supervises and coordinates development of the plan. Second, after the plan is developed and during times of drought when the plan is activated, the task force coordinates actions, implements mitigation and response programs, and makes policy recommendations to the governor. The task force is encouraged to oversee development of a website that would contain information about the planning process, a copy of the plan, and current climate and water supply information.

The task force should reflect the multidisciplinary nature of drought and its impacts, and it should include representatives of both state and federal government agencies and universities (e.g., representatives from extension, climatologists, policy specialists, planners). A representative from the governor's office should be a member of the task force. Environmental and public interest groups and others from the private sector, including industries, can be included on the task force, and/or on sector-specific working groups of the risk assessment committee, or an advisory council, or they can be otherwise involved, as appropriate. The actual makeup of this task force would be highly variable between states, reflecting the state's political and economic character.

Depending on the nature of recent experiences with drought, the task force may find itself in the public spotlight from the outset, or it may work in relative obscurity. No matter what the initial level of public attention is, the task force needs to incorporate people who know how to conduct effective two-way communication with the public. Ideally, the task force should include or have access to a public information official that is familiar with local media's needs and preferences and a public participation practitioner who can help establish processes that accommodate both well-funded and disadvantaged groups.

Step 2: Define the Purpose and Objectives of the Drought Plan

As its first official action, the drought task force should develop and state the general purpose for the drought plan. State and agency officials should consider many questions as they define the purpose of the plan, such as:

- purpose and role of state government and state and federal agencies in drought mitigation and response efforts;
- scope of the plan (e.g. will it include urban water use, public and private land assessment and mitigation, etc.;
- define the role of citizens and NGOs;
- identify the most drought-prone areas of the state;
- assess the historical impacts of drought;

- assess the historical response to drought;
- identify the most vulnerable economic and social sectors;
- clearly define and articulate the role of the plan in resolving conflict between water users and other vulnerable groups:
- during periods of shortage;
- current trends (e.g., land and water use, population growth) that may
- increase/decrease vulnerability and conflicts in the future;
- resources (human and economic) that the entities are willing to commit to the planning process;
- legal and social implications of the plan;
- principal environmental concerns caused by drought.

A generic statement of purpose for a plan is to reduce the impacts of drought by identifying principal activities, groups, or regions most at risk and developing multi-agency mitigation actions and programs that alter these vulnerabilities. The plan is directed at providing government agencies and state leadership with an effective and systematic means of assessing drought conditions, developing mitigation actions and programs to reduce risk in advance of drought, and developing response options that minimize economic stress, environmental losses, and social hardships during drought.

The task force should identify the specific objectives that support the purpose of the plan. Drought plan objectives should reflect the unique physical, environmental, socioeconomic, and political characteristics of the state of Utah. At the state level, plan objectives will place less emphasis on financial assistance measures (traditionally a role of the federal government in the United States) than would the objectives of a national plan. Technical assistance is a common element of state agency missions. Support for educational and research programs is typically a shared responsibility of state and federal government. Objectives that states should consider include the following:

- Collect and analyze drought-related information in a timely and systematic manner.
- Establish criteria for declaring drought emergencies and triggering various mitigation and response activities.
- Provide an organizational structure and delivery system that assures information flow between and within levels of government.
- Define the duties and responsibilities of all agencies with respect to drought.
- Maintain a current inventory of state and federal programs used in assessing and responding to drought emergencies.
- Identify drought-prone areas of the state and vulnerable economic sectors, individuals, or environments.
- Identify mitigation actions that can be taken to address vulnerabilities and reduce drought impacts.
- Provide a mechanism to ensure timely and accurate assessment of drought's impacts on agriculture, industry, municipalities, wildlife, tourism and recreation, health, and other areas.
- Keep the public informed of current conditions and response actions by providing accurate, timely information to media in print and electronic form (e.g., via TV, radio, and the World Wide Web).
- Establish and pursue a strategy to remove obstacles to the equitable allocation of water during shortages and establish requirements or provide incentives to encourage water conservation.
- Establish a set of procedures to continually evaluate and exercise the plan and periodically revise the plan so it will stay responsive to the needs of the state.

Step 3: Seek Stakeholder Participation and Resolve Conflict

Social, economic, and environmental values often clash as competition for scarce water resources intensifies. Therefore, it is essential for task force members to identify all citizen groups and NGO's that have a stake in drought planning (stakeholders) and their interests. These groups must be involved early and continuously in order for there to be fair representation and effective drought management and planning. Discussing concerns early in the process gives participants a chance to develop an understanding of one another's various viewpoints, and to generate collaborative solutions. Although the level of involvement by these groups will vary notably from area to area, the power of public interest groups in policy making is considerable. In fact, these groups are likely to impede progress in the development of plans if they are not included in the process. The task force should also protect the interests of stakeholders who may lack the financial resources to serve as their own advocates.

Public participation takes many forms. Time and money may constrain how actively the task force can solicit input from stakeholders. One way to facilitate public participation is to establish a citizen's advisory council as a permanent feature of the drought plan, to help the task force keep information flowing and resolve conflicts between stakeholders. Another way is to invite stakeholders to serve on working groups of the risk assessment committee.

The state wide Drought Planning Task Force should also consider whether district or regional advisory councils need to be established. These councils could bring neighbors together to discuss their water use issues and problems and seek collaborative solutions. At the state level, a representative of each district council should be included in the membership of the state's citizens' advisory council to represent the interests and values of their constituencies. The state's citizens' advisory council can then make recommendations and express concerns to the task force as well as respond to requests for situation reports and updates.

Step 4: Identify Resources and Identify Groups at Risk

An inventory of natural, biological, and human resources, including the identification of constraints that may impede the planning process, may need to be initiated by the task force. In most states in the United States, much information already exists about natural and biological resources through various state and federal agencies. It is important to determine the vulnerability of these resources to periods of water shortage that result from drought. The most obvious natural resource of importance is water: where is it located, how accessible is it, of what quality is it? Biological resources refer to the quantity and quality of grasslands/rangelands, forests, wildlife, and so forth. Human resources include the labor needed to develop water resources, lay pipeline, haul water and livestock feed, develop resource reserves, implement the systematic maintenance of public land water projects, process citizen complaints, provide technical assistance, and direct citizens to available services.

It is also imperative to identify constraints to the planning process and to the activation of the plan in response to a developing drought. These constraints may be physical, financial, legal, or political. The costs associated with the development of a plan must be weighed against the losses that will likely result if no plan is in place. The purpose of a drought plan is to reduce risk and therefore economic, social, and environmental impacts. Generally speaking, the costs associated with the development of a state-level plan have been $50,000-$100,000, plus in-kind costs to state and federal agencies. This price tag seems inconsequential in comparison to the impacts associated with drought. Legal constraints can include water rights, existing public trust laws, and requirements for public water suppliers, liability issues, and so forth.

In drought planning, making the transition from crisis to risk management is difficult because, historically, little has been done by state and federal agencies to understand and address the risks associated with drought. To solve this problem, areas of high risk should be identified, as should actions that can be taken before a drought occurs to reduce those risks. Risk is defined by both the exposure of a location to the drought hazard and the vulnerability of that location to periods of drought-induced water shortages.[i]. Drought is a natural event; it is important to define the exposure (i.e., frequency of drought of various intensities and durations) of various parts of the state to the drought hazard. Some areas are likely to be more at risk than others. Vulnerability, on the other hand, is defined by social factors such as land use patterns, government policies, social behavior, water use, population, economic development, diversity of

economic base, cultural composition, and so forth. The drought task force should address these issues early in the planning process so they can provide more direction to the committees and working groups that will be developed under Step 5 of the planning process.

Step 5: Develop Organizational Structure and Prepare the Drought Plan

These steps describes the process of establishing relevant committees to develop and write the drought plan and develop the necessary organizational structure to carry out its responsibilities. The drought plan should have three primary components: monitoring, risk assessment, and mitigation and response. It is recommended that committees be established to focus on the first two of these needs; the mitigation and response function can in most instances be carried out by the drought task force (Figure 1).

These committees will have their own tasks and goals, but well-established communication and information flow between committees and the task force is a necessity to ensure effective planning.

Task Force (Mitigation and Drought Response)

It is recommended that the task force (see Step 1), working in cooperation with the monitoring and risk assessment committees, have the knowledge and experience to understand drought mitigation techniques, risk analysis (economic, environmental, and social aspects), and drought-related decision-making processes at all levels of government. The drought task force, as originally defined, is composed of senior policy makers from various state and federal agencies. The group should be in an excellent position to recommend and/or implement mitigation actions, request assistance through various federal programs, or make policy recommendations to the legislature and governor.

Specific responsibilities of the task force at this point are to:

A. Determine mitigation and response actions for each of the principal impact sectors, in close cooperation with the risk assessment committee. Wilhite (1997) recently completed an assessment of drought mitigation technologies implemented by states in response to drought conditions during the late 1980s and early 1990s (http://drought.unl.edu/mitigate/tools.htm). However, the transferability of these technologies to specific situations in other states needs to be evaluated further because they may not be directly transferable in some cases. Working with the risk assessment committee, the task force should come up with recommendations addressing drought on two different time scales:

- Short-term responses to implement during drought, such as voluntary water conservation guidelines, a ready-to-roll hay hotline, streamlined administrative procedures for evaluating emergency assistance applications, and pre-produced infomercials leading agricultural producers and citizens to information on best management practices.

- Long-term drought mitigation projects, such as education programs to give various audiences the background they need to interpret drought news reports or scientific drought indices; programs to persuade people to adopt measures that enhance organic content in soil, conserve water, and otherwise boost the resilience of natural and social systems that are vulnerable to drought. Other projects include regional seminars about preparing for drought on private lands, using various alternative economic models to manage for average conditions (which factors in drought years) instead of optimum conditions on private lands.

Assuming there is no ongoing drought, it's a good idea to publicize the recommendations of the task force and seek public input before the plan is implemented, particularly if anything seems revolutionary or controversial.

B. Inventory all forms of assistance available from local, state, and federal government agencies during severe drought. The task force should evaluate these programs for their ability to address short-term emergencies and long-term vulnerability to drought. Assistance should be defined very broadly to include all forms of technical, mitigation, and relief programs available. Drought program inventories are available on the web: the Catalog of Federal Assistance Programs and the National Drought Policy Commission's analysis, although it's important to note that the NDPC listing includes programs that have never been funded.

C. Work with the monitoring and risk assessment committees to establish triggers. The monitoring committee can advise the task force on which drought and water supply indices are most relevant for the state or region. It is helpful to establish a sequence of descriptive terms for water supply alert levels, such as "advisory," "alert," "emergency," and "rationing" (as opposed to more generic terms such as "phase 1"and "phase 2," or sensational terms such as "disaster"). The task force should review the terminology used by other entities (i.e., local utilities, states, river basin) and choose terms that are consistent in areas where authorities may technical assistance or other forms of encouragement to help local water suppliers establish triggers for different stages of rationing before a drought. Some states, such as California, mandate that every water supplier have a drought contingency plan.

D. Establish drought management areas (i.e., subdivide the state or region into more conveniently sized districts by political boundaries, shared hydrological characteristics, climatologically characteristics, or other means such as drought probability or risk). These subdivisions may be useful in drought management since they may allow drought stages and mitigation and response options to be regionalized.
Climatic divisions are the most commonly used subdivisions at the state level, but they may not be the most appropriate, given topographic features, land use patterns, or water use characteristics. The task force should work closely with the monitoring committee to understand natural boundaries as well as limitations imposed by existing data collection systems, and with the risk assessment committee to understand the timing of drought's effects on different economic sectors and social groups.

E. The drought task force should develop a website for disseminating drought monitoring information and for letting the public know about the drought plan. Models that could be followed are web pages for the states of Texas, Montana, Pennsylvania, Oklahoma, New Mexico, South Carolina, and Nebraska (http://drought.unl.edu/plan/stateplans.htm and http://drought.unl.edu/plan/handbook/other_web_links.htm.

Monitoring Committee

A reliable assessment of water availability and its outlook for the near- and long-term is valuable information in both dry and wet periods. During drought, the value of this information increases markedly. The monitoring committee should include representatives from agencies with responsibilities for monitoring climate and water supply. It is recommended that data and information on each of the applicable indicators (e.g., precipitation, temperature, evapotranspiration, long-range weather forecasts, soil moisture, streamflow, ground water levels, reservoir and lake levels, and snow pack) be considered in the committee's evaluation of the water situation and outlook for the state. The agencies responsible for collecting, analyzing, and disseminating data and information will vary according to the state organizational structure and by geographic region.

The monitoring committee should meet regularly, especially in advance of the peak demand season. Following each meeting, reports should be prepared and disseminated to the state's drought task force, relevant state and federal agencies, and the media. The chairperson of the monitoring committee should be a permanent member of the drought task force. In many states,

this person may be the state climatologist. If conditions warrant, the task force should brief the governor about the contents of the report, including any recommendations for specific actions. It is essential for the public to receive a balanced interpretation of changing conditions. The monitoring committee should work closely with public information specialists to keep the public well informed.

The primary objectives of the monitoring committee are to:

A. Help policy makers adopt a workable definition of drought that could be used to phase in and phase out levels of state and federal actions in response to drought. It may be necessary to adopt more than one definition of drought in identifying impacts in various economic, social, and environmental sectors. Several indices are available (Hayes, 1998), including the Standardized Precipitation Index (McKee et al., 1993; 1995), which is gaining widespread acceptance (Guttman, 1998; Hayes et al., 1999; also refer to http://drought.unl.edu/monitor/spi.htm). The commonly used Palmer Drought Severity Index (Palmer, 1965) is being replaced or supplemented as a monitoring tool in many states. The trend is for states to rely on multiple drought indices as indicators of impacts in various sectors. The current thought is that no single index of drought is adequate to measure the complex interrelationships between the various components of the hydrological cycle and impacts.

B. Help the task force establish drought management areas (i.e., subdivide the state or region into more conveniently sized districts by political boundaries, shared hydrological characteristics, climatological characteristics, or other means such as drought probability or risk). The monitoring committee's advice may be particularly helpful in communicating natural watershed boundaries as well as the limits and constraints imposed by existing data.

C. Develop a drought monitoring system. Most states already have a good data collection system for monitoring climate and water supplies and identifying potential shortfalls. Responsibility for collecting, analyzing, and disseminating the data is divided between many state and federal agencies and other entities. The monitoring committee's challenge is to coordinate and integrate the analysis so decision makers and the public receive early warning of emerging drought conditions. On a national basis, much of this information has been compiled under the Monitoring Drought section of the NDMC's website. Two new products, the Drought Monitor and Current Droughts Affecting the U.S., are good examples. This section is also linked to specific state websites that illustrate how others are organizing information on drought conditions.

Many states (e.g., Nebraska, Oklahoma, California) have developed automated weather data networks that provide rapid access to climate data. These networks can be invaluable in monitoring emerging and ongoing drought conditions. Data from them can be coupled with data available from federal agencies (e.g., Natural Resources Conservation Service) to provide a comprehensive monitoring of climate and water systems. Data and data products should be disseminated on a timely basis in printed form and electronically via the World Wide Web.

D. Inventory data quantity and quality from current observation networks. Many networks monitor key elements of the hydrologic system. Most of these networks are operated by federal or state agencies, but other networks also exist and may provide critical information for a portion of a state or region. Meteorological data are important but represent only one part of a comprehensive monitoring system. Other physical indicators (soil moisture, streamflow, reservoir and ground water levels) must be monitored to reflect impacts of drought on agriculture, households, industry, energy production, and other water users. Helpful technology includes soil moisture sensors, automated weather stations, and satellite data such as digital data obtained from the

Advanced Very High Resolution Radiometer (AVHRR), transmitted from a National Oceanic and Atmospheric Administration satellite, which is useful in detecting areas where moisture deficiencies are affecting vegetation growth. Much of this data will be integrated under the Unified Climate Access Network (UCAN).

E. Work closely with the task force and risk assessment committees to determine the data needs of primary users. Developing new or modifying existing data collection systems is most effective when the people who will be using the data are consulted early and often. Soliciting input on expected new products or obtaining feedback on existing products is critical to ensuring that products meet the needs of primary users and will be used in decision making. Training on how to use or apply products in routine decision-making is also essential.

F. Develop and/or modify current data and information delivery systems. People need to be warned of drought as soon as it is detected, but often they are not. Information needs to reach people in time for them to use it in making decisions. In establishing information channels, the monitoring committee needs to consider when people need various kinds of information. These decision points can determine whether the information provided is used or ignored.

Risk Assessment Committee

Drought impacts cut across many sectors and across normal divisions of responsibility of local, state, and federal agencies. These impacts have been classified by Wilhite and Vanyarkho (2000) and are chronicled in the "Understanding Your Risk" section of the NDMC's website. Risk is the result of exposure to the drought hazard (i.e., probability of occurrence) and societal vulnerability, represented by a combination of economic, environmental, and social factors. Therefore, to reduce vulnerability to drought, it is essential to identify the most significant impacts and assess their underlying causes.

The membership of the risk assessment committee should represent economic sectors, social groups, and ecosystems most at risk from drought. The committee's chairperson should be a member of the task force.

The most effective approach to follow in determining vulnerability to and impacts of drought is to create working groups under the aegis of the risk assessment committee. The responsibility of the committee and working groups is to assess sectors, population groups, and ecosystems most at risk and identify appropriate and reasonable mitigation measures to address these risks. Working groups would be composed of technical specialists and stakeholders representing those areas referred to above. The chair of each working group, as a member of the risk assessment committee, would report directly to the committee.
Following this model, the responsibility of the committee is to direct the activities of each of the working groups and make recommendations to the drought task force on mitigation actions.

The number of working groups will vary considerably between states. Colorado has identified eight impact working groups: municipal water, wildfire protection, agricultural industry, commerce and tourism, wildlife, economic, energy loss, and health. Idaho's drought plan outlines the responsibilities of five subcommittees: water data, public information, agriculture, municipal supplies and water quality, and recreation and tourism. New Mexico uses four sub-groups: agricultural; drinking water, health, and energy; wildlife and wildfire protection; and tourism and economic impact. Nebraska's drought plan identifies two working groups: agriculture, natural resources, wildlife, tourism, and recreation; and municipal water supply, health, and energy.

A methodology for assessing and reducing the risks associated with drought has recently been completed as a result of collaboration between the NDMC and the Western Drought Coordination Council's (WDCC) Mitigation and Response Working Group (Knutson et al., 1998) and is available on the NDMC's website at http://drought.unl.edu/handbook/risk.pdf. The guide focuses on identifying and assigning priorities to drought impacts, determining their underlying causes, and choosing actions to address the underlying causes. This methodology can be employed by each of the working groups. This effort requires an interdisciplinary analysis of impacts and management options and is divided into six tasks:

A. Assemble the team. Select stakeholders, government planners, and others with a working knowledge of drought's effects on primary sectors, regions, and people.

B. Evaluate the effects of past droughts. Identify how drought has affected the region, group, or ecosystem. Consult climatological records to determine the "drought of record," the worst in recorded history, and project what would happen if a similar drought occurred this year or in the near future, considering changes in land use, population growth, and development that have taken place since that drought.

C. Rank impacts. Determine which drought effects are most urgently in need of attention. Various considerations in assigning priority to these effects include cost, area extent, trends over time, public opinion, social equity, and the ability of the affected area to recover.

D. Identify underlying causes. Determine those factors that are causing the highest levels of risk for various sectors, regions, and populations. For example, an unreliable source of water for municipalities in a particular region may explain the impacts that have resulted from recent droughts in that area. To reduce the potential for drought impacts in the future, it is necessary to understand the underlying environmental, economic, and social causes of these impacts. To do this, drought impacts must be identified and the reason for their occurrence determined.

E. Identify ways to reduce risk. Identify actions that can be taken before drought that will reduce risk. In the example above, taking steps to identify new or alternative sources of water (e.g., ground water) could increase resiliency to subsequent episodes of drought.

F. Write a "to do" list. Work with the task force to assign priority to options according to what is likely to be the most feasible, cost-effective, and socially equitable. Implement steps to address these actions through existing government programs or the legislative process. This process has the potential to lead to the identification of effective and appropriate drought risk reduction activities that will reduce long-term drought impacts, rather than ad hoc responses or untested mitigation actions that may not effectively reduce the impact of future droughts.

Step 6: Integrate Science and Policy, Close Institutional Gaps

An essential aspect of the planning process is integrating the science and policy of drought management. The policy maker's understanding of the scientific issues and technical constraints involved in addressing problems associated with drought is often limited. Likewise, scientists generally have a poor understanding of existing policy constraints for responding to the impacts of drought. In many cases, communication and understanding between the science and policy communities must be enhanced if the planning process is to be successful. Integration of science and policy during the planning process will also be useful in setting research priorities and synthesizing current understanding. The drought task force should consider various alternatives to bring these groups together and maintain a strong working relationship.

As research needs and gaps in institutional responsibility become apparent during drought planning, the drought task force should compile a list of those deficiencies and make recommendations on how to

remedy them to the governor, relevant state agencies, and the legislature. For example, the monitoring committee may recommend establishing or enhancing a ground water monitoring program. Another recommendation may be to initiate research on the development of a climate or water supply index to help monitor water supplies and trigger specific actions by state government.

Step 7: Publicize the Proposed Plan, Solicit Reaction

If there has been good communication with the public throughout the process of establishing a drought plan, there may already be better-than-normal awareness of drought and drought planning by the time the task force recommends various drought mitigation and response options. Themes to emphasize in writing news releases and organizing informational meetings during and after the drought planning process could include: How the drought plan is expected to relieve impacts of drought. Stories can focus on the human dimensions of drought, such as how it affects a farm family, on its environmental consequences, such as reduced wildlife habitat; and on its economic effects, such as the costs to a particular industry or to the state's overall economy. What it will cost to implement each option, and how it will be funded. What changes people might be asked to make in response to different degrees of drought, such as restricted lawn watering and car washing, or not irrigating certain crops at certain times.

In subsequent years, it may be useful to do "drought plan refresher" news releases at the beginning of the most drought-sensitive season, letting people know whether there is pressure on water supplies or reason to believe that there will be shortfalls later in the season, and reminding them of the plan's existence and history and any associated success stories. It may be useful to refresh people's memories ahead of time on circumstances that would lead to water use restrictions.

During drought, the task force should work with public information professionals to keep the public well informed of the current status of water supplies, whether conditions are approaching "trigger points" that will lead to requests for voluntary or mandatory use restrictions, and how victims of drought can access assistance. All pertinent information should also be available on the state's drought website so that the public can get information directly from the task force without having to rely on mass media.

Step 8: Implement the Plan

Once the task force and any external constituencies have agreed on the plan, the task force and/or its designated representatives should oversee implementation of both the short-term operational aspects of the plan and long-term mitigation measures. Periodic testing, evaluation, and updating of the drought plan will help keep the plan responsive to state needs. An ongoing or operational evaluation keeps track of how societal changes such as new technology, new research, new laws, and changes in political leadership may affect drought risk and the operational aspects of the drought plan. Drought risk may be evaluated quite frequently while the overall drought plan may be evaluated less often. An evaluation under simulated drought conditions (i.e., drought exercise) is recommended before the drought plan is implemented and periodically thereafter. The virtual drought exercise developed in association with a recent national study conducted by the U.S. Army Corps of Engineers (Werick and Whipple, 1994) is one mechanism that has been used to simulate drought conditions and related decisions. It is important to remember that drought planning is a process, not a discrete event.

Long-term mitigation measures, such as implementing policies that require conjunctive use of ground and surface water, may require drafting new legislation and finding funds to support new monitoring and regulation efforts. In any case, it is essential to recognize that reducing long-term vulnerability to drought will require a sustained effort, although it may be a matter of long-term programs undertaken by a variety of agencies.

Step 9: Develop Education Programs

A broad-based education program to raise awareness of short- and long-term water supply issues will help ensure that people know how to respond to drought when it occurs and that drought planning does not lose ground during non-drought years. It would be useful to tailor information to the needs of specific groups

(e.g., elementary and secondary education, small business, industry, homeowners, and utilities). The drought task force or participating agencies should consider developing presentations and educational materials for events such as a water awareness week, community observations of Earth Day, relevant trade shows,
specialized workshops, and other gatherings that focus on natural resource stewardship or management.

Step 10: Post-Drought Evaluation

A post-drought evaluation or audit documents and analyzes the assessment and response actions of government, nongovernmental organizations, and others, and provides for a mechanism to implement recommendations for improving the system. Without post-drought evaluations, it is difficult to learn from past successes and mistakes, because institutional memory fades.

Post-drought evaluations should include an analysis of the climatic and environmental aspects of the drought; its economic and social consequences; the extent to which pre-drought planning was useful in mitigating impacts, in facilitating relief or assistance to stricken areas, and in post-recovery; and any other weaknesses or problems caused or not covered by the plan. Attention must also be directed to situations in which drought-coping mechanisms worked and where societies exhibited resilience; evaluations should not focus only on those situations in which coping mechanisms failed. Evaluations of previous responses to severe drought are also a good planning aid.

To ensure an unbiased appraisal, governments may wish to place the responsibility for evaluating drought and societal response to it in the hands of nongovernmental organizations such as universities and/or specialized research institutes.

The following references are suggested reading for a drought Task Force:

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[i] Blaikie et al., 1994

Appendix G

UTAH DIVISION OF WILDLIFE RESOURCES

DROUGHT RESPONSE PLAN FOR WILDLIFE

Approved by the UTAH WILDLIFE BOARD on August 13, 2002

INTRODUCTION

The State of Utah is experiencing an extended drought with only occasional wetter years. Conditions for fish and wildlife have gradually deteriorated over this period throughout much of the state. Already this year range conditions have deteriorated to critical, nearly unprecedented levels. Stream flows and reservoir levels are in fair shape depending on where they occur, and angling appears good in many locations despite drought circumstances. Continuing drought conditions will no doubt worsen in some areas, although outdoor recreation including angling is expected to remain popular and enjoyable in many parts of the state. Southern Utah is experiencing particularly severe conditions, although almost every part of the state is affected to some degree. Conditions are tough, and there will be impacts although hunting and fishing should still provide good enjoyment throughout the year.

The purpose of this response plan is to inform Division personnel and others concerning the drought, its impacts on wildlife, actions needed to cope with drought conditions, key Division policies for dealing with critical issues, and appropriate means for disseminating information. This is necessary to ensure consistency and accuracy in informing the public of drought impacts on wildlife and related recreational opportunities which may interest them.

Our foremost concern is for the welfare of wildlife. We are also concerned about drought impacts on revenue to the Division and our ability to carry out Division programs that benefit wildlife. We want to emphasize the quality of time spent recreating outdoors, regardless of whether a drought is on-going. We should encourage participation in hunting and angling among those who enjoy participating in these sports.

SUMMARY OF DROUGHT IMPACTS ON WILDLIFE

Fisheries

A prolonged drought may cause severe losses of fish in many streams, lakes, and reservoirs. Much of this loss is not preventable, and angling quality may be temporarily reduced. At present, the impacts have not grown to severe levels in most locations and angling opportunities remain very good. Low stream flows and lake levels typically result in increased water temperature and consequent decreased dissolved oxygen content.

Increased biochemical oxygen demand, due to greater organic debris relative to the volume of water present, may further deplete oxygen levels and cause additional fish losses due to

suffocation.

Low stream flows in populated or industrialized areas can concentrate pollutants beyond fish tolerance levels and cause further mortality.

Low stream flows and resulting water shortages for crop irrigation usually results in increased efforts to chemically control aquatic vegetation in canals and ditches. Improper use of herbicides can result in extensive fish kills.

Low water levels in lakes resulting from extended drought can jeopardize fish populations in many reservoirs, and especially in small high mountain lakes, by a threat of winter kill.

As water levels diminish in lakes, reservoirs and streams, fish carrying capacity also declines. If levels are significantly reduced, excess fish either move, are caught by anglers, or simply die. Obviously, given those choices, an increased harvest is most desirable, since there is usually little opportunity for movement to better water conditions, and fish may be concentrated and easy to harvest. This fact produces good angling opportunities where conditions are right, and anglers can benefit during early months of the summer.

Given the above impacts of drought on our fisheries, the fisheries outlook for the future hinges on the moisture received between now and winter. Angling after all is fun, and the quality of the experience can be emphasized over the catch rate.

Wildlife

Adverse impacts of drought on terrestrial wildlife can most simply be summarized as depletions of cover, food, and water and the effects of these depletions on productivity and populations.

Impacts on individual species vary, but it is safe to assume that extended severe drought will cause significantly reduced reproductive success and declining populations of most species. This is unavoidable except in areas where wildlife water developments may provide some respite from the drought, although vegetation growth is still affected in those areas.

Greatest impacts of the current drought have been observed with those species found primarily in desert and desert mountain areas where forage and drinking water supplies are limiting, even in normal moisture years. Reduced plant growth and vigor has also been significant on seasonal ranges for migratory species such as mule deer and elk.

A lack of sufficient spring and summer rainfall for several years has had an adverse effect on vegetation growth and resulting range condition and trend over much of the state. Forage supplies for many wildlife species are extremely low, except in some of the higher mountains which naturally receive higher precipitation. Competition for forage between livestock and wildlife is much greater than normal, as forage is reduced. This has intensified agricultural depredation in certain areas.

Big game - Mule deer, elk, pronghorn, and bison herds appear to reflect the impacts of prolonged drought and deteriorating range conditions: i.e., winter kill, reduced production of young, and decreased fawn/calf survival through summer. Pronghorn production has been particularly hard hit for the past three years on many of the state's wildlife management units. Some units have shown almost no recruitment into the population for three years.

Drought impacts are clearly demonstrated in mule deer productivity data for the past several years. For the first time in several years, estimated statewide deer population numbers in 2002 have decreased from about 10,000 animals this past year after previously steady increases since the winter of 1992-93. Most of the decreases have occurred in the southern and eastern deer management units.

Big game animals, especially antelope and deer in dry areas, are also adversely affected by the loss of springs, seeps, and other drinking water sources. A secondary, significant effect can be heavy forage use by animals forced to concentrate around remaining water supplies. These habitat impacts can last many years longer than the drought itself. Concentration of big game animals around water sources also can increase the transmission likelihood of certain diseases (e.g., blue-tongue virus in mule deer).

Drought conditions invariably result in increased depredation of private irrigated croplands. Such damage poses serious problems and economic impacts to both the farmers and the Division.

A most serious concern in big game management in Utah, that is magnified in drought years, is big game/livestock competition for forage on critical big game ranges. Winter ranges are of particular concern as such areas are typically used by livestock in spring, prior to moving to higher summer ranges, and again in fall. During drought years, very little growth occurs on plant species important to big game. Much of the available growth is used by livestock prior to winter when big game descend to the

winter range.

This causes extensive wildlife losses, particularly of mule deer, during winters following drought years. This phenomenon has caused significant mortality in deer populations across the state and can be especially devastating if followed by severe winter conditions as occurred in the winter of 1992-93. With continued drought situations, livestock permittees often see their numbers cut substantially which lessens support for maintaining big game numbers on these same ranges.

Upland game - Upland game populations typically fluctuate widely over time. Such fluctuations are primarily a reflection of annual reproductive success. Reproductive success, on a short-term basis, is principally a function of weather conditions, with the most critical time period being late winter and early spring. Weather affects production either through a direct impact on reproductive success or indirectly through forage production. Extreme weather conditions (temperature and precipitation) generally have a detrimental effect on reproduction; however, not all species are influenced in the same way.

Game birds of relatively dry habitats, such as the chukar, greater sage grouse, and Gambel's quail, are very dependent on the production of annual forbs and grasses. They therefore usually respond well to cool, wet spring weather that produces abundant forage. Forest species -- including the ruffed grouse, blue grouse, and wild turkey -- tend to respond to mild spring weather with less rainfall. Those associated with irrigated areas, such as the ring-necked pheasant, California quail, and Hungarian partridge are most affected by breeding season temperature rather than precipitation. Cold April weather is usually detrimental to these species.

Extreme drought conditions which significantly reduce vegetation growth, forage production, and available drinking water will undoubtedly adversely impact all upland game species.

Waterfowl - Drought invariably results in a drying up of many natural wetlands and reduced water levels and decreasing water quality in managed marshes. Extensive drought in waterfowl production areas always results in population declines due to the loss and degradation of nesting and brood-rearing habitat.

Extensively developed wetlands can temper impacts on local waterfowl numbers to the extent that water levels and marsh conditions can be maintained.

Waterfowl habitat not associated with the Great Salt Lake,

has been and will continue to be adversely affected by drought in three basic ways: (1) reduced inflows, (2) increased evaporation, and (3) reduced water quality. Impacts will be less in spring-fed marshes than in those dependent upon surface flows.

Because most waterfowl management areas are at the "end-of-the-ditch" we can expect not only reduced flows, but also substantially poorer water quality. The extent to which this will impact waterfowl production and use of the areas will depend on the extent of the drought in any given area.

Another major waterfowl threat that is often linked with poor water quality and reduced flows is avian botulism. This disease can kill literally hundreds of thousands of waterfowl and shorebirds in a few week period and is extremely difficult to control. This disease tends to recur in the same general area when conditions are suitable. Historic hot spots include most wetlands along the eastern shore of the Great Salt Lake and Provo Bay on the Utah Lake system.

Sensitive species - Animals categorized as sensitive species include fish, mammals, amphibians, reptiles, and birds which are typically not harvested. There is great variation among species insofar as habitat requirements are concerned, and consequent diverse responses to drought. Even so, it is safe to conclude that prolonged drought will not benefit any species, even those well adapted to dry conditions. Impacts on food supplies should affect them if nothing else. Smaller mammals and larger predators which depend on smaller mammals, especially those associated with desert/upland areas, will be adversely impacted.

There is particular concern for those species known to be endangered, threatened, or of known sensitive status. Severe drought reflected in greatly reduced stream flows or forage production could set back recovery efforts. Low flows may diminish spawning success of endangered fishes in the Colorado River system.

Natural biotic communities have evolved with an ability to cope with drought. While population levels may fluctuate widely, they can be expected to recover.

The drying of wetlands, riparian, grassland, and rangeland habitat reduces nesting areas and decreases insect food bases, which diminish avian productivity. Wetland and riparian habitats are particularly rich in avian diversity and are affected the greatest by drought conditions.

In addition to drought effects described above under **Fisheries**, reproduction and recruitment of sensitive species

fishes is adversely affected by low stream flows and reduced water quality associated with their spawning and rearing periods. Low flows have seriously impacted spawning of the endangered June sucker during past dry years.

DROUGHT MITIGATION ALTERNATIVES

Fisheries

The current drought has already adversely affected stream flows, reservoir storage, water temperature, and water quality in many areas. As it continues we can expect further declines and possible fish losses. Nothing can be done to restore lost stream flows. Despite the effects of drought, fishing remains good in many areas.

The Aquatics Section has already adjusted hatchery production and fish distribution schedules to compensate for drought conditions. Regional fisheries managers have been given full authority to modify stocking quotas and schedules within constraints imposed by drought conditions.

Despite the drought, there are many opportunities for good fishing. It is extremely important that we apprise the public of these opportunities now, and throughout the summer and fall. This will require a joint effort by Aquatics, Conservation Outreach, and Law Enforcement to monitor water conditions and fishing success and inform the public accordingly.

We must closely monitor conservation pool levels and prescribed minimum stream flows to assure compliance with contract or permit conditions and to ensure the Division's water rights are protected.

Hatchery personnel and regional fisheries managers must evaluate fish stocking needs in light of the current drought in order to program hatchery production schedules.

Division personnel must be prepared to respond to fish kills when assigned. Such losses can be expected as a result of low water levels, excessive diversions, low oxygen levels, and chemical treatments to control aquatic vegetation. Each incident must be investigated by appropriate personnel, making certain to notify appropriate contact people in the Department of Environmental Quality as is typically done in these matters.

We must anticipate losses in perennial problem areas and initiate efforts to avoid losses to the extent possible. Regions must take the lead in this effort. Cooperative efforts with irrigation companies may prevent or minimize losses.

Wildlife

Reduced production and subsequent wildlife population declines have already somewhat lessened grazing pressures on rangelands to some degree. This is expected to continue through this year, and in some ways matches the cuts which livestock producers have been forced to take. The Wildlife Board has established harvest regulations for 2002 that have taken into consideration potential problems with continued drought, and harvest numbers reflect these considerations. It is essential that wildlife managers further monitor range conditions to ensure an appropriate future balance between herd size and carrying capacity. This must be done in concert with the federal land management agencies who control the dominant share of habitat.

Water developments installed for wildlife must be maintained in good working order. Consideration should be given to the feasibility of hauling water in critical situations. Land management agencies should be encouraged to ensure proper maintenance of water developments benefiting wildlife.

It is expected that depredation problems will escalate and every effort -- within legal, funding, and work force constraints -- must be made to assist farmers and ranchers in minimizing wildlife impacts on crop production. In areas where big game herds are substantially below management objective, killing of animals that move into agricultural lands during drought should be minimized where possible.

The new tools we have to deal with big game depredation on private cultivated land will help alleviate some problems. These tools were not available in 1993, and include the changes in the Utah Code for irrigation equipment and fence damage, antlerless mitigation permits for landowners, the development of a statewide depredation account, and the hiring of many full-time/seasonal personnel by the Division to deal with landowners' needs and their depredation problems in the regions.

Drought usually increases nuisance beaver complaints in canals and ditches. A diligent effort will be required to control these problems at a time when water is in short supply.

Dry, unproductive rangelands may cause unusual dispersal of young bears. Increased human/bear conflicts can be expected and must be handled promptly and within policy guidelines.

In the final analysis, little can be done to significantly alter the impact of extreme drought on wildlife populations. We must work with the public in an informational mode to provide accurate information on drought and its effects on wildlife.

Management efforts should focus on diminishing or avoiding human-caused disturbances that further stress populations whose status is already tenuous.

Waterfowl management area superintendents must closely monitor inflows and adjust water levels in individual units in a way that maximizes habitat quantity and quality. They will also need to closely monitor waterfowl populations for signs of botulism and implement remedial actions required to minimize losses and diminish public concerns.

GUIDELINES FOR DISSEMINATION OF INFORMATION

Concerning Drought Impacts on Fish and Wildlife

Information should be provided to the media and the public so that it becomes clear the Division is aware of the many drought-related problems, and that steps have been and will continue to be taken to cope to the extent feasible.

The public should understand that the Division has considered drought impacts in the establishment of harvest regulations, and that prescribed harvests are within harvestable surpluses of game species.

News releases should stress that hunting and fishing will not be detrimental to populations, and that a reasonable harvest will minimize natural mortality next winter. This is especially true of big game populations that must be kept within management objectives. An adequate harvest not only will tend to minimize potential winter loss, but at the same time will relieve pressure on short forage supplies and help conserve range conditions for the future.

We must be candid in explaining potentials for mitigating drought impacts on widespread populations of fish and wildlife. Drought conditions are natural, wildlife species are generally adapted to them, but drought is often unpleasant. We must be sensitive to deep-seated public concern for the welfare of wildlife during drought, and take the appropriate actions where we can.

Concerning Fishing

Drought conditions dictate a need to increase our conservation outreach efforts over a "normal" year. We must make an extra effort to inform the public of promising fishing opportunities which in fact can be quite good during drought conditions, at least in certain areas. Aquatics personnel,

Habitat and Wildlife staff, and conservation officers must take the initiative to provide our Conservation Outreach staff with needed information and guidance on drought matters. We need to help the public identify the waters which are providing good angling during different times through the year, and Conservation Outreach staff need detailed up-to-the-minute reports they can use in various information releases which should help the public during this drought period.

The following key points should be considered in the preparation of news releases:

* Be positive and upbeat about fishing opportunities.
* Identify current hot spots that can sustain pressure, and the increased fishing opportunities in reservoirs and lakes subject to fishing proclamation changes.
* Make timely news releases.
* Emphasize opportunities on the larger reservoirs and in fisheries below reservoirs.
* Stress that even with the drought, fishing is one of the greatest outdoor recreational opportunities available, and at the best price.
* Encourage use of relatively unfished areas that provide good opportunity, such as the high mountain lakes of the Uintas and Starvation Reservoir for walleye.
* Place greater emphasis on the growing smallmouth bass fisheries in Rockport, Flaming Gorge, and Lake Powell.
* Identify regional variation in drought conditions and fishing opportunities.
* Be honest, absolutely honest as at all times, but be prudent. It is not dishonest to state that fishing is always good, but sometimes it is better than at other times. Advise the public in the way you would want to be advised if the roles were reversed.
* In communicating with the mass media, be sure your information is accurate. If you do not know, tell them that; seek to find the answers the press needs.

Concerning Hunting

As with fishing, a concerted Conservation Outreach effort will be needed to inform the public of hunting opportunities. Wildlife Managers must work closely with Conservation Outreach to provide needed information.

It is important that we emphasize that a harvestable surplus exists in hunted populations, even during drought years. It is important that hunting be used in critical situations where wildlife populations can potentially exceed a drought reduced carrying capacity.

The following key points should be considered in the preparation of news releases during the continuing drought conditions:

* If dry conditions persist, a major effort will be needed to warn of fire danger and possible local closures as fire prevention measures.
* Stress the importance of annual harvest of big game in maintaining a proper balance between herd size and available forage. Habitat damage is long term.
* Stress that antlerless permits authorized for big game species are intended to ensure keeping herd size in balance with available forage.
* Emphasize species which should provide good hunting.
* Avoid predictions of hunter success which becomes very hard to predict during times of drought.

DROUGHT-RELATED POLICIES

Protection of Fish Conservation Pools

Drought-caused declines in stream flows and reservoir water levels inevitably result in local government requests for using water reserved in fish conservation pools for culinary and irrigation use. The Division is obligated to protect conservation ("C") pools purchased for fish using sportsmen's money - after all, drought conditions are the only time when conservation pools are needed! Nonetheless, we must also be sensitive to critical human needs.

Regional supervisors will take the lead in negotiating "C" pool protection and possible diversion to satisfy critical human needs, if, when, and where it becomes necessary. It must be understood that the Division is willing to work cooperatively with local government in seeking solutions to their problems, but we will only surrender water in fish conservation pools **as a last resort** in meeting critical needs. The following guidelines apply to such negotiations:

1. Fish conservation pool water will be relinquished only for critical culinary use, **not** for irrigation or industrial purposes.

2. Conservation pool water will not be provided in lieu of strict water conservation measures being implemented by local government.

3. Any use of conservation pools for culinary purposes

will be kept to the minimum required to meet an existing crisis. As much water as possible should be retained in a "C" pool to protect the fishery.

4. The minimum conditions for relinquishing "C" pool water will be that the Division receive first priority replacement from subsequent increased stream flows, at no cost to the Division.

   Compensation at fair market value for water provided or for fishery replacement costs may be required in some situations. Such decisions will be made by the Director on a case-by-case basis, in consultation with the Regional Supervisor.

5. A written agreement between the Division Director and local officials must be executed before relinquishing any "C" pool water. Such agreement must specify the quantity of water to be used, the timing of use, and compensation required.

   Failure to adequately protect conservation pools purchased with Federal Aid funds will jeopardize future Federal Aid appropriations, and as such the Director will secure approval from Federal Aid prior to any such agreement being made.

Following is a list of conservation pools and stabilized lakes owned by the Division. Regional Supervisors and Aquatics Managers must review this list and identify potential areas of conflict. If a local demand for water is anticipated, supervisors should consider initiating contacts with community/water company officials to advise them of actions required before submitting requests for "C" pool water: e.g., implementation of strict water conservation measures. Without having first exhibited strict water conservation measures being put in place and enforced, no water will be relinquished.

Occasionally, a demand for "C" pool water will coincide with Division goals to treat or repair reservoirs. In such instances, Regional supervisors are granted the latitude to negotiate the best interest of the Division, aside from the above guidelines.

Conservation Pools/Stabilized Lakes

The Division of Wildlife Resources has in the past and is presently pursuing opportunities to enhance fishing recreation on Utah's lakes and reservoirs. In an effort to preserve aquatic habitat, "Conservation Pools" and "Stabilized Lakes" are acquired to provide the environment needed to sustain fish populations on a year-round basis.

The term conservation pool refers to a given volume of water that is maintained in a reservoir basin. In most cases, conservation pools are acquired from irrigation companies to provide needed fish habitat. Generally speaking, this amounts to the minimum water level to which the company may release water from the reservoir.

Stabilized lakes on the other hand are reservoirs that are maintained at a given water level to provide recreational fishing. These reservoirs, or lakes, are kept at a constant volume and water level is fluctuated only when it becomes necessary to protect fish populations or satisfy dam safety requirements.

Conservation pools and stabilized lakes are extremely important in the management of Utah's fisheries program. The following is a list of conservation pools and stabilized lakes that have been acquired by the Division of Wildlife Resources in an effort to preserve aquatic habitat.

CONSERVATION POOLS

Name of Water	Year Acquired	Acre Feet	County	Region
Yankee Meadows Reservoir	1940	300	Iron	Southern
Upper Enterprise Reservoir	1942	200	Washington	Southern
Scofield Reservoir	1944	8,000	Carbon	Southeast
Navajo Lake	1958	3,000	Kane	Southern
Red Creek Reservoir	1959	128	Duchesne	Northeast
Lower Bown Reservoir	1959	725	Garfield	Southern
East Park Reservoir (F-13-D)	1960	1,300	Uintah	Northeast
Porcupine Reservoir	1960	1,500	Cache	Northern
Blanding Reservoir No. 3	1961	64	San Juan	Southeast
Woodruff Narrows Res. (F-16-D)	1962	4,000	Wyoming	Northern
Tibble Fork Reservoir	1963	166	Utah	Central
Big Sandwash Reservoir (F-19-L)	1965	1,200	Duchesne	Northeast
Blanding Res. No.4 (F-4-D-1, *APW)	1965	219	San Juan	Southeast
Minersville Res. (F-20-L), Rocky Ford	1965	2,000	Beaver	Southern
Johnson Valley Reservoir (F-18-D)	1965	2,500	Sevier	Southern
Pelican Lake (F-21-L)	1966	4,500	Uintah	Southeast
Whitney Reservoir	1967	500	Summit	Northern
Upper Woodruff Res. (F-23-L)	1968	450	Rich	Northern
(Additional acquired) (F-57-L4)	1989	249		
Birch Creek Reservoir (F-23-L)	1968	400	Rich	Northern
Mill Site Reservoir (F-25-L)	1968	2,000	Emery	Southeast

Gunlock Reservoir (F-27-D)	1970	1,014	Washington	Southern
Silver Lake Flat Reservoir	1971	100	Utah	Central
Newcastle Reservoir	1974	500	Iron	Southern
Brough Reservoir (F-33-L)	1975	1,145	Uintah	Northeast
Kents Lake Reservoir	1977	300	Beaver	Southern
Paragonah Reservoir (F-36-D)	1980	350	Iron	Southern
Long Park Reservoir (F-35-D)	1980	3,000	Daggett	Northeast
Oak Creek Reservoir (F-37-D)	1982	370	Garfield	Southern
Cottonwood Reservoir	1983	700	Uintah	Northeast
Woods Pond (F-57-L-6)	1989	6	Iron	Southern
Upper Kents Lake (F-57-L-13)	1992	80	Beaver	Southern
Sand Hollow (F-27-D)##	2002	1,086	Washington	Southern

*APW (Applied Public Works)
From July 2002 until February 15, 2003, some or all of this conservation pool may be retained in Kolob Reservoir where valuable fisheries exist, and warrant protection

STABILIZED LAKES

Name of Water	Year Acquired	Surface Acres	County	Region
Burraston Ponds (3)	1901	17.3	Juab	Central
Gooseberry Pond	1938	25.0	Sanpete	Southeast
Duck Creek Springs	1939	7.5	Kane	Southern
Aspen-Mirror Lake	1939	3.0	Kane	Southern
Pine Lake (F-31-D)	1947	80.0	Garfield	Southern
Monticello Lake (F-6-D)	1954	3.5	San Juan	Southeast
Browne Lake (F-10-D)	1958	54.0	Daggett	Northeast
Anderson Meadow Lake (F-11-D)	1958	8.7	Beaver	Southern
Sheep Creek Lake (F-12-D)	1959	80.0	Daggett	Northeast
Barker Reservoir (F-34-D)	1960	12.0	Garfield	Southern
Lower Barker Reservoir	1960	5.0	Garfield	Southern
Long Willow Bottom Res. (F-34-D)	1960	5.0	Garfield	Southern
Round Willow Bottom Res. (F-34-D)	1960	9.0	Garfield	Southern
Joe Lay Reservoir (F-34-D)	1960	4.0	Garfield	Southern
Mill Hollow Lake (F-15-D)	1962	17.1	Wasatch	Central
LeBaron Lake (F-2-D-1, *APW)	1965	23.0	Beaver	Southern
Crouse Reservoir	1966	115.0	Uintah	Northeast
Foy Lake	1966	4.9	San Juan	Southeast
Ferron Reservoir (566 **SWP)	1974	65.0	Sanpete	Southeast
Bullock Reservoir	1977	90.0	Uintah	Northeast
Duck Fork Reservoir (566 **SWP)	1977	42.0	Sanpete	Southeast
Willow Lake (566 **SWP)	1977	25.0	Sanpete	Southeast
Wrigley Springs Reservoir (F-25-L)	1980	12.7	Sanpete	Southeast
Calder Reservoir (F-40-L)	1980	100.0	Uintah	Northeast

Matt Warner Reservoir (F-40-L)	1980	356.0	Uintah	Northeast
Manning Meadow Res. (F-57-L1)	1988	55.0	Piute	Southern
Barney Lake (F-57-L1)	1988	19.0	Piute	Southern
Deep Lake (F-57-L2)	1988	5.0	Sanpete	Central
Shingle Mill Lake (F-57-L2)	1988	2.0	Sanpete	Central
Daggett Lake	1989	44.0	Daggett	Northeast
Jesson Lake	1989	22.0	Daggett	Northeast
Tamarack Lake	1989	64.0	Daggett	Northeast
Wellsville Reservoir (F-57-L2)	1989	6.0	Cache	Northern
Pacer Lake (F-57-L8)	1996	33.0	Garfield	Southern
Spirit Lake	2000	42.8	Daggett	Northeast
Little Montes Cr. Res. (Ottosen Res.)	2000	16.3	Uintah	Northeast
Gates Lake	2001	5.0	Sevier	Southern
Lake Canyon Lake	2002	25.5	Duchesne	Northeast

*APW (Applied Public Works)
**SWP (Small Watershed Project)

Protection of Prescribed Instream Flows and Flow Rights

Historically, instream flows were not recognized as a beneficial use of water under Utah law. Of course that has changed to permit both the Division of Wildlife Resources and the Division of Parks and Recreation to hold instream flow rights. Several have been established, and they are important. However, even before the instream flow rights, through the years a number of instream flow requirements were established on various waters throughout the state, as stipulated by operating agreements associated with federally-funded water projects. Other flows were derived from hydroelectric licensing requirements or protection of endangered species. In time of drought, the pressure to reduce or eliminate the required instream flows mounts. In almost all cases, the instream flow required is already at the minimum level needed to protect the existing fishery. We should therefore resist efforts to reduce these flows. In most cases the required flows are mandated by federal regulation and the Division therefore has only partial responsibility for making such decisions.

Regional supervisors will take the lead in negotiating any modification to instream flows to satisfy critical human need. It must be understood that the Division is willing to work cooperatively with local government in seeking solutions to their problems, but we will allow reductions in stream flow only **as a last resort** in meeting critical human needs. The following guidelines apply to such negotiations:

1. Instream flow reductions will be agreed to only for critical culinary use, **not** for irrigation or industrial purposes.

2. Instream flow reductions will not be agreed to in lieu of strict water conservation measures being implemented by local government.

3. Any reduction of instream flow will be kept to the minimum needed to meet an existing crisis.

4. Compensation for the instream flow reduction shall be subsequent increases in instream flow during other critical periods, pending approval by the Division Director. In-kind, in-place compensation is preferred, but other kinds may be considered. The Director will make such decisions on a case-by-case basis.

5. Any reductions in instream flow shall be time-limited to 30 days maximum duration, and require written agreement specifying amounts and durations. Involved parties shall reconvene after 30 days to reassess conditions. Agreements may be revoked, modified, or extended at that time.

Fish Salvage

Drought conditions this year will be severe in most parts of the state which will lead to dewatering of streams and lakes. This may cause stranding and/or concentrations of fish. The Division will no longer attempt to salvage fish from one water and move them to another water. This activity is not cost effective, and risk of moving diseases is just too great. This is particularly true since the discovery of whirling disease in the state.

Regional aquatic managers, conservation officers and other Division personnel should carefully monitor areas where fish are likely to become stranded. These sites need to be publicized and anglers encouraged to take a legal limit. In cases where the fish cannot be utilized by maintaining standard regulations, consideration will be given to liberalizing the bag limit. It will be very important for the field personnel to act quickly if these types of situations develop. We can usually amend the proclamation within a 24-hour period if an emergency situation develops.

For further information contact: Bill James, Habitat Section Chief, @ 801.538.4752 OR Bill Bradwisch, Aquatic Habitat

Coordinator, @ 801.538.4866. See the Division's website at http://www.wildlife.utah.gov and thank you for helping to conserve Utah's wildlife and natural diversity.

Drought to impact wildlife

July 31, 2002

by Walt Donaldson NER DWR Supervisor

The Northeastern Region (NER) is in the fourth year of a chronic drought. This year, 2002, is considered by hydrologists to be one of the worst droughts on record for the Uintah Basin. As a general rule, all ranges (particularly lower elevations) have exhibited little or no vegetative growth. The winter snowpack and subsequent precipitation has been marginal or nonexistent, creating lower than normal spring flows and maximum use of reservoir water storage. Prolonged drought, along with limited water supply and low vegetative/soil moisture, creates ideal conditions for large fire events. The following is a brief summary of drought related impacts affecting wildlife and fisheries in the NER.

Pronghorn: The drought has had a serious impact on pronghorn due to depleted water sources in arid units, loss of succulent forbs for lactation by does, and no forage production on their winter ranges. Water has been hauled to guzzlers on the Myton and East Bench units, but not on the more northern and eastern units (i.e., North Slope, Daggett and Three Corners, South Slope--Vernal, Diamond Mtn, and Bonanza). The long term impacts to pronghorn are now being documented in terms of population reduction. For example, aerial counts of animals on the Myton Unit by fixed wing in 1998 were about 1,400 pronghorn; the same type of count for this unit in 2002 was about 350 pronghorn...or a relative herd reduction of about 75 percent in only four years. Fawn production is significantly down on all units within NER, and has been declining during the last four years.

Deer: The drought has impacted deer winter ranges as browse production region wide has been minimal or nonexistent since early spring. Marginal production of grasses and stem growth of browse has occurred in the Uinta Mountains on summer ranges. But no production has occurred with grasses or browse on summer ranges in the more desert herd units (i.e., Anthro, Book Cliffs). Browse species (mainly sage and four-wing) this summer have desiccated and are showing leaf loss, a protective mechanism used by browse plants during extreme drought periods. Livestock trespass or overgrazing on winter units in portions of the north Book Cliffs unit, Vernal sub-unit and Avintaquin sub-unit have adversely affected the browse. All deer herd units in NER indicated lower fawn production during the 2002 Spring classification. Also, we are now receiving reports that fawns are dying this summer on the Vernal and Diamond Mtn sub-units due to either malnutrition, desiccation or abandonment.

Elk: Range conditions are identical to that described for deer. Due to lack of grass production this spring, it is expected that elk will forage on browse intended for deer, creating higher levels of plant stress this coming winter. Dual species foraging on browse will occur within overlapping winter ranges used by deer and elk, and will cause negative impacts on browse on the desert units south of US Highway 40 on the Book Cliffs and Anthro units, and on the Daggett and Three Corners sub-unit in Browns Park. Some calf production is anticipated, but we won't be able to document any herd population shifts until after the aerial census work scheduled this coming winter.

Moose/Bighorn Sheep: Water availability for these species appears sufficient at this time, as these animals associate themselves to large bodies of water (i.e., moose in the Uintah Mountains and bighorn sheep along the Flaming Gorge/Green River corridor). However, forage production this year is dismal, as it was for the aforementioned big game species. Lower calf/lamb production is anticipated this year for both species.

Bear/Cougar: Bear problems are escalating rapidly in the Uintah Basin due to lack of grass and mast

crop production this year. Body condition for bears is poor. NER personnel have documented bear/human interactions since July 1 at the following locations: Camelot Resort on the Strawberry River, and USFS campgrounds at Rock Creek, Yellowstone/Swift Creek, Uinta River, and Lodgepole (U.S. Highway 191 near Flaming Gorge). To date, two bears have been trapped and killed (Strawberry River and Yellowstone). Formal contacts have already been made with Camelot Resort and Ashley National Forest in terms of better garbage or food management. Based on the Book Cliffs bear study, we anticipate very little cub production for 2003. A juvenile cougar was killed by a Tabiona, Utah resident in June, 2002 on the porch of his house. It was in an emaciated, starving condition.

Upland Game/Waterfowl: Both cover and food crops normally provided by the agricultural community in the Uintah Basin will not occur this year. With the exception of irrigation water from Starvation Reservoir, all other irrigation areas will not produce either hay or field grain. Therefore, cover and food grains will be limited for both upland game species and resident/migrating waterfowl. Production of young is predicted to be reduced due to the drought.

Fisheries (reservoirs/lakes): Most of the High Uinta lakes associated with inflowing water are stable and should over-winter trout populations. However, high cirque lakes with limited inflow are expected to have either partial or total winterkill of trout. All reservoirs have or are depleting their water storage. Flaming Gorge, Starvation and Red Fleet reservoirs have not reached minimal storage pool, but are losing their storage of water at a rapid rate. Steinaker, Upper Stillwater, East Park, Oaks Park, Brown's Draw, Paradise, Sand Wash, Moon Lake and Pelican Lake are near or at conservation pool or dead storage. The Diamond Mtn lakes had no inflow of water during spring run off. Crouse Reservoir suffered a winterkill. Matt Warner Reservoir could suffer some fish loss this winter, as it will be used to keep Calder Reservoir alive if the need arises. Cottonwood Reservoir will be drawn down into the conservation pool this Fall in order for some construction work to occur on the outlet works. The irrigation company is working with NER to replace the conservation pool later in the Fall season to avoid winterkill of the bass/tiger muskie fishery. Pelican Lake is at conservation pool; and if no winter flows are provided to this lake for storage as in the past, expect a severe loss of bluegill during ice-on. It should be noted that despite the low storage levels in our reservoirs, many of them are still providing good to excellent fishing.

Fisheries (streams): All streams from the Uinta Mountains are showing lower than normal flows, but impacts to fish populations have not as yet occurred. However, there are no flows below stream diversions throughout the Uintah Basin. The Green River below Flaming Gorge dam is at a minimum flow of 800 cfs, and expected to remain constant through the rest of the year. Streams originating from the Tavaputs Plateau in the southern part of NER are showing some of the lowest flows in years. Examples include Willow Creek (Book Cliffs) and Timber Canyon (Avintaquin). Fish losses are expected in these small plateau streams as spring sources dry up later this summer and fall. Minimal flow releases this spring from Flaming Gorge and low flows on the Yampa River did not flood any of the backwaters or side channels in the middle Green River. Limited reproduction and growth of razorback suckers and Colorado pike minnow are expected to cause a weak year class for these species in 2002. Surprisingly sampling on the river has been very difficult due to clear water associated with very low sediment transport.

Fire

The Uintah Basin has experienced two large fire events during this month. In the long term, both fires will be beneficial to wildlife; as much of the burned areas were either decadent Douglas fir stands (Roadless Area) or pinion/juniper seral stage vegetation (Dutch John). The Mustang fire occurred near Dutch John, Utah and burned just over 20,000 acres (map/Dutch John Draw photo) and is contained.

This fire did close down fishing for a week at facilities near Flaming Gorge dam and on the Green River from the dam to Little Hole. NER personnel are working with the USFS/BLM rehabilitation team to reseed the critical range and watershed areas this fall. This assistance on the rehabilitation is to avoid cheat grass regeneration, develop grass/browse forage for big game (particularly bighorn sheep), and to minimize soil erosion/transport into the Green River (Section A). Reseed funding is provided by DWR's Habitat Council.

The Rattle Complex fire is located along the west Book Cliffs divide and in the Roadless Area. It is still burning, having consumed over 90,000 acres; and is currently 40 percent contained (map). To date, 50 percent or more of the Roadless Area has been burned. NER personnel are working with the BLM/SITLA rehabilitation team to reseed parts of the burned area, and to coordinate with SITLA on restoring the Roadless Area to its former "no unauthorized motor vehicle" status. Replacement of fences, reinstallation of signs, and elimination of fire line roads is part of the work needing to be addressed. Due to the massive extent of this fire, consideration must be given as to what should be done with big game hunting permit holders for the Book Cliffs Roadless Area in both 2002 and 2003. Many deer and elk have temporarily emigrated from the Roadless Area to avoid the burn and to find a source of forage.

Recommendations

— Work with the BLM and USFS to maintain or repair existing guzzlers for big game. This recommendation may be directed by the Board to the State BLM Director and the Regional USFS Supervisor for Utah.

— As funding permits, haul water to those guzzlers that will best be utilized by pronghorn during the rest of the summer and early fall.

— Increase antlerless deer and elk permits for this fall's hunting season as recommended by NER Wildlife Biologists.

— Regarding the Roadless Area hunting permits, consider refunding the permits for this and next year, and then reissue the permits in 2004. Or give individuals the option of turning their permits back in, but retaining their bonus points for future draw opportunities.

— Continue to make nuisance bear/cougar calls a priority. Work with private resort operators and federal agencies in charge of public campground to improve garbage management, proper food containment and public compliance.

— Monitor all DWR conservation pools in reservoirs to ensure compliance. Where reconstruction of outlet structures are necessary (i.e., Cottonwood Reservoir), coordinate with Ouray Park Irrigation Company to replenish the water depletion as a priority before going into the winter months.

— Coordinate with rehabilitation teams on the Mustang and Rattle Complex fires to ensure proper reseeding for watershed and big game forage purposes. Also work with SITLA to continue the compliance associated with "no unauthorized motor vehicles" in the Roadless Area of the Book Cliffs. This effort includes sign replacement, fence repair, and reclamation of fire line roads.

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Six County Association of Governments

Comprising:

JUAB, MILLARD, PIUTE, SANPETE, SEVIER, AND WAYNE COUNTIES

Pre-Disaster Mitigation (PDM) Plan

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Executive Summary

Plan Mission

The mission of the Six County Association of Governments (SCAOG) Pre-Disaster Mitigation Plan is to substantially and permanently reduce, communities within the SCAOG, vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer more sustainable community.

Plan Organization

The Six County Association of Governments plan was developed and organized within the rules and regulations established under 44 CRF 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within SCAOG, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the ability of communities within the SCAOG planning district to handle disasters and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing

The SCAOG Pre-Disaster Mitigation Plan has been financed and developed under the Pre-Disaster Mitigation Program provided by the Federal Emergency Management Agency (FEMA) and the Department of Public Safety Division of Emergency Services and Homeland Security. The SCAOG aided in funding, providing in-kind assistance to local governments.

Plan Participation

The SCAOG Pre-Disaster Mitigation Plan has been completed as a result of a collaborative effort between Six County Association of Governments, Department of Public Safety Division of Emergency Services and Homeland Security, public agencies, and the citizens, elected officials, and public employees of the cities and towns within Juab, Millard, Piute, Sanpete, Sevier, and Wayne Counties. Interviews were conducted with stakeholders from the communities, and a workshop was conducted during the plan developments. Additionally, through public hearings, workshops, and draft plan displays; ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan. Completion of this multi-jurisdiction mitigation plan was completed with assistance and input from:

Juab County

- Emergency Manager; Roads Department; GIS Department, Eureka City, Town of Levan, Mona City, Nephi City, and Rocky Ridge.

Millard County

- Emergency Manager, Roads Department, Sheriff's Department, Delta City, Fillmore City, Town of Hinckley, Town of Holden, Town of Kanosh, Town of Leamington, Town of Lynndyl, Town of Meadow, Town of Oak City, and Town of Scipio.

Piute County

- Emergency Manager, Roads Department, Sheriff's Department, Town of Circleville, Town of Junction, Town of Kingston, and Town of Marysvale.

Sanpete County

- Emergency Manager, Town of Centerfield, Ephraim City, Fairview City, Town of Fayette, Fountain Green City, Gunnison City, Manti City, Town of Mayfield, Moroni City, Mt. Pleasant City, Spring City, Town of Sterling, and Town of Wales.

Sevier County

- Emergency Manager, Town of Annabella, Aurora City, Town of Elsinore, Town of Glenwood, Town of Joseph, Town of Koosharem, Monroe City, Town of Redmond, Richfield City, Salina City, and Town of Sigurd.

Wayne County

- Emergency Manager, Town of Bicknell, Town of Hanksville, Town of Loa, Town of Lyman, and Town of Torrey.

Hazards Identified

It was suggested by the Division of Emergency Services and Homeland Security, at a minimum, Six County Association of Governments address the hazards of: earthquake, flood, landslide, problem soils, wildfire, dam failure, severe weather, and drought. However, there are other hazards that were identified which are not in the minimum criteria established by DESHS that were added to the discussion.

The hazard identification study recognized the following hazards as being the most prevalent and posing the most potential risk to the counties and towns within the SCAOG planning district.

- Earthquake, Flood, Drought, Landslide, Wildfire, Problem Soil, Dam Failure, and Severe Weather.

Plan Goals

In an effort to ensure that the mission of the Six County Association of Governments Pre-Disaster Mitigation Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan.

The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.

- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

Part I. Pre-requisite Adoption by the local jurisdiction

The Six County Executive Board, as well as the counties and communities participated in and promulgated this plan. The Six County Association of Government PDM plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 of the local hazard planning regulations the final plan was to be adopted by each of the municipalities as well as the six counties. This section documents each jurisdiction participated in the process and adopted the plan. The plan was adopted prior to being submitted to FEMA region VIII for final review. Table 1 identifies the communities that participated in the planning process and have adopted the plan. Promulgation letter copies have been included in *Appendix K* of this plan. Once the plan is approved *Appendix K* will also include a copy of the letter of transmittal, the community resolutions, etc.

Table 1: Community Participation

Counties/Jurisdictions	Participated (Yes/ No)	Date
Juab County		
Eureka City		
Town of Levan		
Mona City		
Nephi City		
Town of Rocky Ridge		
Millard County		
Delta City		
Fillmore City		
Town of Hinckley		
Town of Holden		
Town of Kanosh		
Town of Leamington		
Town of Lynndyl		
Town of Meadow		
Town of Oak City		
Town of Scipio		
Piute County		
Town of Circleville		
Town of Junction		
Town of Kingston		
Town of Marysvale		
Sanpete County		
Town of Centerfield		
Ephraim City		
Fairview City		
Town of Fayette		
Fountain Green City		
Gunnison City		
Manti City		
Town of Mayfield		
Moroni City		
Mt. Pleasant City		
Spring City		
Town of Sterling		
Town of Wales		
Sevier County		

Counties/Jurisdictions	Participated (Yes/ No)	Date
Town of Annabella		
Aurora City		
Town of Elsinore		
Town of Glenwood		
Town of Joseph		
Town of Koosharem		
Monroe City		
Town of Redmond		
Richfield City		
Salina City		
Town of Sigurd		
Wayne County		
Town of Bicknell		
Town of Hanksville		
Town of Loa		
Town of Lyman		
Town of Torrey		

Acknowledgements

Six County Association of Governments would like to extend their appreciation to the following agencies, which assisted in the development of this plan.

- Division of Emergency Services and Homeland Security
- Utah Geologic Survey
- Automated Geographic Reference Center
- United States Army Corps of Engineers
- Division of Water Rights Dam Safety Section
- Federal Emergency Management Agency Region VIII
- National Weather Service
- Utah Division of Forestry, Fire, and State Lands
- Councils of Governments (Tribal and local)
- Juab County Emergency Management
- Millard County Emergency Management
- Piute County Emergency Management
- Sanpete County Emergency Management
- Sevier County Emergency Management
- Wayne County Emergency Management
- Six County Mayors and Commissioners
- Six County Emergency Managers and city personnel
- Salt Lake City Emergency Management
- Utah Division of Water Resources
- Wasatch Front Regional Council
- Mountainland Association of Governments
- Southeast Utah Association of Local Governments
- Uintah Basin Association of Governments
- Bear River Association of Governments
- Five County Association of Governments
- Paiute Indian Tribe of Utah (PITU)
- PITU Emergency Management
- Kanosh Band, PITU
- Koosharem Band, PITU

In addition we offer a sincere thanks to Clackamas County, Dunn County, Salt Lake City, Kidder County, Jefferson County, and Hyde County for allowing review of their mitigation plans.

Preface

The Six County Association of Governments (SCAOG) in 1970 received official designation as a planning district. Its geographic service delivery area of Central Utah comprises Juab, Millard, Piute, Sanpete, Sevier, and Wayne counties. This organization is required to establish and implement all future planning endeavors to benefit its citizenry. Due to economies of scale this regional methodology is a pragmatic and effective utilization of limited resources.

In accordance to the Six County Executive Board's governance all pertinent (natural hazard mitigation) planning groups were contacted by the SCAOG planning staff. These groups included elected officials and special interest representation for units of local government, i.e., emergency managers, law enforcement officers, etc. Their input was essential in the development of the SCAOG Pre-Disaster Mitigation Plan and recommended for adoption by the Six County Association of Governments.

Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be lessened when attention is turned to mitigating their impacts and effects before they occur or re-occur.

What is Hazard Mitigation? Hazard mitigation is defined as any cost-effective action(s) that have the effect of reducing, limiting, or preventing vulnerability of people, property, and the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation measures, which can be used to eliminate or minimize the risk to life and property, fall into three categories. The first categories are those that keep the hazard away from people, property, and structures. The second categories are those that keep people, property, and structures away from the hazard. The third categories are those that do not address the hazard at all, but rather reduce the impact of the hazard on the victims, such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation measures must be practical, cost effective, and environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

The primary focus of hazard mitigation actions must be at the point at which capital investment decisions are made and based on vulnerability. Capital investments, whether for homes, roads public utilities, pipelines, power plants, chemical plants or warehouses, or public works, determine to a large extent the nature and degree of hazard vulnerability of a community. Once a capital facility is in place, very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which insure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

Previously, mitigation measures have been the most neglected programs within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures take time to implement. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to eliminating long-term risk to people and property living in Utah from hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

The State Division of Emergency Management and Homeland Security (DESHS) have identified the following hazards to be analyzed by each county. These hazards include avalanche, dam failure, debris flow, drought, earthquake, flood, flash flooding, infestation, landslide, problem soils, summer storm, tornado, urban and rural fires, and winter storm.

This regional/multi-jurisdictional plan evaluates the impacts, risks and vulnerabilities of natural hazards in a jurisdictional area affected by a disaster. The plan supports, provides assistance, identifies and describes mitigation projects for each annex. The suggestive actions and plan implementation for local and tribal governments could reduce the impact of future disasters. Only through the coordinated partnership with emergency managers, political entities, public works officials, community planners and other dedicated individuals working to implement this program was it accomplished.

To develop the mitigation plan, The Utah DESHS, based on the Governor's Office of Planning and Budget, the Utah League of Cities and Towns, and the U.S. Department of Housing and Urban Development, chose to use the planning services of the Utah Associations of Governments.
Seven regional Associations of Governments:

1. Bear River Association of Governments
2. Wasatch Front Association of Governments / Wasatch Front Regional Council
3. Mountainland Association of Governments
4. Six County Association of Governments
5. Southeast Utah Association of Local Governments
6. Southwestern / Five County Association of Governments
7. Uintah Basin Association of Governments

Scope

Six County Association of Governments, which encompasses much of Central Utah, including the counties of Juab, Millard, Piute, Sanpete, Sevier, and Wayne, was placed under contract by the Utah Division of Emergency Services to complete a Pre-Disaster Mitigation Plan, which meets the requirements of the Disaster Mitigation Act of 2000, for the areas they serve.

This plan is applicable of not only the six counties served by the Association but also for the cities, towns, and municipalities within each county. The plan also takes into account the five bands of the Paiute tribe. The scope of this plan only includes natural hazards

defined as a concern to local counties and jurisdictions. These natural hazards identified by stack holders include: earthquakes, floods, landslides, wildfires, problem soils, dam failures, sever weather, and drought. Although there were the only hazards considered much of the data is applicable to other federally funded planning currently taking place. Planning included local level data for each incorporated area within the six counties.

Purpose

The purpose of the Six County Association of Government Natural Hazard Mitigation Plan is to fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is to aid in enhancing city and state officials, agencies, and public awareness to the threat hazards pose to property and life and what can be done to help prevent or reduce the vulnerability and risk to jurisdiction with in the Six County planning area.

Authority

Federal:

Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards risks and vulnerabilities in that plan.

State:

- The Governor's Emergency Operation Directive
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended.
- Title 44, CFR, Federal Emergency Management Agency Regulations, as amended.
- State Emergency Management Act of 1981, Utah Code 53-2, 63-5.

- Disaster Response Recovery Act, 63-5A.
- Executive Order of the Governor, Executive Order 11
- Emergency Interim Succession Act, 63-5B.

Six County Association of Governments:
The Associations of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

Local:
Local governments play an essential role in implementing effective mitigation, both before and after disaster events. Each local government will review all damages, losses, and related impacts to determine the need or requirement for mitigation action and planning whenever seriously effected by a disaster, or when applying for state or federal recovery assistance. In the counties and cities making up the Six County Association of Governments the local executive responsible for carrying out plans and policies are the County Commissioners and City Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

Goals
One goal is to coordinate with each participating local government to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document and any additional State planning expectation, both regionally and specifically, as needed, by gathering local input. Another goal is to reduce risk from natural hazards in Central Utah, through the implementation and updating of regional plans.

Short Term Goals
These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.

- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards.
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources. If an earthquake occurs outside of the county seat it will still affect the county seat. This is similar to many natural hazards.
- Establish a framework and database for the county seat to use to apply for aid.

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation.
- Projecting a time frame for implementation.
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available.
- Identifying alternative measures, should financing not be available.
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties.
- Be based on the county seat Vulnerability Analysis.
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters.
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options.
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal.
- Property, damage to critical facilities, economic loss, and hardship or human suffering.
- Meet applicable permit requirements.
- Not encourage development in hazardous areas.

- Contribute to both the short and long term solutions to the hazard vulnerability risk problem.
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation.
- Have manageable maintenance and modification costs.
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement.
- Whenever possible, use existing resources, agencies and programs to implement the project.

Environmental Considerations

Natural hazards are naturally occurring phenomena, only becoming natural disasters when humans and there structures become involved. The events themselves play an integral part in maintaining balance in our world. Meteorological, geological, and hydrological processes have shaped Utah for millions of years and will continue to shape the state for millions more years. Modern engineering has made it possible to prevent damage from natural hazards; however, the economic and environmental costs can be rather high. Tampering with natural systems can also create an imbalance in the natural environment. The effects of many of these imbalances are still unknown. It is better to live will a small amount of risk, respecting the natural process where appropriate, than to construct mitigation at every chance. Nature provides its own mitigation measures that need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation projects all applicable city codes; county codes, state and federal laws pertaining to the environment will and must be followed. A description of all federal laws can be found in *Appendix D*.

Part II. Planning Process

Documentation of the Planning Process
This plan was prepared in the offices of the Six County Association of Governments by appointed staff members Planning Director, Emery Polelonema and Regional Planner, Edwin Benson, and was supported by Ryan Pietramali of DES. Other local agencies that have aided in the process include the city and county GIS departments of the Six County region. Elected officials including tribal leaders, local officials, emergency managers, police and fire staff members, planning departments, and local governmental agencies have all aided in the planning and implementation process. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 and supporting guidance documents developed by FEMA and the Utah Division of Emergency Services and Homeland Security.
The planning process included the following steps.

1. Organize Resources
2. Public Officials Out Reach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. Hazard Risk Identification and Analysis
6. County Vulnerability Assessment
7. Community Goals Assessment
8. Contact Regional Mitigation Emergency Managers (County & Tribal)
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

Step 1: Organize Resources
The seven regional Associations of Governments (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah Division of Emergency Services and Homeland Security contracted the seven AOGs as sub-grantees to coordinate, develop, and write the seven multi-regional hazard mitigation plans under the planning guidelines included in the Disaster Mitigation Act of 2000.

Six County Association of Governments was contracted with by the Division of Emergency Services and Homeland Security (DESHS) to conduct the planning for the six-county region. The association worked closely with local jurisdictions to ensure their input was incorporated into the plan.

Six County Association of Governments designated a core planning team. The core planning team made up of members outlined in Table 2 were the main constituents of the planning process from the initiation of the plan to the development and coordination to the resolution of the plan's adoption. Adjunct to the core planning team a technical team committee was created on a technical level that is identified in Table 3. The Executive Board (Table 4) was utilized to assure and affirm their respective county local inputs.

County Pre-Disaster Mitigation Planning Teams were organized by Six County AOG to provide local input, review, and oversight of the PDM plan and planning process. The County Teams where made up of local, county, state, and AOG resources (see Tables 5-10). Coordination was maintained by the AOG, if cities and towns were not able to attend a meeting AOG staff emailed or sent pertinent items.

Many of the jurisdictions in the planning area have small populations and limited tax base, with most of the day-to-day running of the town conducted by volunteer elected officials. Getting participation from these jurisdictions proved difficult at times, due not to lack of interest, but because of limited time and resources. The AOG was familiar with this from past planning efforts and set up a process which enabled each jurisdiction to participate. Jurisdictions were met with individually to solicit comments; the plan was emailed or printed out and sent to jurisdictions that could not make it to the meetings. Six County AOG placed the plan on their website and encouraged local jurisdictions to review the numerous iterations. AOG staff also spent the month of October 2002 and again in October 2003 meeting will all 48 mayors and 18 commissioners in the planning area to explain why PDM was important and identify hazards. County Pre-Disaster Mitigation Planning Team members further aided in allowing participation of each jurisdiction in their County. Through this process each jurisdiction was able to participate in completing this mitigation plan.

Table 2: Core Planning Team

Name	Organization
Edwin Benson	Six County Association of Government
Emery Polelonema	Six County Association of Government
Ryan Pietramali	Division of Emergency Services and Homeland Security

Table 3: Technical Team Committee

Name	Organization
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council
Jeff Adams	Southeastern Utah Association of Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Table 4: Executive Board

Name	Organization
Boyd Howarth	Juab County Commissioner
John Cooper	Millard County Commissioner
Paul Morgan	Piute County Commissioner, Chair
Bruce Blackham	Sanpete County Commissioner
Doug Peterson	Sevier County Commissioner
Clenn Okerlund	Wayne County Commissioner
Chad Brough	Mayor Nephi
Sam Starley	Mayor Fillmore
Gary James	Mayor Marysvale
Chesley Christensen	Mayor Mt. Pleasant
Jake Albrecht	Mayor Glenwood
Stan Alvey	Mayor Hanksville

County Pre-Disaster Mitigation Planning Teams:

Table 5: Juab County Pre-Disaster Mitigation Planning Team

Name	Representing:
Fred Smalley, Emer. Mgr.	Juab County
Wm. Boyd Howarth, Commissioner	Juab County
Robert Steele, Commissioner	Juab County
Neil Cook, Commissioner	Juab County
Lloyd Conder, Mayor	Eureka
Robert Shepherd, Mayor	Levan
Bryce Lynn, Mayor	Mona
Chad Brough, Mayor	Nephi
Darrell Allred, Mayor	Rocky Ridge
Kelly Allen	Forestry, Fire, and State Lands (FFSL)
Emery Polelonema	Six County Association of Governments (SCAOG)
Edwin Benson	SCAOG

Table 6: Millard County Pre-Disaster Mitigation Planning Team

Name	Representing:
Forrest Roper, Emer. Mgr.	Millard County
John Cooper, Commissioner	Millard County
Craig Greathouse, Commissioner	Millard County
Daren Smith, Commissioner	Millard County
Gayle Bunker, Mayor	Delta
V.B. “Sam” Starley, Mayor	Fillmore
Donald Brown, Mayor	Hinckley
Brent Bennett, Mayor	Holden
Terry Higgs, Mayor	Kanosh
Jim Rasch, Mayor	Leamington
Jese Ruiz, Mayor	Lynndyl
Jim Talbot, Mayor	Meadow

Name	Representing:
Winston Nielson, Mayor	Oak City
Burtis Quarnberg, Mayor	Scipio
Kelly Allen	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Table 7: Piute County Pre-Disaster Mitigation Planning Team

Name	Representing:
Ryan Horton, Emer. Mgr.	Piute County
Paul Morgan, Commissioner	Piute County
Tarval Torgersen, Commissioner	Piute County
W. Kay Blackwell, Commissioner	Piute County
Joe Dalton, Mayor	Circleville
Rick Dalton, Mayor	Junction
Carlos Jessen, Mayor	Kingston
Gerald James, Mayor	Marysvale
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Table 8: Sanpete County Pre-Disaster Mitigation Planning Team

Name	Representing:
Kevin Holman, Emer. Mgr.	Sanpete County
Bruce Blackham, Commissioner	Sanpete County
Greg Dettinger, Commissioner	Sanpete County
Claudia Jarrett, Commissioner	Sanpete County
Darwin Jensen, Mayor	Centerfield
Morris Casperson, Mayor	Ephraim
Don Worley, Mayor	Fairview
Shawn Crane, Mayor	Fayette
Scott Collard, Mayor	Fountain Green
Scott Hermansen, Mayor	Gunnison
Kim Anderson, Mayor	Manti
Doug Bjerregaard, Mayor	Mayfield
L. Scott Robertson, Mayor	Moroni
Chesley Christensen, Mayor	Mt. Pleasant
John Thomas, Mayor	Spring City
Steven Thomas, Mayor	Sterling
Byron Davis, Mayor	Wales
Fred Johnson	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Table 9: Sevier County Pre-Disaster Mitigation Planning Team

Name	Representing:
Jim Porter, Emer. Mgr.	Sevier County
Doug Peterson, Commissioner	Sevier County
Gary Mason, Commissioner	Sevier County
Ralph Okerlund, Commissioner	Sevier County
Dale Albrecht, Mayor	Annabella
Lawrence Mason, Mayor	Aurora
Valerie Hopper, Mayor	Elsinore
Jake Albrecht, Mayor	Glenwood
Robert Owen, Mayor	Joseph
Harlow Brown, Mayor	Koosharem
Craig Mathie, Mayor	Monroe
Linda Mickelsen, Mayor	Redmond
Woody Farnsworth, Administrator	Richfield
Marilyn Anderson, Mayor	Salina
James Freeby, Mayor	Sigurd
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Table 10: Wayne County Pre-Disaster Mitigation Planning Team

Name	Representing:
Vicky Bower, Emer. Mgr.	Wayne County
Clenn Okerlund, Commissioner	Wayne County
Allen Jones, Commissioner	Wayne County
Scott Durfey, Commissioner	Wayne County
Sherwood Albrecht, Mayor	Bicknell
Stan Alvey, Mayor	Hanksville
Ellis Brown, Mayor	Loa
Vanor Okerlund, Mayor	Lyman
Fred Hansen, Mayor	Torrey
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Step 2: Public Officials Outreach
To ensure the planning process had backing from the elected officials a representative from Six County Association of Governments met with each County Commission and each city mayor to inform them of the need for the plan and how it can better help the communities (refer to *Appendix H*). With local support in place the plan was introduced to commissioners and other elected officials along with public entities by means of an informational website created by the Six County Association of Governments (http://www.sixcounty.com/six%20county%20web%20page/Planning/Reg_Planning/regional_planning.htm).

Step 3: Establish Continuity in the Planning Process
Mitigation planning within Six County Association of Governments was part of a Pre-Disaster Mitigation Planning initiative to meet the requirements of the Disaster Mitigation Act of 2000. To meet this requirement the seven Associations of Government were contracted by the Division of Emergency Services and Homeland Security to assist the 29 counties with completion of a mitigation plan, which meets the requirements of sections 322. The Seven Associations of Government formed a Technical Team Planning committee to share ideas and ensure the plans were similar and that there was little duplication of effort. Planners from the Six County Association of Governments were involved with this committee. Please refer to Table 3 above.

Step 4: Data Acquisition
Contact was made with designated personnel in each city and county to assess what data was available on the local level. Agreements were put in place, where needed, to allow the Association of Governments planning staff use of county and city data. Data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs, and land development data.

Step 5: Hazard Risk Identification and Analysis
This step was conducted by gathering data on the hazards that occurred in the planning area. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations, surveys, interviews, and meetings with key informants within the planning area. Mitigation discussions were held during this process and are explained in further detail in Table 11 below. During these meeting attendees had the opportunity to review the general information on previous hazards and comment on them in a more specific manner. These meeting also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation, natural resources, and water resources of the Planning Area. These initial contacts with local entities also provided visual understanding of the planning area for planners of the Core Planning Team.

Table 11: Six County Association Governments Pre-Disaster Mitigation Planning Process Timeline

Date	Activity	Purpose
March 29, 2002	Letter of Intent that identifies the seven Associations of Governments as sub-grantees of the state to write the PDM plans. The AOGs were chosen by the Utah Interagency Technical Team who are a part of Nature-Safe Utah (Utah's Pre-Disaster Mitigation Program).	Continue the relationship with local council members and municipalities.
May 15-16, 2002	Utah's first regional mitigation planning training piloted toward the seven AOGs	Establish a guideline and timeframe.
July 12,2002	News Release from Governor Michael Leavitt announcing the new program to develop local hazard mitigation plans statewide.	Conduct public awareness and involvement.
August, 2002	Gather information.	Data Collection.
September 10, 2002	Meeting. Met with all AOGs and DESHS to discuss the planning process.	Identify planning team and available resources.
September 30, 2002	Contacted Emergency Managers in the Six County region.	Identify level of involvement.
October-November, 2002 (see *Appendix H*)	Met with all six county commissions and 48 mayors in the Six County region to identify hazards.	Hazard Identification. Went over questionnaires with mayors and commissioners.
November 2002	Gathered community data for regional data section of the plan.	Data Collection.
November 6, 2002	Public Meeting. Met with Six County Association of Governments Executive Board.	Obtain Approval to conduct mitigation planning.
November 22, 2002	Meeting. Met with technical team members.	Solicit public involvement, Army Corps proposal for flood study, GIS training, timeline, review the regional plans
December, 2002	Gathering data.	Data Collection
January, 2003	Gathering data.	Data Collection.
January 22, 2003	Public Meeting. AOG executive director's meeting.	Signed contracts for Army Corps flood proposal.
February 27, 2003	Meeting. Met with technical team members in St. George.	Review of plans, mapping.
March, 2003	Information gathering	Data Collection, plan

Date	Activity	Purpose
April, 2003	Drafting of the plan.	For review.
May 14, 2003	Meeting. SCAOG Executive Board meeting.	Discussion of progress; plans to DESHS by December with additional money.
May 22, 2003	Meeting. Met with technical team members at DESHS.	Progress report, deadlines, mapping, mitigation actions, internal webpage.
May, 2003	Gather mapping data.	Complete hazard identification and profile.
June, 2003	Website addressing Natural Hazards.	Public involvement and comment.
July 17, 2003	Meeting. Met with technical team members in Orem City.	Discussed mapping and plan review.
August 22-23, 2003	Fire Planning Meeting in Ephraim.	Public involvement facilitated by Six County Planning Staff.
August 29, 2003	Fire Planning Meeting at Indian Ridge Subdivision in North Sanpete County	Volunteers from six communities came together to write a Fire Plan (included in *Appendix F)* facilitated by Six County Planning Staff.
October 1, 2003	Discussed Draft of PDM Plan with Exec. Board	Public meeting with Exec. Board.
October 1, 5, & 12, 2003	Met with Paiute Tribe Emergency Mangers and Band Councils	Public Tribal and Band Council Meeting. Discussed PDM and review of draft.
October-November, 2003 (see *Appendix H*)	Met with all six county commissions and 48 mayors in the Six County region.	Hazard Identification. Reviewed draft plan with mayors and commissioners.
December 11, 2003	Met with Sanpete County's Pre-Disaster Mitigation Committee (Kevin Holman, Emergency Mgr., Fred Johnson, Fire Warden, Ty Bailey, State LNO)	Determined a course of action in order to develop a mitigation plan and funding for mitigation. Identified problems, set goals and recorded objectives.
December 23, 2003	Met with Millard County's Emergency Mgr., Forrest Roper	Decided upon mitigation projects that would most benefit Millard County.
December 23, 2003	Met with Kanosh Band's Emergency Mgr., McKay Pikyavit	Decided upon mitigation projects that would most benefit the Kanosh Band of the Paiute Tribe of Utah.

Step 6: County Vulnerability Assessment
This step was conducted through a review of local base maps, topographical maps, floodplain maps, and other data. A detailed vulnerability analysis was completed with the use of Geographic Information Systems for each county within the Six County Association of Governments. HAZUS MH was used to determine vulnerability to earthquakes, for the hazards such as floods, landslides, and wildfire of loss estimation methodology was developed by the core planning team, with assistance from the Technical Team, to determine vulnerability to hazards. Each county section explains the data sources and the methodology used can be found in *Appendix B*. During these meetings attendees had the opportunity to review the specific information on all GIS products and to review areas of vulnerability in association with specific hazards.

Step 7: Community Goals Assessment
This step was conducted through a review of the governing documents of the planning area, as well as, conversations, interviews, and meetings with key responsible individuals within the planning area. This step identified what goals are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

Step 8: Contact Regional Mitigation Emergency Managers (County & Tribal)
Juab, Millard, Piute, Sanpete, Sevier, and Wayne counties along with their respective communities were contacted to ascertain mitigation strategies. These counties and communities have volunteers and individuals with an interest in mitigation and public employees with technical expertise pertinent to mitigation. They include elected officials, county/city planners, county staff, and emergency managers. County emergency managers and their assistants were tasked with completing the Mitigation Strategies Workbook issued by the State Division of Emergency Services and Homeland Security. The Paiute Tribal emergency response council was also assigned to complete the workbook.

Step 9: Mitigation Strategy Development
Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each County that participated in the County Pre-Disaster Mitigation Planning Grant was asked to evaluate the vulnerability assessment completed by Six County Association of Governments and complete a Mitigation Strategies Workbook that can be found in the annexes for each county.

Step 10: Prioritization of Identified Mitigation Strategies
The Disaster Mitigation Act of 2000 requires state, tribal, and local governments show how mitigation actions were evaluated and prioritized. This was completed by the AOGs with assistance from each county and city. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, 386-3, April 2003 (available online at http://www.fema.gov/fima/planning_howto3.shtm). Additionally, jurisdictions reviewed the prioritization and understood that a benefit/cost analysis would aid in determining the true benefit to cost of each project. Prior to grant submittal a benefit/cost analysis would be completed for each project. At this time funding reality limited the project development, preventing a proper benefit/cost analysis from being conducted.

Step 11: State Review
The Division of Emergency Services and Homeland Security pulled together a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003 and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

Step 12: Adoption
The plan went through a public hearing process on (date) and was adopted by:

Juab County
- Eureka City, Town of Levan, Mona City, Nephi City, and Rocky Ridge.

Millard County
- Delta City, Fillmore City, Town of Hinckley, Town of Holden, Town of Kanosh, Town of Leamington, Town of Lynndyl, Town of Meadow, Town of Oak City, and Town of Scipio.

Piute County
- Town of Circleville, Town of Junction, Town of Kingston, and Town of Marysvale.

Sanpete County
- Town of Centerfield, Ephraim City, Fairview City, Town of Fayette, Fountain Green City, Gunnison City, Manti City, Town of Mayfield, Moroni City, Mt. Pleasant City, Spring City, Town of Sterling, and Town of Wales.

Sevier County
- Town of Annabella, Aurora City, Town of Elsinore, Town of Glenwood, Town of Joseph, Town of Koosharem, Monroe City, Town of Redmond, Richfield City, Salina City, and Town of Sigurd.

Wayne County
- Town of Bicknell, Town of Hanksville, Town of Loa, Town of Lyman, and Town of Torrey.

A. Public Involvement

Public involvement opportunities were available throughout the design and completion of this plan. Such opportunities included a public website for comment and review (http://www.sixcounty.com/six%20county%20web%20page/Planning/Reg_Planning/regional_planning.htm) and public meetings (refer to Table 11). Public comments taken from these public meetings were incorporated into the plan. Emergency managers, the Fire Department, Sheriff Department, State and Local Agencies, all community members that could be affected by a hazard within the region, business leaders, educators, non-profit organizations, private organizations, and other interested members were all a part of the planning process. It should be noted that in the rural setting of the region, most community planning and development occur in a collaborative effort. For example, the elected officials are business professionals and governmental officials (i.e. CPA's, School Administrators, small business owners, et al.), thus in one meeting a broad spectrum of interested parties are allowed the opportunity to comment. The Six County Executive Board meetings are open to the public and attendees during these dialogues have the opportunity to comment. The county commission meetings are announced as open meetings, as well as, the city council meetings. County community and economic

development professionals also have input during their regular meetings. In summation, SCAOG staff indeed provided a wide-open comment opportunity for all interested parties through these public venues.

B. Information Sources

The following sources were look at during the completion of this plan:

- Federal Emergency Management Agency (How-to Guides).
- National Weather Service (Hazard profile).
- National Climate Data Center (Drought, Severe Weather)
- Army Corps of Engineers (Flood data).
- Utah Division of Emergency Services and Homeland Security (Salt Lake City Mitigation Plan, GIS data, Flood data, HAZUS data for flood and earthquake).
- Utah Geologic Survey (GIS data, Geologic information).
- Utah Division of Forestry, Fire and State Lands (Fire data).
- Utah Avalanche Center, Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service.
- Utah Automated Geographic Resource Center (GIS data).
- University of Utah (drought climate charts from internship students).
- University of Utah Seismic Station (Earthquake data).
- Utah State University (climate data).
- Councils or Government
- Association of Governments
- Juab County and municipalities (Juab County Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Millard County and municipalities (Millard County Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Piute County and municipalities (Municipal Water Plans, Greenwich Water Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Sanpete County and municipalities (Sanpete County Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Sevier County and municipalities (Sevier County Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Wayne County and municipalities (Wayne County Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).

Other Plans:

- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah

- Natural Disaster Analysis, State of Utah Office of Emergency Services 1976
- State of Utah Mitigation Plan 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Salt Lake City Mitigation Plan 2002
- Planning for a Sustainable Future
- Town of Merrimack, NH Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Hazard Mitigation Plan Dunkerton, Iowa
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001
- Jefferson County West Virginia All Hazard Mitigation Plan 2003

Plan Methodology

The information in this mitigation plan is based on research from a variety of sources. SCAOG/DES conducted data research and analysis, facilitated steering committee meetings and public workshops, developed the final mitigation plan, and presented the plan for formal adoption with participating jurisdictions. The research methods and various contributions to the plan include:

State and federal guidelines and requirements for mitigation plans:
During the completion of this plan SCAOG examined and followed state and federal guidelines and requirements. These guidelines included FEMA planning standards, National Flood Insurance Program's Community Rating system, FEMA Flood Mitigation Assistance Program and various State reference material. A list of guidelines and requirements is as follows:

- FEMA 386-1,2,3,4,5,6,7,8,9
- FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12
- Disaster Mitigation Act of 2000
- 44 CRF parts 201 and 206, Interim Final Rule
- FEMA Region VIII "crosswalk"

Previous plans and studies:
SCAOG examined existing mitigation plans from around the country and incorporated numerous plans and studies from within the jurisdictions they serve. These plans include:

- West Colorado River Basin Plan
- West Desert Basin Plan
- Sevier River Basin Plan
- Manti City Flood Insurance Study
- Elsinore City Flood Insurance Study
- Town of Joseph Flood Insurance Study
- Richfield City Flood Insurance Study
- Salina City Flood Insurance Study
- Sevier River and Tributaries, Utah Reconnaissance Report US Army Corp of Engineers March 1994

- Flood Damage Prevention Study Sevier River Basin Investigation, Utah US Army Corp of Engineers January 1994.
- Utah Statewide Fire Risk Assessment Project
- Natural Disaster Hazard Analysis, State of Utah Office of Emergency Services 1976
- Salt Lake City Mitigation Plan 2002
- State of Utah Mitigation Plan 1984, 1985, 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Six County Flood Hazard Identification Study
- Emergency Operations Plans for Juab, Millard, Piute, Sanpete, Sevier, and Wayne Counties.
- University of Utah Seismograph Stations History of Utah Earthquakes
- National Weather Service "Flood and Flash Flood Deaths in Utah"
- Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service Utah Avalanche Center.
- Town of Merrimack, New Hampshire Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001

Hazard Specific Research and Vulnerability Analysis Methodology

Geographic Information Systems (GIS) were used as the basic analysis tool to complete the hazard analysis for the Six County Association of Governments Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. Fortunately digital data exist statewide for landslides, quaternary faults, wildfire, dam locations, and epicenter locations. The goal of the vulnerability study is to estimate the number of homes, and infrastructure vulnerable to each hazard and assign a dollar value to this built environment. To this end, census data and natural hazard maps are the basic information used in the analysis. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

Earthquakes

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS-MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss

estimates for a region. The HAZUS-MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS-MH Earthquake Model, possibly *at best* a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS-MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

Landslides and Wildfire

The methodology used to determined vulnerability for landslides and wildfire within the study area was almost identical. Demographic information from census 2000 was manipulated to obtain vulnerability numbers. The methodology used, assumes and even distribution of built housing across the county and each city within the county. Assuming even distribution a housing density was determined by dividing the total number of homes (census 2000) by the total number of acres. For example the Town of Eureka in Juab County is 940 acres in size and contains 342 housing units. Thus the housing density is .364 i.e. each acre contains .364 housing units.

From this point the number of acres of extreme, high, and moderate wildfire along with acres of historically active landslides were determined for each city and the unincorporated county. Once and acre total was know it was multiplied by the density value for each particular city or county to determine the total number of homes. This new figure was then multiplied by the average housing value as reported by the County assessors office, to determine the total value of potential loss residents. In the case of wildfire the value of the land (20% of total) was subtracted from the totals reported in the vulnerability tables. This was done because wildfires do not render the land useless as

landslides often do. Additionally content values are not included, which would raise the potential loss numbers for housing by approximately 50%.

Table 12: Assessor Land Values

County	Assessor Land Value
Juab	95,000
Millard	72,000
Piute	75,000
Sanpete	95,000
Sevier	90,000
Wayne	75,000

Transportation and utilities information was determined using the Geoprocessing Wizard, an extension in ArcView 3.2. This extension allows the GIS user to clip one theme based on another. For example the roads theme was clipped by the landslide theme, resulting in a new shape file containing all of the roads within a historically active landslide area. The new database was then queried through several simple equations to determine the length in miles of each linear feature (pipelines, electric lines, and roads). Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These costs include:

Table 13: Transportation/Utilities Cost per Mile

Item	Cost per Mile
Local Roads	2,413,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to the linear features point data such as critical facilities, dams, care facilities, schools, power generation facilities, and substations were analyzed to determine if the feature was within a hazard area. Where point data was determined to be within a hazard area the following values from HAZUS MH were assigned:

Table 14: Power Generation Facilities/Substations Costs

Item	Cost
Small Power Plant	100,000,000
Large Power Plant	500,000,000
Low Voltage Substation 115 KV	10,000,000
Medium Voltage Substation 230 KV	20,000,000
Large Voltage Substation 500 KV	50,000,000

(Facility value was assigned based on Square footage.)

Limited availability of digital data represented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, landslides, and wildfires in this plan. Additional limitations to the above described analysis method includes:

- Assuming random distribution
- Limited data sets for water, gas, electrical, resulting in, incomplete numbers for these features.
- Lack of digital parcels data from the county assessors office.
- HASUZ MH is not designed for small population counties.
- No digital data for dam failure inundation, flood plains, or infestation.
- Relied on state wide data not intended for manipulation at the scale it was used.
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data.
- Meta data was lacking on some of the used data sets.

In terms of hazard mapping presentation in this document, simple maps were created to provide a graphical illustration of location. These maps are done at a scale, which allows them to fit on a standard letter sized page rendering the useless. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool, to be used, by interested persons within the Six County Association of Governments and the jurisdictions the AOG serves. This information should not take the place of accurate field verified mapping from which ordinances need to be based off of.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas, which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available but this data does not necessarily indicate which, areas will be developed and which will not.

Part III. General Regional Data

Six County Association of Governments

As the name states the Six County Association of Governments is comprised of six Utah Counties: Juab, Millard, Piute, Sanpete, Sevier, and Wayne. This plan incorporates the following entities within each county. Also, the Paiute Indian Tribe of Utah is an integral entity within the State of Utah and the six-county region.

Juab County

Contained within Juab County are five incorporated areas: Eureka City, Town of Levan, Mona City, Nephi City, and Rocky Ridge Town.

Millard County

There are ten incorporated municipalities within Millard County: Delta City, Fillmore City, Hinckley Town, Holden Town, Kanosh Town, Leamington Town, Lynndyl Town, Meadow Town, Town of Oak City, and Scipio Town.

Piute County

Contained within Piute County are four municipalities: the Town of Circleville, Junction Town, Kingston Town, and Marysvale Town.

Sanpete County

Sanpete County the most populous county in the Six County region contains 13 municipalities: Centerfield Town, Ephraim City, Fairview City, Town of Fayette, Fountain Green City, Gunnison City, Manti City, Mayfield Town, Moroni City, Mt. Pleasant City, Spring City, Town of Sterling, and Wales Town.

Sevier County

Within Sevier County are eleven municipalities: Annabella Town, City of Aurora, Elsinore Town, Glenwood Town, Joseph Town, Koosharem Town, Monroe City, Redmond Town, Richfield City, Salina City, and the Town of Sigurd.

Wayne County

Within Wayne County are five municipalities: Bicknell Town, Hanksville Town, Loa Town, Lyman Town, and Torrey Town.

Paiute Indian Tribe of Utah

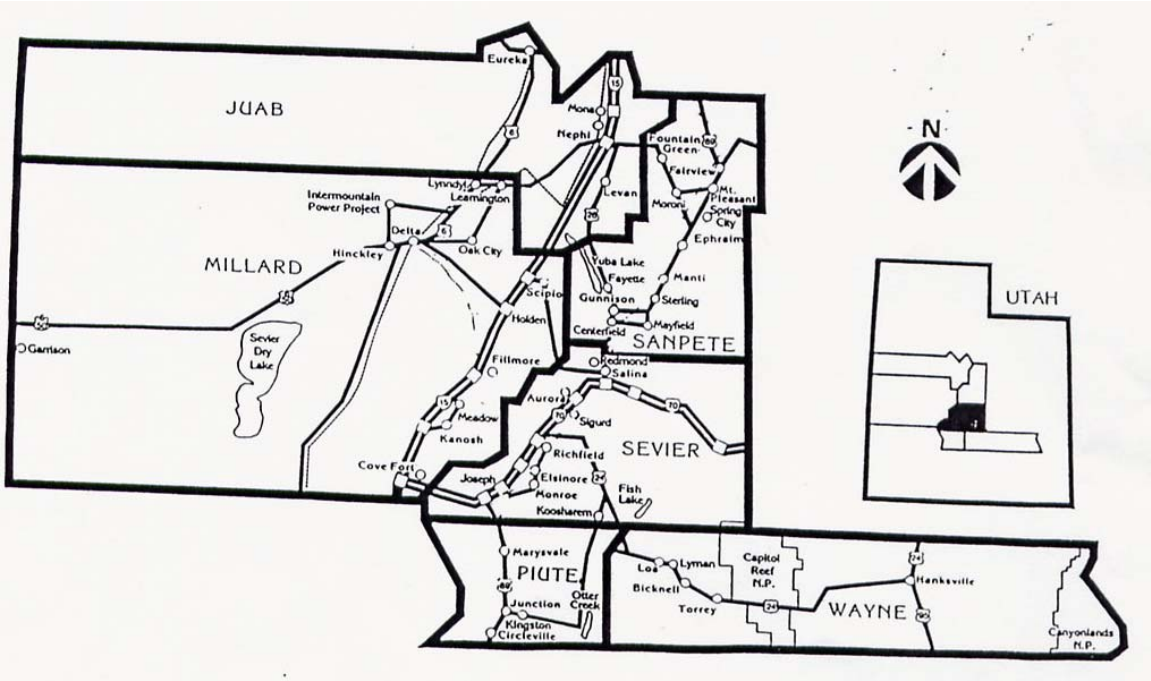
The Paiute Tribe has two bands of the tribe located in the Six County Region. These Bands include the Koosharem in Sevier County and the Kanosh Band in Millard County. Detailed information on their demographics and other vital economic statistics is found in *Appendix M*.

Geographic and Physiographic Background

The Six County region is located in the center of the state of Utah. It comprises six counties including Juab, Millard, Piute, Sanpete, Sevier and Wayne. *See Figure 1, Central Utah's Six Counties.* It is geographically located approximately 500 miles from

Denver, Colorado; 600 miles from Los Angeles, California; and 600 miles from Phoenix, Arizona. Travel time from the District Offices in Richfield to County Economic Development Offices in Nephi, Delta, Junction, Ephraim, Richfield, and Loa are: 90 minutes, 80 minutes, 45 minutes, 60 minutes, 0 minutes, and 50 minutes respectively. Interstates 15 and 70 serve the Six County region.

Figure 1: Six County Region



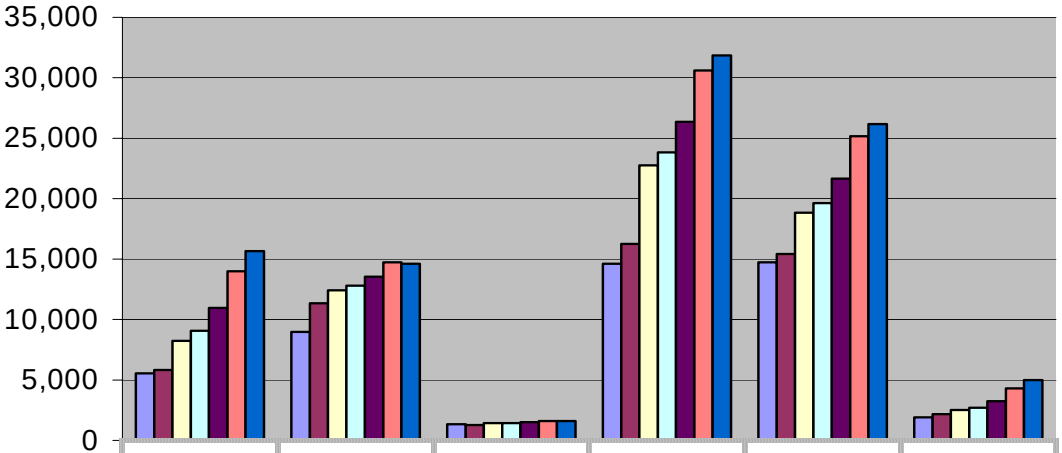
The Six County region contains 16,698 square miles making it the second largest region in the state of Utah behind Southeastern. However, Six County encompasses 96% of the area of Southeastern and makes up just over 20% of the land area of the entire state of Utah. Putting this in perspective, you could fit the states of New Hampshire and New Jersey within Six County's borders and still have room for all of Davis County, Utah. In addition, the combined population of New Hampshire, New Jersey, and Davis County is 9,889,130 which is more than 142 times Six County's 69,478. The varied landscape has been divided into four major physiographic provinces: the **Basin and Range Province** of the western part; the **Middle Rocky Mountain Province** which includes the Wasatch Range in the extreme north; the **Colorado Plateau Province** of canyons, mountains, and plateaus in the east; and the **Basin and Range-Colorado Plateau Transition** in the center of the Six County region. The last area is also known as the "High Plateaus" and shares structural features such as faults with its eastern and western neighbors.

Most of the Six County region is dry. The Great Basin and Colorado Plateau receive the least amount of precipitation, about 5-10 inches annually. The transition zone in the center, which has the highest population density, averages about 13 inches of annual precipitation. However, rainwater runs quickly off the rocky desert surfaces and into gullies and canyons. Flash floods can form and sweep away anything in their path, including boulders, cars, and campsites. Summer lightning causes forest and brush fires threatening the wide variety of flora and fauna, as well as cabins and homes, in the area.

Demographics

According to 2003 population estimates, 69,478 people live in the Six County region. This compares to 47,087 in 1980, 52,294 in 1990 and 66,192 in 2000. All counties within the region have experienced growth over the past two decades. *See Chart 1, County Population Comparisons*

Chart 1: County Population Comparisons



	JUAB	MILLARD	PIUTE	SANPETE	SEVIER	WAYNE
1980	5,530	8,970	1,329	14,620	14,727	1,911
1990	5,817	11,333	1,277	16,259	15,431	2,177
2000	8,238	12,405	1,435	22,763	18,842	2,509
2003	9,067	12,805	1,443	23,831	19,631	2,701
2010	10,954	13,538	1,508	26,351	21,649	3,256
2020	13,996	14,730	1,606	30,611	25,159	4,286
2030	15,660	14,605	1,588	31,860	26,174	4,987

Source: U.S. Census Bureau / Governor's Office of Planning & Budget 2000 Baseline Projections / Six County Planning Estimates

Diversity in the ethnic composition of the Six County Region has increased over the past 20 years. Industrial growth utilizing workers from minority populations has contributed to this change. *See Table 15, Ethnic Composition of the Six County Region.*

Table 15: Ethnic Composition of the Six County Region.

	1980	% 1980	1990	% 1990	2000	% 2000	% Increase (1980-2000)
White	45869	97.4%	50389	96.4%	62475	94.4%	36%
African American	28	0.1%	22	0.0%	153	0.2%	446%
American Indian	533	1.1%	767	1.5%	848	1.3%	59%
Asian	222	0.5%	391	0.7%	382	0.6%	72%
Hispanic	435	0.9%	1364	2.6%	3213	4.9%	639%

Source: U.S. Census Bureau

Tables 16-21 contain population change and projection data through 2030.

Table 16: Population Projections / Future Growth

	1990 Census Pop.	2000 Census Pop.	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop.	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Juab County	5,817	8,238	2,421	41.6%	3.5	21	15	6	6
Millard County	11,333	12,405	1,072	9.5%	0.9	18	21	27	27
Piute County	1,277	1,435	158	12.4%	1.2	28	29	26	26
Sanpete County	16,259	22,763	6,504	40.0%	3.4	12	10	7	7
Sevier County	15,431	18,842	3,411	22.1%	2.0	14	13	17	17
Wayne County	2,177	2,509	332	15.3%	1.4	26	25	21	21

Sources:

1) http://www.governor.state.ut.us/dea/rankings/county/00county.pdf;
2) U.S. Bureau of the Census; Utah Population Estimates Committee.

Notes:

1) AARC is average annual rate of change.

Table 17: STATE OF UTAH POPULATION
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
CENTRAL	47,087	52,294	66,192	71,500	77,256	84,409	90,388	94,874	1.21%
Juab County	5,530	5,817	8,238	9,577	10,954	12,552	13,996	15,660	2.16%
Millard County	8,970	11,333	12,405	13,051	13,538	14,250	14,730	14,605	0.55%
Piute County	1,329	1,277	1,435	1,448	1,508	1,570	1,606	1,588,	0.34%
Sanpete County	14,620	16,259	22,763	24,488	26,351	28,685	30,611	31,860	1.13%
Sevier County	14,727	15,431	18,842	20,117	21,649	23,570	25,159	26,174	1.10%
Wayne County	1,911	2,177	2,509	2,819	3,256	3,782	4,286	4,987	2.32%

Sources:

1) http://www.governor.state.ut.us/projections/EDPT3.pdf;
2) U.S. Bureau of the Census; Utah Population Estimates Committee;
3) 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.

Notes:

1) AARC is average annual rate of change.
2) 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations;
3) 2000 populations are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations.

Table 18: STATE OF UTAH HOUSEHOLDS
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
CENTRAL	14,526	16,237	20,323	22,553	24,987	27,568	29,931	32,505	1.58%
Juab County	1,707	1,870	2,456	2,942	3,482	4,098	4,670	5,447	2.69%
Millard County	2,728	3,390	3,840	4,152	4,513	4,844	5,103	5,229	1.03%
Piute County	435	450	509	516	544	567	588	583	0.45%
Sanpete County	4,454	4,916	6,547	7,254	7,901	8,592	9,230	9,878	1.38%
Sevier County	4,587	4,911	6,081	6,676	7,364	8,096	8,784	9,528	1.51%
Wayne County	615	700	890	1,013	1,177	1,371	1,556	1,840	2.45%

Sources:

1) http://www.governor.state.ut.us/projections/EDPT3.pdf;
2) U.S. Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.

Notes:

1) AARC is average annual rate of change.
2) 1980, 1990 and 2000 households are April 1 U.S. Census households; all others are July 1 households.

Table 19: STATE OF UTAH POPULATION
Percent of State Total
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
CENTRAL	3.22%	3.04%	2.96%	2.90%	2.77%	2.70%	2.68%	2.52%	-0.55%
Juab County	0.38%	0.34%	0.37%	0.39%	0.39%	0.40%	0.42%	0.42%	0.39%
Millard County	0.61%	0.66%	0.56%	0.53%	0.49%	0.46%	0.44%	0.39%	-1.20%
Piute County	0.09%	0.07%	0.06%	0.06%	0.05%	0.05%	0.05%	0.04%	-1.40%
Sanpete County	1.00%	0.94%	1.02%	0.99%	0.95%	0.92%	0.91%	0.84%	-0.62%
Sevier County	1.01%	0.90%	0.84%	0.82%	0.78%	0.75%	0.75%	0.69%	-0.65%
Wayne County	0.13%	0.13%	0.11%	0.11%	0.12%	0.12%	0.13%	0.13%	0.54%

Sources:

1) http://www.governor.state.ut.us/projections/EDPT3.pdf;
2) U.S. Bureau of the Census; Utah Population Estimates Committee;
3) 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.

Notes:

1) AARC is average annual rate of change.
2) 1980, 1990 and 2000 households are April 1 U.S. Census households; all others are July 1 households.

Table 20: STATE OF UTAH HOUSEHOLDS
Percent of State Total
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
CENTRAL	3.24%	3.02%	2.90%	2.84%	2.73%	2.65%	2.62%	2.46%	-0.55%
Juab County	0.38%	0.35%	0.35%	0.37%	0.38%	0.39%	0.41%	0.41%	0.54%
Millard County	0.61%	0.63%	0.55%	0.52%	0.49%	0.47%	0.45%	0.40%	-1.08%
Piute County	0.10%	0.08%	0.07%	0.07%	0.06%	0.05%	0.05%	0.04%	-1.65%
Sanpete County	0.99%	0.92%	0.93%	0.92%	0.86%	0.83%	0.81%	0.75%	-0.74%
Sevier County	1.02%	0.91%	0.87%	0.84%	0.81%	0.78%	0.77%	0.72%	-0.62%
Wayne County	0.14%	0.13%	0.13%	0.13%	0.13%	0.13%	0.14%	0.14%	0.31%

Sources:
1) http://www.governor.state.ut.us/projections/EDPT3.pdf;
2) U.S. Bureau of the Census;
3) 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.

Notes:
1) AARC is average annual rate of change.
2) 1980, 1990 and 2000 households are April 1 U.S. Census households; all others are July 1 households.

Table 21: STATE OF UTAH AVERAGE HOUSEHOLD SIZE
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
CENTRAL	3.19	3.17	3.15	3.07	3.00	2.98	2.94	2.83	-0.36%
Juab County	3.21	3.06	3.31	3.22	3.11	3.03	2.96	2.84	-0.52%
Millard County	3.28	3.32	3.19	3.10	2.96	2.90	2.85	2.75	-0.49%
Piute County	306	2.84	2.79	2.78	2.75	2.75	2.71	2.70	-0.10%
Sanpete County	3.17	3.20	3.27	3.18	3.15	3.16	3.14	3.05	-0.23%
Sevier County	3.19	3.11	3.03	2.95	2.88	2.85	2.81	2.69	-0.39%
Wayne County	3.11	3.07	2.81	2.77	2.76	2.75	2.75	2.70	-0.13%

Sources:
1) http://www.governor.state.ut.us/projections/EDPT3.pdf;
2) U.S. Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.

Notes:
1) AARC is average annual rate of change.
2) 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes.

Economy

EMPLOYMENT

Employment statistics play a vital roll in mitigation, as percentages of small businesses that never re-open following a large disaster are quite high. In addition knowing which sectors of the economy employ a large number of people and were those sectors are physically located factors into the development of mitigation strategies. Preventing damage insures employers will reopen lessening the lasting effect of a large event. Detailed information on other regional economic statistics and land use is found in *Appendix L*.

Physiography, Climate, Geology, and Hazards

For the purpose of geologic, climatic and physiographic descriptions within Six County the following narratives will follow river basins rather than political subdivisions or municipal boundaries. Six County falls within three river basins the West Colorado River Basin, Sevier River Basin, and West Desert Basin.

Physiography

West Colorado River Basin
Wayne County falls almost entirely within the West Colorado River Basin, which is entirely within the Colorado Plateau Physiographic Province. Located within Wayne County are the Dirty Devil, Fremont, and Green Rivers along with the confluence of the Green and Colorado Rivers along its eastern boundary. The Colorado Plateau Physiographic Province is best characterized by high relief between the many tablelands or plateaus and intervening stream cut valleys with deep, steep-sided canyons. Elevations within the Wayne County portion of the Colorado Plateau exceed 11,000 in both the Thousand Lake Mountains and Boulder Mountains.

Sevier River Basin
The majority of the Six County region is within the Sevier River Basin. This basin is part of the landlocked Great Basin Region drains which the Sevier River proper, the Fillmore-Kanosh area, often called the Pahvant Valley, and Beaver River drainage. The Sevier River drainage is separated from the ocean by prominent mountain ranges and geologic features on all four sides. The basin is bounded by the Pink Cliffs, of the Grand Stair Case, Wasatch Plateau, Tintic Mountains, Sheeprock Mountains, Tushar Mountains, Markagunt Plateau, and Pahvant Range.

The topography is diverse, with irrigated valleys between 4,600 and 7,000 feet above sea level. The highest point in the basin being Delano Peak which crowns the Tushar Mountains at 12,173 feet. 12 additional peaks within the basin rise over 11,000 feet.

Within the mixed physiography, each plateau and mountain range has its own character, influencing soils as well as surface and groundwater hydrology. Past erosion and

deposition cycles have left piedmont benches and terraces, and produced spectacular scenery.

West Desert Basin
The western half of Juab and Millard Counties fall within the West Desert Basin. This basin lies within the Great Basin Physiographic province and has no external drainage. The basin consists mainly of broad arid alleviated valleys bounded by a series of mountainous regions. Mountain Ranges within the basin run north and south with peaks reaching over 10,000 feet. Contained within the SCAOG portion of the West Desert Basin are the Fish Springs Range, Confusion Range, and the Deep Creek Mountains.

Climate

West Colorado River Basin
Precipitation in the area is influenced by two major storm patterns: one, frontal systems from the Pacific Northwest during winter and spring; the other late summer and early fall thunderstorms from the south and southwest. The southern Utah Low, a high altitude low-pressure system often covering parts of the several states, causes widespread precipitation between the winter frontal systems and summer thunderstorms.

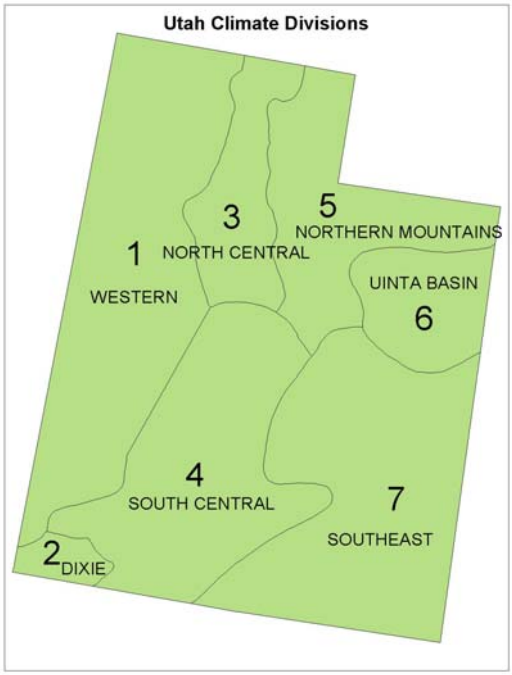


Figure 2

The precipitation ranges from over 30 inches on the Wasatch and Fish Lake plateaus to less than eight inches in the desert areas of the central and southern parts of the basin. Annual water surface pan evaporation varies from about 45 inches at Loa to 58 inches at Hite Marina on Lake Powell. Possible sunshine varies from 85 percent during the summer to 45 percent during the winter. Prevailing winds are generally from the southwest at four to six miles per hour, with maximum wind movement generally occurring during May.

Sevier River Basin
The climate of the Sevier River Basin reflects its location in the transition zone from the Basin and Range Physiographic Province to the Rocky Mountain Colorado Plateau Provinces. The high mountain valleys in the upper drainage areas blend into the semi-arid climate common to the southwest deserts. The northern part of the basin reflects different storm patterns than the southern part.

Mean annual temperatures vary from a high of 50.9 F at Fillmore to a low of 43.9 F at Koosharem. The record high temperature is 110 F at Delta and the record low is –40 F at Scipio.

Precipitation is influenced by two major storm patterns: one, frontal systems from the Pacific Northwest during the winter and spring; the other, late summer and early fall thunderstorms from the south and southwest. Topographic aspects further influence weather systems.

Mean annual valley precipitation varies from a high of 16.00 inches at Fillmore to a low of 8.11 inches at Delta. Basin wide precipitation varies from more than 35 inches in the highest mountains to less than 8 inches in the Sevier Desert. Precipitation extremes include a daily valley rainfall of 2.61 inches at Circleville and a record daily snowfall of 33.3 inches at Gunnison.

West Desert Basin

The climate of the West Desert Basin is typical of mountain-desert areas in the west with wide ranges in temperature between summer and winter, and between day and night. The high mountain regions experience long, cold winters, and short, cool summers. The lower valleys experience greater seasonal fluctuations with temperatures ranging from recorded extremes of -40° F at Ibapah in the winter to over 110° F in arid valleys during the summer. Daily temperature fluctuations can be dramatic; it is not uncommon to have temperature swings of over 40 degrees during any season.

The West Desert Basin lies within the rain shadow of the Sierra Nevada Mountains and except for the high mountaintops; the lands within the basin are classified as arid or semi-arid. June to September is the driest part of the year with precipitation at its lowest and evapo-transpiration rates at there highest. Little benefit is obtained from summer rains which are either too light to soak the soil, or come as cloudbursts, resulting in rapid run-off and consequently providing little soil moisture.

Geology

West Colorado River Basin

Within this basin, each plateau, mountain and canyon has its own character, which influences soil forming processes and the surface and groundwater hydrology. Past erosion and deposition cycles have left pediment slopes and terraces. Rocks from all eras of geologic time are found here with large areas being covered by sedimentary rocks of Mesozoic age. Included in this group is the Navajo Sandstone, which is an important source of groundwater. Igneous rock is found on many of the basins mountain ranges. In many places they occur as Tertiary age extrusive basalt, andesite, and latite lava flows and dacitic to rhyolitic ash flow tuffs. Unconsolidated eolian and alluvial deposits cover small areas.

While the Colorado Plateau is characteristically aseismic and lacks the large faults found in the transition zone to the west, the rocks in this basin have suffered much structural deformation. Powerful forces at work in the crust of this area have resulted in the formation of large folds, anticlines, synclines, and monoclines. These features have a tremendous influence on the occurrence and movement of surface water and groundwater. Some of these features include the Waterpocket Fold, the Cockscomb Ridge, Caineville Monocline, and the Saleratus Creek Syncline.

Sevier River Basin
Rocks from all eras of geologic time are represented, but either Tertiary volcanic or Jurassic, Cretaceous, Tertiary or Quaternary sediments cover most of the area. Quaternary basalts are found on the Markagunt and Paunsaugunt plateaus and in the Sevier Desert.

Two major faults trend northeasterly through the area. The Paunsaugant fault runs from northern Arizona, past Bryce Canyon, through Grass Valley. The Sevier fault runs from near Pipe Springs in northern Arizona, through the eastern side of Sevier Valley, and into Sanpete Valley to the Cedar Hills. A third fault, the Elsinore fault, although smaller is one of the most active faults in Utah.

West Desert Basin
Mountain blocks are composed mostly of rocks or Paleozoic and Precambrian age. These hard, brittle rocks are permeable when fractured, and can provide groundwater aquifers. The Paleozoic formations include several limestone and dolomite units, which constitute an important regional aquifer system. The centers of the valleys and basins are typically underlain with lacustrine silts and clay, which have low permeability, and contain water with high dissolved solids. The alluvial slopes fringing the mountain blocks are composed of more permeable sand and gravel, and form important local aquifers.

Hazards
Natural hazards differ throughout the state and throughout the SCAOG study area, based on variables such as underlying geology, topography, hydrology, development patterns, and climate. For this reason a risk assessment was conducted by the Six County Association of Governments to determine what natural hazards might affect the Pre-Disaster Mitigation planning. The first step in risk assessment is identifying the hazards that could affect the region. Hazard identification addresses the geographic extent and intensity / magnitude of a hazard as well as the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Planning Team
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Department of Emergency Services and Homeland Security
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in the table below have the possibility of affecting each county within the SCAOG region. The identification process for each county and participating jurisdictions utilized those natural hazards, which consistently affected each county prior to and during the planning process based on history of occurrences, future probability, and risk. Table 22 identifies those hazards on a county level for easy reference.

The SCAOG in conjunction with DES and local officials created maps, which identified municipalities affected by each identified hazards. Initial data from this study was also used to determine those hazards that presented the greatest risk to each of the counties. The geographic extent is identified in the maps at the end of every county section. The hazard intensity/ magnitude and probability is also profiled in each county section.

Within each of the six counties, there are a total of 48 jurisdictions. All of these jurisdictions contributed to the risk assessment analyses performed for each county when located within a hazard boundary. Within each county section refer to the "description and location of extent" paragraph detailing this risk assessment.

Table 22 shows the results of their risk assessment and how and why each hazard with the potential of affecting areas within the Six County Association of Governments was identified. Table 23 shows the composite natural hazard frequencies and recurrence intervals. In the annexes of this plan identified hazards are planned for on a county-by-county basis, with the exception of drought and severe weather. While all hazards don't stop at county boundaries politics dictated this planning process, as did the availability of GIS data.

Table 22: Natural Hazard Identification

Hazard	How Identified	Why Identified
Dam Failure	• Review of County Emergency Operations Plans • Assistance from Utah Division of Water Rights, Dam Safety Section • Community's profile	• Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc.
Drought	• Review of County Emergency Operations Plans • Community's profile • National Climate Data Center • Palmer Drought Severity Index readings	• Affects local economy, water reservoirs, soil • Previous experiences
Earthquake	• Review of County Emergency Operations Plans • Input from City and County Emergency Operations Managers • United States Geological Survey • Utah Geological Survey • HAZUS analysis	• Utah is predicted, 1/5 chance, to experience a large earthquake within the next fifty years. • Numerous faults throughout Utah • Utah experiences approximately 13 earthquakes a year with a magnitude over 3.0. • Can create fire, flooding, hazardous materials incident, transportation and communication limitations
Flooding	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Division of Water Resources • Utah Geological Survey • Flood Insurance Studies • Army Corps of Engineers • Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Division of Water Resources • Utah Geological Survey • Army Corps of Engineers	• Associated with drought and dry soils that the State is frequented with • Several previous incidents have caused severe damage and loss of life • Many of the rivers and streams are located near neighborhoods • Many neighborhoods are located on floodplains, alluvial fans • Associated with drought and dry soils that the State is frequented with • Previous incidents have caused severe damage and loss of life • Many neighborhoods are located near canyon mouths and on floodplains
Infestation	• Review of County Emergency Operations Plans • Input from County Emergency Managers	• Affects local economy and vegetation
Slope Failure (landslide, debris flow and slide)	• Review of County Emergency Operations Plans • Utah Geological Survey • Input from County Emergency Managers • Community's profile • Community's profile • National Climate Data Center • GIS analysis • Past State Mitigation Plans	• Past incidents have caused loss of life property damage, disruption of power lines and communication • Have caused damage in the past

Hazard	How Identified	Why Identified
Problem Soils	• Review of County Emergency Operations Plans • Utah Geological Survey • GIS analysis • Past onsite investigations by Inter-Agency Technical Team.	• Related to subsequent effects from earthquakes that happen regularly • Affect infrastructure
Sever Weather (Winter storms, Avalanches, tornados, lightening)	• Review of County Emergency Operations Plans • Community's profile • Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Avalanche Forecast Center • Utah Department of Transportation • Review of County Emergency Operations Plans • National Climate Data Center • National Weather Service Special Publication	• Communities, homes, infrastructure, roads, ski areas, and people can be affected by an Avalanche • Avalanches have caused property damage and loss of life in the past • Have caused property damage and loss of life
Urban Fire	• Review of County Emergency Operations Plans • Input from County Emergency Managers	• Serious threat to property and life • Associated with flooding, earthquake
Wildland Fire	• Past Wildfire Occurrences • Review of County Emergency Operations Plans	• Potential structure damage • Watershed damage

Table 23: Composite Natural Hazard Frequencies and Recurrence Intervals For Six County Association of Governments

Hazard	Number of Events	Year in Record	Recurrence Interval (years)	Hazard Frequency (% chance/year)
Wildfire	1540	17	.011	9,058.8
Wildfire greater than 100 acres	150	17	.113	882.3
Tornados	22	52	2.36	42.3
Drought	35	107	3.05	32.7
Dam Failure	1	103	103	0.9
Lightning	7 deaths	53	7.6	13.2

Building Code Effectiveness Grading BCEGS Scores:
The Insurance Services Office, Inc performs building Code Effectiveness Grading Reports (BCEGS). Table 24 shows the BCEGS Scores for communities in the Six County Region. The program implemented in 1995 assesses the building codes in effect in a particular community and how well the community enforces it building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with one showing

exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides and incentive for communities to enforce their building codes rigorously.

Table 24: BCEGS

Community	County	Commercial Score	Residential Score	Date Completed
Eureka	Juab	4	4	2000
Nephi	Juab	6	6	2001
Fillmore	Millard	4	4	2000
Millard County	Millard	4	4	1997
Sanpete County	Sanpete	4	4	2001
Sevier County	Sevier	3	3	2001

Part IV. Plan Maintenance Procedures

Monitoring, Evaluating and Updating the Plan
Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for the Six County Region are kept current and that local mitigation efforts are being carried out. The Plan has therefore been designed to be user-friendly in terms of monitoring implementation and preparing regular progress reports.

Annual Reporting Procedures
The Plan shall be reviewed annually, as required by the SCAOG Executive Board, or as situations dictate such as following a disaster declaration. Each year the SCAOG Planning and Community Development Department Staff will review the plan and ensure the following:

1. The Executive Director and the SCAOG Executive Board will receive an annual report and/or presentation on the implementation status of the Plan at the January Executive Board Meeting which is open to the public.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan.

If the SCAOG Executive Board determines that a modification of the Plan is warranted, the Board may initiate a Plan amendment.

Revisions and Updates
Periodic revisions and updates of the Plan are required to ensure that the goals and objectives for the Six County Region are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review
Based on funding, the entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the Six County Region that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the Plan. The local elected officials in the Six County area will be consulted in the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update. Each community will hold public meetings to gain input on how the plan should be updated. The requirements of the mitigation plan will be incorporated into the Six County AOG Consolidated Plan including FEMA mitigation projects as part of the Six County Capital Improvements List.

Further, following a disaster declaration, the Plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review should become summarized in the annual report prepared for this Plan under the direction of the Planning and Community Development Director. The annual report will include an evaluation of the effectiveness and appropriateness of the Plan, and will recommend, as appropriate, any required changes or amendments to the Plan.

If the SCAOG Executive Board, local jurisdiction, Division of Emergency Services, or FEMA determines that the recommendations warrant modification to the Plan, the Board may either initiate a Plan amendment as described below, or, if conditions justify, may direct the SCAOG Planning and Community Development Department to undertake a complete update of the Plan.

Plan Amendments

An amendment to the Plan should be initiated only by the SCAOG Executive Board, either at its own initiative or upon the recommendation of the Executive Director, Planning and Community Development Director or Mayor of an affected community.

Upon initiation of an amendment to the Plan, SCAOG will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. At a minimum, the information will be made available through public notice in a newspaper of general circulation and on the SCAOG Website at http://www.sixcounty.com/. Information will also be forwarded to the Utah Department of Public Safety, Division of Emergency Services and Homeland Security. This information will be sent out in order to seek input on the proposed Plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Executive Director or designee for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Executive Director or designee will review the proposed amendment along with comments received from other parties and submit a recommendation to the SCAOG Executive Board within sixty (60) days.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the Plan; and/or

3. There has been a change in information, data or assumptions from those on which the Plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or designee, the SCAOG Executive Board will hold a public hearing. The SCAOG Executive Board will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the SCAOG Executive Board will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Refer the amendment request back to the Executive Director for further consideration.

4. Defer the amendment request for further consideration and/or hearing.

5. Reject the amendment request.

Implementation through Existing Programs

Implementation
Each jurisdiction included in the Six County Association of Governments Pre-Disaster Hazard Mitigation Plan has a current Capital Improvements Plan (CIP). The Capital Improvement Planning that occurs in the future will contribute and be a reflection of the goals in the Hazard Mitigation Plan. It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to include within the Capital Improvements Plan action items that have been outlined within the Mitigation Plan and ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Many mitigation strategies can be implemented through existing federal, state, and county programs and administered by the county emergency manager. Examples include the National Flood Insurance Program, Fire Wise, Living with Fire Committee, and Storm Ready. County Emergency Managers are constantly looking to implement low or no cost mitigation measures.

Prioritization
For this plan projects were prioritized using that STAPLEE method and given a rating of high, medium or low. These rating take into account the following evaluation criteria: social, technical, administrative, political, legal, and funding. Emphasis was given to funding which is a fundamental consideration in any hazard mitigation project. Benefit cost analysis was not formally conducted on any of the projects suggested in the mitigation strategies. With few exceptions, none of the projects in the plan were

developed far enough to derive a meaningful benefit to cost ratio. Should funding become available the extent by which benefits are maximized with regard to cost, would play a significant roll in determining which, projects get funded and which do not.

Administrative
Project administration is purely a function of project size and complexity, for given jurisdictions within the planning area. Jurisdictions have self-funded or received state and federal funding for numerous projects in the past. The larger the project the more administration resources are needed. Local jurisdictions with current staff could administer small projects or request county or state assistance. Larger projects would most likely still by managed "in-house" but would require additional staff be hired and may request state technical assistance.

Funding Sources
Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The Six County jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the Plan identifies the primary Federal and State grant programs for Six County jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal
The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency
Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects

- Community outreach and education (up to 10% of State allocation)

Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state,

since the state is responsible for setting priorities for funding and administering the program.

Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

Their recipients to incorporate mitigation techniques into the repair and restoration of their business can utilize SBA loans.

Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

State Programs
The state of Utah maintains a philosophy of local responsibility for hazard mitigation. State agencies still provide an integrated network of support, services, and resources for hazard mitigation activities. As demonstrated during past disasters, these agencies are well organized in their delivery and coordination of services. The following is a review of State departments with disaster responsibilities describing their existing and planned mitigation programs.

An evaluation of the laws, regulations, authorities, policies, and programs used in Utah to mitigate hazards demonstrate that they work exceptionally well, as evidenced by the massive amount of mitigation accomplished in Utah, the few numbers of disasters, and the limited nature of those emergencies that do occur. According to the Utah SHMT, the only changes that could be considered by the Legislature might be ones that parallel the Federal Disaster Mitigation Act of 2000, which would integrate pre-disaster mitigation considerations into the code of various state agencies.

Utah Division of Emergency Services and Homeland Security (DESHS)

The capabilities of DESHS Hazard Mitigation Program include:

- Prepare, implement, and maintain programs and plans to provide for preventions and minimization of injury and damage caused by disasters.
- Identify areas particularly vulnerable to disasters.
- Coordinate hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters.
- Assist local officials in designing local emergency actions plans.
- Coordinate federal, state, and local emergency activities.
- Coordinate emergency operations plans with emergency plans of the federal government.

Through the State Hazard Mitigation Program, the following occurs:
- Provide a state coordinator for hazard mitigation, the State Hazard Mitigation Officer.
- Provide a central location of the coordination of state hazard mitigation activities.

- Provide coordination for the Federal Pre-Disaster Mitigation Program.
- Provide for coordination of Project Impact.
- Provide coordination for Comprehensive Multi-hazard Mitigation Plan development, implementation, and monitoring.
- Provide for interagency coordination
- Provide development of procedures for grant administration and project evaluation.
- Provide State Hazard Mitigation Team assistance to local governments.
- Provide for development of specific hazard mitigation plans, such as drought and wildfire.
- Provide for local hazard and risk analysis.
- Provide for development of SHMT mitigation recommendations following disasters.

Utah Department of Agriculture

The Utah Department of Agriculture administers programs serving the state's large agricultural sector. The department's response role during and after a disaster period has been to coordinate damage reports for funding needs and provides loan and recovery program information and assistance to disaster victims. This service is provided for flood, drought, insect infestation, fire, livestock disease, and frost.

Assistance during Drought Disasters
A damage reporting network coordinated through the existing County Emergency Boards was established during the drought disaster of 1996. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

Loans Handbook
The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and applications procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage:

1) Rural Rehabilitation Loan Program (federally funded and operated by the state)
2) Agriculture Resource Development Loan Program (state funded)
3) Emergency Loan Program (state funded)

Soil Conservation Program
The Department of Agriculture also administers the ongoing Soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service, which provides most of the technical assistance. The ongoing program is not regulatory, but is directed towards improved water use and soil conservation.

Disaster Easements
Because of the similarity between past events, the department is now working on a permanent hazard mitigation concept known as "Disaster Easements", which may have widespread agreements with irrigation companies, water districts, or water users' associations for the purpose of routing flood water through local communities.

Monitoring Ground Water Quality
The Department also monitors the quality of groundwater, including individual wells and springs throughout the State.

Non-Point Source Pollution
The Department's Non-Point Source Pollution Program focuses on flood prevention through reduction of erosion, vegetating streams, and restoring "natural stream structure". The Department also monitors drought conditions, which are a precursor to wildfire.

Department of Community and Economic Development

Permanent Community Impact Fund Board
The Permanent Community Impact Fund Board provides loans and/or grants to state agencies and subdivisions of the state, which are or may be socially or economically impacted, directly or indirectly, by mineral resource development on federal lands.

Under the Federal Mineral Lease Act of 1920, leaseholders on public land make royalty payments to the federal government for the development and production of non-metalliferous minerals. In Utah, the primary source of these royalties is the commercial production of fossil fuels on federal land held by the U.S. Forest Service and the Bureau of Land Management. Since the enactment of the Minerals Lease Act of 1920, a portion of these royalty payments, called mineral lease payments, have been returned to the state in an effort to help mitigate the local impact of energy and mineral developments on federal lands.

Funding Options
The Board has the option of funding projects with loans and/or grants. The Board's preferred financing mechanism is an interest-bearing loan.

Loan Requirements
In providing financial assistance in the form of a loan, the Board may purchase an applicant's bonds only if the bonds are accompanied by legal opinion of recognized municipal bond counsel to the effect that the bonds are legal and binding under applicable Utah Law.

The Board may purchase either a taxable or tax-exempt bond. The board may purchase taxable bonds if it determines, after evaluating all relevant circumstances, including the applicant's ability to pay, that the purchase of the taxable bonds is in the best interest of the state and the applicant.

Grants
Grants may be provided only when the other financing mechanisms cannot be utilized, where no reasonable method of repayment can be identified, or in emergency situations regarding public health and/or safety.

Community Development Block Grant
The Community Development Block Grant, or CDBG program, provides funding from the federal government's Department of Housing and Urban Development or HUD, to small cities and counties in the State of Utah.

Utah Division of State History

The Utah State Historical Society, Utah's Division of State History, was founded in 1897 on the 50th anniversary of the first settlement in the Salt Lake Valley by the Mormon Pioneers. The Society became a state agency in 1917, now housed in the historic Rio Grande Depot since 1980. The Division stimulates archaeological research and study; oversees the protection and orderly development of sites; collects and preserves specimens; administers site surveys; keeps excavation records; encourages and supports the preservation of historic and pre-historic sites and publishes antiquities records. The Division also issues archaeological permits and consults with agencies and individuals doing archaeological work.

Preserving and Sharing Utah's Past
The mission of the State Division of History is "preserving and sharing Utah's past for the present and the future".

State Historical Preservation Officer (SHPO)
The SHPO administers the Section 106 process (national Historic Preservation Act) in Utah. The SHPO also serves on the Utah State Hazard Mitigation Team, providing guidance on historical and cultural preservation regulations.

Historic properties include districts, buildings, structures, objects, landscapes, archeological sites, and traditional cultural properties that are included in, or eligible for inclusion in, the National Register of Historic Places. These properties are not just "old buildings" or "well-known historic sites, but places important in local, state, or national history. Facilities as diverse as bridges and water treatment plants may be considered historic.

Utah Geological Survey (UGS)

The Utah Geologic and Mineral Survey is the principle state agency concerned with geologic hazards. Through years of study, the UGS has developed considerable information on Utah's geologic hazards. When geologic events occur or threaten to occur, the UGS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat from natural hazards. The UGS works in partnership with other agencies, such as DESHS, in relating the threats from natural hazard to the communities at risk.

Functions
The functions of the UGS include the following:

- Evaluation of individual geological hazards;
- Participation on local government and state agency technical teams;
- Prediction of the performance on individual slides once they began to move;
- Coordination and awareness of research efforts undertaken by other agencies;
- Provide information on status of individual geologic hazards;
- Reconnaissance reports on status of hazards statewide;
- Advise Division of Water Rights on geologic hazards associated with dam sites; and
- Provide geologic information for use during planning of remedial actions.

Laws/authorities/policies of the Utah Geological Survey for conducting mitigation

Utah Code Annotated
Chapter 73 Geological and Mineral Survey
Section 68-73-6 Objectives of Survey
(1) Determine and investigate areas of geologic and topographic hazards that could affect the safety of, or cause economic loss to, the citizens of this state; (f) assist local and state government agencies in their planning, zoning, and building regulations functions by publishing maps, delineating appropriately wide special earthquake risk areas, and, at the request of state agencies, review the citing of critical facilities:

Utah State Office of Education (USOE) Rule R277-455 Standards and Procedures for building plan review

R277-455-4 Criteria for Approval; to receive approval of a proposed building site, the local school district must certify that:

Staff of the Utah Geologic Survey have reviewed and recommended approval of the geologic hazards report provided by the school districts geo-technical consultant.

Division of Water Resources

The Divisions role of planning, funding and constructing water projects serves as both active and passive hazard mitigation against drought and flood situations throughout the state. The various State water plans contain brief summaries of flood threat and risk for each drainage.

The Division is one of seven agencies in the State Department of Natural Resources. The eight member Water Resources Board, appointed by the governor, administers three state water conservation and development funds. These include:

- Revolving Construction fund – This fund started in 1947 with 1 million legislative appropriation to help construct irrigation projects, wells and rural culinary water systems. Further appropriations have added to this fund.

- Conservation and Development Fund – This fund was created in 1978 with the sale of 25 million in general obligations bonds. Money was added to this fund with bond sales in 1980 and 1983. The C & D Fund generally helps sponsors finance larger multi-purpose dams and water systems.
- Cities Water Loan Fund – Established with an initial legislative appropriation of 2 million dollars in 1974, and with continued appropriations, this fund provides financing to help construct new culinary water projects for cities, towns, improvement districts, and special service districts.

Construction Funds
In addition to overseeing these three construction funds, the Division also manages the State funds appropriated each year for renovation and reconstruction of unsafe dams. As the funding arm of the state for water resource projects the Division works closely with Water Rights, the Regulatory arm of the state charged with jurisdiction over all private and state owned dams.

Water Resource Planning
The Division is also charged with the general water resource planning for the state. The State Water Plan is a process that is coordinated to evaluate existing water resources in the state, determine water-related issues that should be confronted and recommend how and by whom issues can be resolved. The plan identifies programs and practices of state and federal agencies, water user groups and environmental interests and describes the state's current, future, and long-term water related needs. The plan is continually updated using current hydrologic databases, river basin simulations, water supply and demand models and water related land use inventories. Revisions reflect the latest water conservation and development options concerning water rights, water transfers, population, zoning, and many other complex issues for the next 50 years in the state's major river basins.

Utah Division of Forestry, Fire, and State Lands

The Division of Forestry, Fire & State Lands utilizes the principles of stewardship and ecosystem management to assist non-federal landowners in management of their natural resources. The agency provides wildland fire protection for non-federal landowners commensurate with risk; and optimizes the benefits from ecosystem based, multiple-use management of resources held in the public trust. Wildfires are managed from six area offices 1) Bear River Office, 2) Northeast Area, 3) Wasatch Front Area, 4) Central Area, 5) Southwest Area, and 5) Southeast Area. The Division operates under the authority of the Utah Code Annotated 65-A-3-1 though 10.

The Flame-n-Go's (pronounced Flamingoes)
In 1978 the Division of Forestry, Fire, and State Lands and the Utah State Prison signed a cooperative agreement establishing Utah's first volunteer, inmate wildland fire hand-crew. The inmates named themselves the "Flame-N-Go's" and designed a logo that has become well known in the wildland fire fighting community.

All Flame-N-Go's are carefully screened for the program. They must complete rigorous training and sign a yearly contract committing themselves to preserving Utah's natural resources and building responsible lives.

The Flame-N-Go's are divided into three crews, each of which can respond to fires anywhere in the United States. A twenty-man type II hand line crew is the backbone of the group, responding to each assignment with all tools and equipment needed to do battle on the fire line. An Engine Strike Team, (five fire engines, outfitted with men and equipment) is ready to respond when needed as an Engine Strike Team or a Type II Hand line Crew. The Hotshot crew is trained to tackle the most dangerous fires in the most rugged terrain. All crews during peak fire season are on 24-hour call to respond within an hour's notice. These crews respond to an average of 50 fires per year and typically spend 45,000 hours fighting fires each season. At least one Division of Forestry, Fire, and State Lands supervisor and two Department of Corrections staff accompany each crew.

Each year, Flame-N-Go's are put through at least 80 hours of extensive training including classroom work and practical field exercises. Safety, individual and team skills, and professionalism are stressed.

National Fire Plan
The Division administers the State responsibilities of the National Fire Plan, a current emphasis of the U.S. Congress, which also addresses hazard and risk analysis and hazard mitigation.

Living with Fire Committee
The Division works in partnership with the U.S. Forest Service, Bureau of Land Management, and various other entities tasked with suppressing wildland fires on the "Living with Fire" program promoting wildland fire mitigation.

Utah Division of State Parks and Recreation

The goal of the Division of Parks and Recreation is to enhance the quality of life for residents and visitors of our state through parks, people, and programs. They are responsible for protecting, preserving, and managing many of Utah's natural and heritage resources.

Hazard and Risk Analyses
The Division develops hazard and risk analyses for the State Parks as part of the park resource management plans. The Utah Division of Emergency Services and Homeland Security produced one analysis for Snow Canyon State Park in Washington County.

Non-Motorized Trail Program
The Recreational Trails Act of 1991 charged Utah State Parks and Recreation with coordinating the development of a statewide network of non-motorized trails. The Non-Motorized Trail program makes state and federal funds available on a 50/50 matching basis to any federal, state, or local government agency, or special improvement district for the planning, acquisition, and development of recreational trails.

Grants from State Parks Boards
The council advises the Division of Parks and Recreation on non-motorized trail matters, reviews requests for matching grant fiscal assistance, rates and ranks proposed trail projects and along with State Park's staff provides recommendations for funding to the State Parks Board.

River Way Enhancement Program
In 1986, the Utah Legislature passed a bill, which established the River Way Enhancement Program. The program makes state funds available on a 50/50 matching basis to state agencies, counties, cities, towns, and/or special improvement districts for property acquisition and/or development for recreation, flood control, conservation, and wildlife management, along rivers and streams that are impacted by high density populations or are prone to flooding. Public outdoor recreation should be the primary focus of the project.

Utah Division of Water Rights

The Division of Water Rights is the state agency that regulated appropriation and distribution of water in the State of Utah. It is an office of public record. The Utah State Engineer's Office was created in 1897. The State Engineer's Office is the chief water rights administrative officer. A complete "water code" was enacted in 1903 and was revised and reenacted in 1919. This law, with succeeding complete reenactments of State statutes, and as amended, is presently in force mostly as *Utah Code, Title 73*. In 1963, the name was changed from State Engineers office to the Division of Water Rights.

All water in Utah is public property. A water right is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use.

Dam Regulation
The State engineer has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.

Stream Alterations Program
The Utah State Engineer's Office administers a Stream alterations program with the purpose of regulation activities affecting the bed or banks of natural streams. The State Engineer's working definition of a natural stream is any natural waterway in the state, which has flows of sufficient duration to develop a characteristic ecosystem distinguishing it from the surrounding environments. Any individual planning an activity that will affect a natural stream must first obtain a Stream Alterations Permit from this office.

Most proposals reviewed by the State, are covered by General Permit 40, which authorizes the state to have its Stream Alteration Permit fulfill the requirements of Section 404 of the Clean Water Act for most activities. General permit 40 does not apply in some instances and a U.S. Army Corps of Engineers Individual Permit is required.

Projects requiring this additional permit include those involving wetlands, threatened or endangered species, properties listed on the National Historic Register, stream relocation, or the pushing of streambed material against a stream bank.

Dam Safety Program

The Dam Safety Section of the Division of Water Rights was established under Chapters 73-5a 101 thru 73-5a 702 including chapters 73-2-22 for Flood Control and the Chapter 63-30-10 Waiver of Immunity of the Utah Code and Rules R655-10 thru R655-12-6A. The program basically has jurisdiction over all private and state owned dams in the state during design, construction, operation, and decommissioning. This involves periodic inspections according to hazard classifications, inventory maintenance, design, and construction approval and systematic upgrade of all the high hazard structures to current dam safety Minimum Standards and creation of Emergency Action Plans for High Hazard dams. Since 1991, detailed dam reviews have been undertaken by the staff and by private consulting firms. Since 1995, the State Legislature has provided 3-4 million dollars per year to finance 50% of the instrumentation, investigations, and design and 80 to 90% of the construction costs of retrofitting and upgrading deficient dams, starting with the worst dams in the most hazardous locations.

The impetus for this dam safety program has been in reaction to dam failures, both in Utah and in other states, including the Teton Dam in Idaho and the Trial Lake Dam in Summit County and the Quail Creek Dam near St. George Utah. Since the establishment of our Minimum Standards program we have fostered the repair of dozens of dams and have not had a catastrophic failure since.

Future recommendations include continuation of the funding for dam upgrades for all the high hazard dams, and then the moderate hazard dams, continued annual inspections for maintenance items and dangerous deficiencies, upgrading EAP, and hazard assessment to reflect downstream development. Inclusion of the scanned design drawings and inundation maps from the EAP studies is being considered for our web page for public information and emergency access. Possible expansion of the program to cover canals and dikes has been considered.

Utah Division of Wildlife Resources

It is the mission of the Utah Division of Wildlife Resources to serve people of Utah as trustee and guardian of the State's wildlife. The Division Regulates hunting, fishing and trapping, and promotes recreational, educational, scientific and aesthetic enjoyment of wildlife.

Wildlife Habitats and Hazards

Wildlife species and/or their habitats are frequently exposed to hazards. These may be either natural or human influenced (i.e. drought, flood, fire, wind, snow, wetland drainage, water diversions, hazardous material spills, improper/illegal chemical use, earthquake, and other land or water construction/development). Impact resulting either directly or indirectly, from individuals or an accumulation of several hazards, may cause but not be limited to: decreased water supply, stream/lake channel/basin morphology change, riparian/upland vegetation loss or degradation, and impairment of water quality.

These in turn have a varying influence, in the extreme causing death or at a minimum temporary stress, on wildlife populations and their habitats. Hazards mentioned may affect a fairly large geographic area or be very localized in nature.

While the Division of Wildlife Resources (DNR) is charged with the management of wildlife, they do not have regulatory authority over water appropriations, water quality, development, or land management; except as allowed or occurring on properties they own. Therefore, when hazards occur, outside DWR property, DWR is limited to be a participating influence only through comments to the other regulatory agencies or individuals.

DWR management of wildlife is carried out largely through regulation of taking, controlling disturbance and/or possession of wildlife, and introduction or movement of species. However, there are numerous non-regulatory means (i.e. conservation agreements, memorandums of understanding, contracts, lease agreements, cooperative agreements, and technical assistance) by which DWR interacts with other agencies, groups and individuals, to have an influence on wildlife and/or their habitat.

Hazard Areas of Commentary Interaction

While not being able to control/regulate many of the elements necessary for the benefit of wildlife; DWR provides technical comments for the maintenance, protection, and enhancement of wildlife and/or habitats for various value reasons. It is too extensive to list all the areas of comment; however, the following are examples of fairly frequent concern:

- Steam Channel Alteration Permit Applications
- Water Rights Filings
- Energy and Mineral Exploration and Extraction Applications
- Federal Agency land management plans
- Waste Water Discharge Permit Applications
- Hydroelectric plant licensing or regimenting
- Urban and rural development project planning
- Utility transmission line style and locations
- Wetland alteration
- Federal land management planning
- Highway constructions

Utah Division of Drinking Water

Division of Drinking Water's Mission Statement is to "protect the public against waterborne heath risks through assistance, education, and oversight". The Division acts as the administrative arm of the Utah Drinking Water Board. It implements the rules, which they adopt. As such, it is engaged in a variety of activities related to the design and operation of Utah's public drinking water system. The Utah Drinking Water Board is an 11-person board appointed by the Governor. It is empowered by Title 19, Chapter 4 of the Utah Code to adopt rules governing the design, operations, and maintenance of Utah's "public drinking water system".

Safe Drinking Water Act
There is a Federal Safe Drinking Water Act, which applies to all public drinking water systems in the country. The U.S. Environmental Protection Agency (EPA) has given Utah "primacy" for enforcing the federal act within its boundaries. To qualify for this Utah's laws and rules governing public drinking water systems must be at least as strict as the federal law.

Sanitary Surveys
The Division performs sanitary surveys on the water systems, which is a compliance action that identifies system deficiencies.

Emergency Response Plans
The Division of Drinking Water requires water utilities to prepare emergency response plans under the State Safe Drinking Water Act, Utah Code Section 19-4. The Division operates according to DDW Rules: R309 gives them authority to administer actions: R309-301 through R309-104 and R309-113, R309-150, R309-301, and R309-211.

Utah Division of Solid and Hazardous Waste

The Tier II Chemical Inventory report, required by the Federal Emergency Planning and community Right-to-Know Act, requires facilities to submit lists of hazardous chemicals present on site. These reports are computerized and the information is provided to local emergency planning committees, the general public, and others for contingency planning purposes. To implement the Federal law, the State operates under Utah State Code, Section 63-5-5. The Division of Solid and Hazardous Waste requires that hazardous waste treatment storage and disposal facilities prepare an emergency response plan as required by regulations authorized by the State Solid and Hazardous Waste Act, Utah Code Section 19-6.

Other Agency programs are regulatory in nature requiring proper use or disposal of hazardous substances or pollutants. For example the Division of Solid and Hazardous Waste regulates the disposal of hazardous waste, the Division of Radiation Control regulates the proper usage and disposal of radioactive materials. As such there is a threat mitigation nature to these programs.

Utah Division of Water Quality

The Utah Division of Water Quality protects, maintains, and enhances the quality of Utah's surface and underground water for appropriate beneficial uses; the Division of Water Quality regulates discharge of pollutants into surface water, and protects the public health through eliminating and preventing water related health hazards which can occur as a result of improper disposal of human, animal, or industrial wastes while giving reasonable consideration to the economic impact.

Water Quality Fund and Wastewater Treatment Project Fund
The Division Manages the Water Quality Revolving Fund that can be used by local governments for water quality projects and a Wastewater Treatment Project Fund.

Abating Watershed Pollution
Federal and State regulations charge the Division with "preventing, controlling, and abating" watershed pollution. Other state and local agencies have similar responsibilities. The Watershed Approach forms partnerships with these groups to pool resources and increase the effectiveness of existing programs. For each watershed management unit, a watershed plan will be prepared. The watershed plan addresses management actions at several spatial scales ranging from those that encompass a watershed management unit to specific sites that are tailored to specific environmental conditions. Ground water hydrologic basins and eco-region areas encompassed within the units will also be delineated.

State Revolving Fund Program
In 1987, Congress replaced the Construction Grants Program, with the State Revolving Fund Program. Rather than provide direct grants to communities, the federal government provides each state with a series of grants, then each state contributes a 20 percent state match. Grants from the federal government are combined with state funds in the Water Quality Project Assistance Program (WQPAP) and are used to capitalize a perpetual source of funds to finance water quality construction control activities at below market interests rates. Projects eligible for WQPAP financing include such traditional activities as construction of wastewater treatment plants and sewers. The program also will finance non-traditional water quality-related activities such as agricultural runoff control, landfill closures, contaminated industrial property (Brownfield) remediation, stream bank restoration, and wellhead protection.

Local
Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects. Many small mitigation projects are implemented by the County Emergency Managers, who are funded either partially or entirely by county governments.

Non-Governmental
Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this Plan.

Continued Public Involvement
Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. On a yearly basis the plan will be profiled during the meetings with each jurisdiction, i.e., the county commissioners and elected officials in the Six County Region to which the public is invited. The plan will also be available on the Six County website (http://www.sixcounty.com/) to provide additional opportunities for public participation and comment.

Six County Association of Governments staff has been designated by its Executive Board in preparing and submitting the *Six County Pre-Disaster Mitigation Plan*, which includes coverage for all incorporated cities and counties within the Six County Region, i.e., Juab, Millard, Piute, Sanpete, Sevier and Wayne Counties. The strategy of the Six County Association of Governments in preparing the plan is to use available resources in the most efficient and cost effective manner to allow its cities/towns and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the SCAOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The SCAOG will publicly advertise all hearings, requests for input and meetings directly related to the Pre-Disaster Hazard Mitigation Plan process. SCAOG Executive Board meetings where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the SCAOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the newspapers of general circulation. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The SCAOG has established a mailing list of many local agencies and individuals that may have an interest in the Pre-Disaster Hazard Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the Hazard Mitigation Plan; however, the SCAOG reserves the right to limit comments that are excessively long due to the size of the Plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the SCAOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Hazard Mitigation Plan will be presented to the SCAOG Executive Board at its regularly scheduled monthly meeting for adoption and approval to submit the document to State authorities. Executive Board policies on

adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the Plan, the Plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide SCAOG staff in making access and input to the Hazard Mitigation Plan as open and convenient as possible:

A. Participation: All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The SCAOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings: Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information: Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Hazard Mitigation Plan, and/or any other documents prepared for distribution by the Six County Association of Governments that may be adopted as part of the plan by reference. The SCAOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance: Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. SCAOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The SCAOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings: The SCAOG will plan and hold public hearings according to the following priorities: 1- Hearings will be conveniently timed for people who might benefit most from Mitigation programs, 2- Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy), 3- Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: a-identify and profile hazards, b-develop mitigation strategies, and c-review plan goals, performance, and future plans.

F. Comment Period: The SCAOG will sponsor a 30-day public comment period prior to final plan submission. The comment period will begin with a public hearing to open the 30-day solicitation of input. Comments may be made orally, or in writing, and as far as possible, will be included in the final Six County Pre-Disaster Hazard Mitigation Plan according to the outlined participation rules.

Annex 1 – Six County Regional Hazards

Regional Hazards

Due to the geographic extent these hazards have not been mapped and risk assessments were unable to be compiled. Therefore all of the information for the following regional hazards is in the narrative below. The entire region is subject to these hazards with no unique risk affecting a single jurisdiction. Refer to each county Annex for a list of historical hazard events. Mitigation strategies are included in *Annex 8* and in *Appendices P-U*.

1. Severe Weather

Table 1: FEMA Hazard Profile for Severe Weather in the Six County Region

Frequency	Highly Likely
Severity	Moderate
Location	Regional event with higher wind speeds at the mouth of canyons and in the west desert.
Seasonal Pattern	None
Duration	6 to 24 hours
Speed of Onset	0 to 6 hours

Description of Location and Extent

For the purpose of this plan climatic phenomena of avalanche, tornados, lightning, high wind, and winter storms have been joined together under and referred to as severe weather.

High Winds

High winds can occur with or without the presence of another storm and are determined to be unpredictable in regards to time and place. Each of the six counties making up the Six County planning area has experienced high winds in the past, generally during the spring and summer months. These counties can expect regional high wind events in the future. Winds are usually strongest near the mouths of canyons and have resulted in the loss of power and the inability to heat homes and businesses. Winds in the past have damaged roofs, destroyed and knocked down large trees and fences, overturned tractor -trailers, railroad cars, and small airplanes.

Severe Storm

Severe storms can include thunderstorms, hailstorms, heavy snow or rain, and extreme cold. They are generally related to high precipitation events during the summer and winter months. Severe storms can happen anywhere in the region and the damage can be

extensive especially for agriculture, farming, and transportation systems. They can also disrupt business due to power outages.

Thunderstorms
A thunderstorm is a storm made up of heavy rain or hail along with thunder and lightning resulting from strong rising air currents. Based on historical evidence thunderstorms can strike anywhere in the region mainly during the spring and summer months

Lightning
Lightning is the electric discharge accompanied by light between clouds or from a cloud to the earth. In Utah, lightning is the number one natural hazard killer. Lightning can also start wildland fires, which could be potentially fatal or disruptive.

Hailstorms
Hailstorms occur when freezing water in thunderstorm type clouds accumulates in layers around an icy core generally during the warmer months of May through September. Hail causes damage by battering crops, structures, and automobiles. When hailstorms are large (especially when combined with high winds), damage can be extensive. The risk of hailstorms is not targeted to any particular areas within the region.

Heavy Snow or Rainfall
Heavy amounts of precipitation from rain or snow can result in flash flood events. Historically, This region has been susceptible to these types of storms in the past. Major winter storms can produce five to ten times the amount of snow in the mountains than in the valley locations.

Some of the valley development occurs on old alluvial fans at the canyon mouths. During heavy precipitation flood waters and debris will occur on these same alluvial fans, damaging residential and commercial property along with infrastructure. The associated threat with heavy snowfall is avalanches. Heavy snow can also block roads, strand motorists, and disrupt business.

Extreme Cold
Sub-zero temperatures occur during most winters, however prolonged periods of extremely cold weather are infrequent. January is generally the coldest month of the year. Historically extreme cold in the region has disrupted agriculture, farming, and crops. Extreme cold also affects life, especially vulnerable are the young and elderly and animals.

Avalanche
Avalanches occur on steep slopes between 35 and 45 degrees and therefore the mountainous areas as well as the foothills around the region are all vulnerable. Even though most avalanches occur on forested lands they affect mostly city and county dwellers. Therefore, avalanches should be given a priority in Utah due the number of historical occurrences and historic deaths. Avalanche response and often body recover is often conducted by county staff with county funding. Search and rescue efforts can be prevented or reduced through basic avalanche awareness skills.

The probability of a future event is likely dependant on the amount of heavy snowfall during a given year. Most deadly avalanches occur in the backcountry away from developed areas. Avalanche control is performed regularly in developed ski areas to minimize the threat and increase awareness. The Avalanche Center was initiated as another resource for measuring risk and increasing awareness to the residents of the Six County region.

Tornado

Historically, atmospheric conditions have not been favorable for the development of tornadoes in Utah due to the dry climate and mountainous terrain. Utah averages about two tornados per year. Utah tornados are usually no more than 60 feet wide at the base and last up to 15 seconds. Tornadoes occur during the months of May, June, July, and August usually preceding a cold front. Utah is one of the lowest ranked nations for incidences of tornadoes with only one F2 or stronger tornado every seven years.

2. Drought

Table 2: FEMA Hazard Profile for Drought in the Six County Region

Frequency	Highly Likely
Severity	High
Location	Regional event with greater severity occurring in those smaller towns whose wells have gone dry.
Seasonal Pattern	More severe in late Summer after the reservoirs have dried up and the water table has dropped.
Duration	2 to 6 years
Speed of Onset	2 to 6 months

Description of Location and Extent
Drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. The entire region is currently experiencing a drought from 1999- present. Drought dramatically affects this area because of the lack of water for agriculture and industry, which limits economic activity, irrigation and culinary uses. The severity of the drought results in depletion of agriculture lands and deterioration of soils. In the Southeastern region the risk of drought is high.

Drought is not targeted to any particular area within the region and the geographic extent of drought is hard to identify or map on a local or even county level. During the making of this plan, drought related GIS layers were unavailable to complete the mapping and analysis portions of the plan. Therefore, a vulnerability analysis including types and numbers of buildings, critical facilities, and infrastructure affected by drought were unable to be determined.

The secondary threats associated with drought include infestation and wildfire, all of which the region as historically been susceptible to.

Impacts of Drought
- Decreased land prices
- Loss to industries directly dependent on agricultural production (machinery and fertilizer manufactures, food processors, dairies, etc)
- Unemployment from drought related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capitol shortfalls)
- Revenue losses to federal, state, and local governments from reduced tax base.
- Reduction of economic development.
- Rural population loss and relocation to larger cities.
- Loss to recreation and tourism industry
- Energy related effects

- Water suppliers revenue shortfalls
- Higher cost of water transport
- Decline in food production causes increase in food prices and increase in importation of food

Social

- Mental and physical stress
- Health related low flow problems including cross-connection contamination diminished sewage flows, increased pollutant concentrations, and reduced fire-fighting capabilities.
- Loss of human life
- Public safety concerns caused by increased threat of forest and range fires
- Increases in conflicts of water users.
- Changes lifestyles of those living in rural areas.
- Reduction of modification of recreation activities.
- Public dissatisfaction with government drought response plan

Environmental

- Damage to animal species
- Reduction and degradation of fish and wildlife habitat
- Increased contact of wild animals with agricultural producers.
- Loss of biodiversity
- Lower water levels in reservoirs and lakes
- Reduced stream flow.
- Loss of wetlands
- Increased ground water depletion, land subsidence, reduced recharge.
- Increased number and severity of wild fires.
- More dust and pollutants in the air.
- Visual and landscape qualities diminished.

Utah and Six County Association of Government Drought History

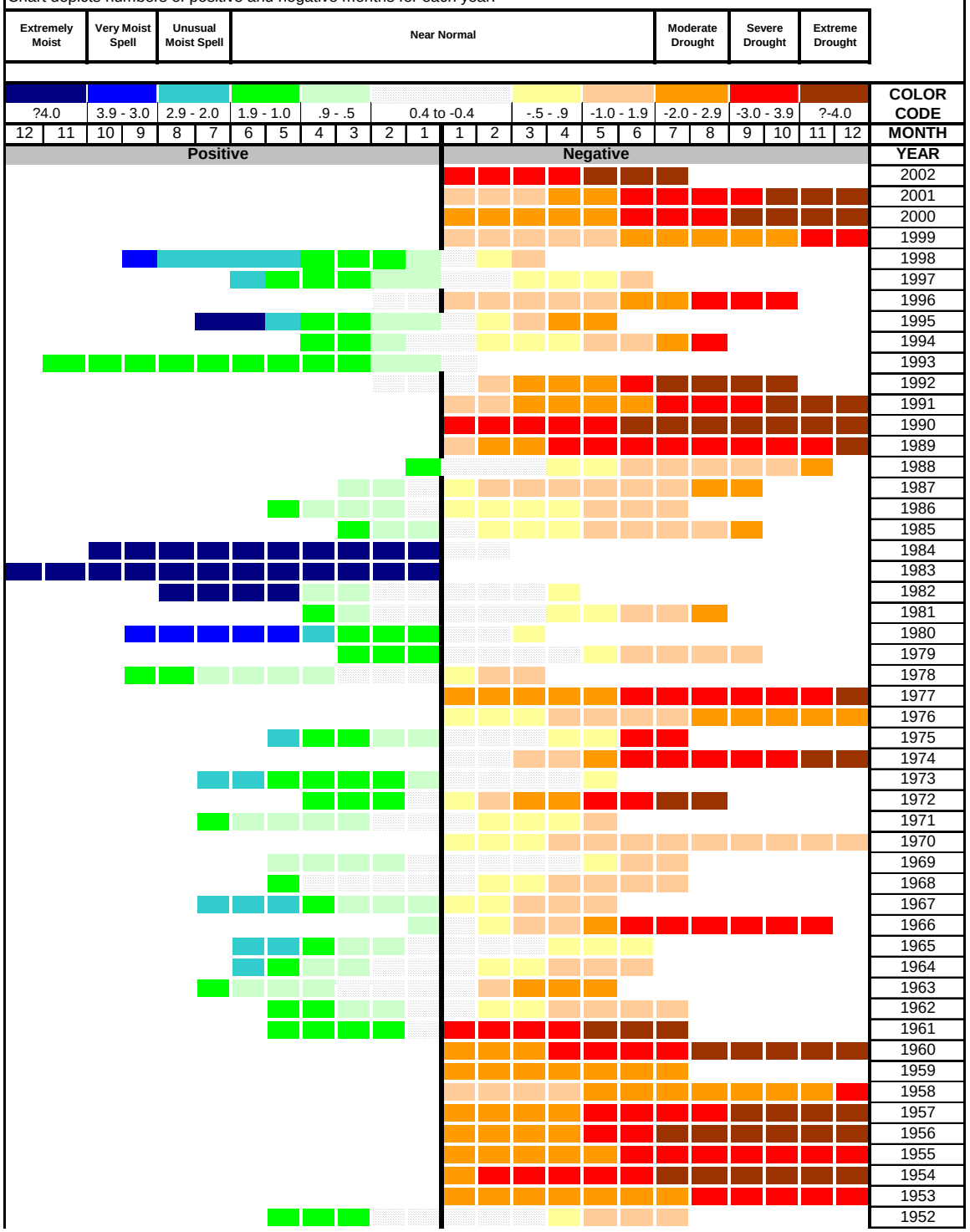
According to Utah's annual Palmer Drought Severity Index Charts, Utah has experienced as many as 60 years of drought out the past 100 years, with several of these being multi-year droughts" (35). Multi-year droughts affecting the entire state occurred during 1896-1905, 1930-1936, 1939-1940, 1953-1956, 1958-1964, 1976-1979, and 1995-1996. Single year droughts occurred during "1924, 1966, and 1974" (State of Utah 35). The Chart below provides a drought history for the Six County planning area, using date for Utah climate zone one and four, from the present back to 1895. Drought severity is measured using the Palmer Drought Severity Index (PDSI). The PDSI drought severity is represented monthly with a numerical id between +6 and –6 with more severe droughts having higher negative numbers.

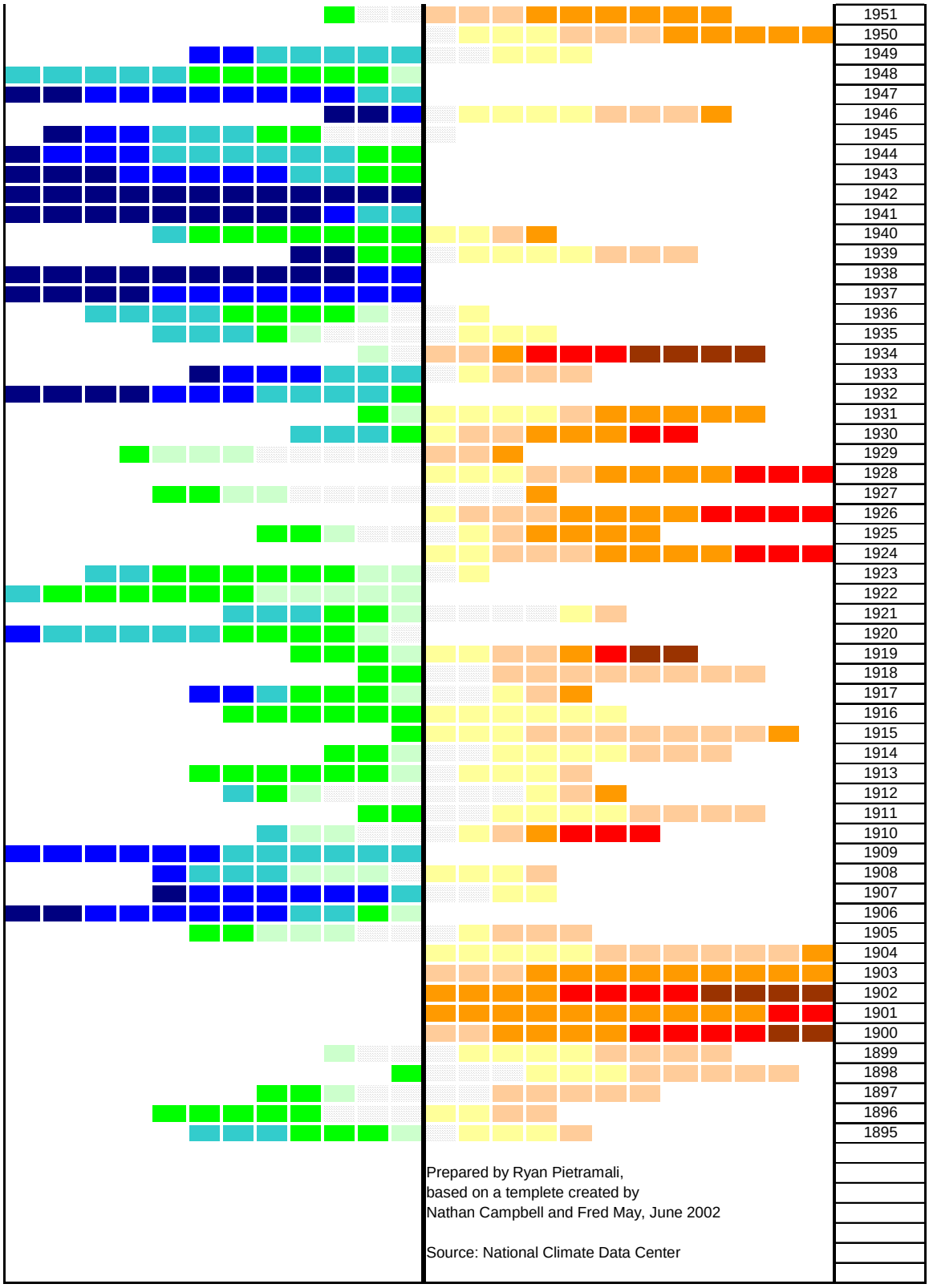
The Palmer Drought Severity Index developed by Wayne Palmer in the 1960's, measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is

"standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc.

PALMER DROUGHT SEVERITY INDEX CHART
UTAH CLIMATE DIVISION 1
1895 - 2001

Chart depicts numbers of positive and negative months for each year.

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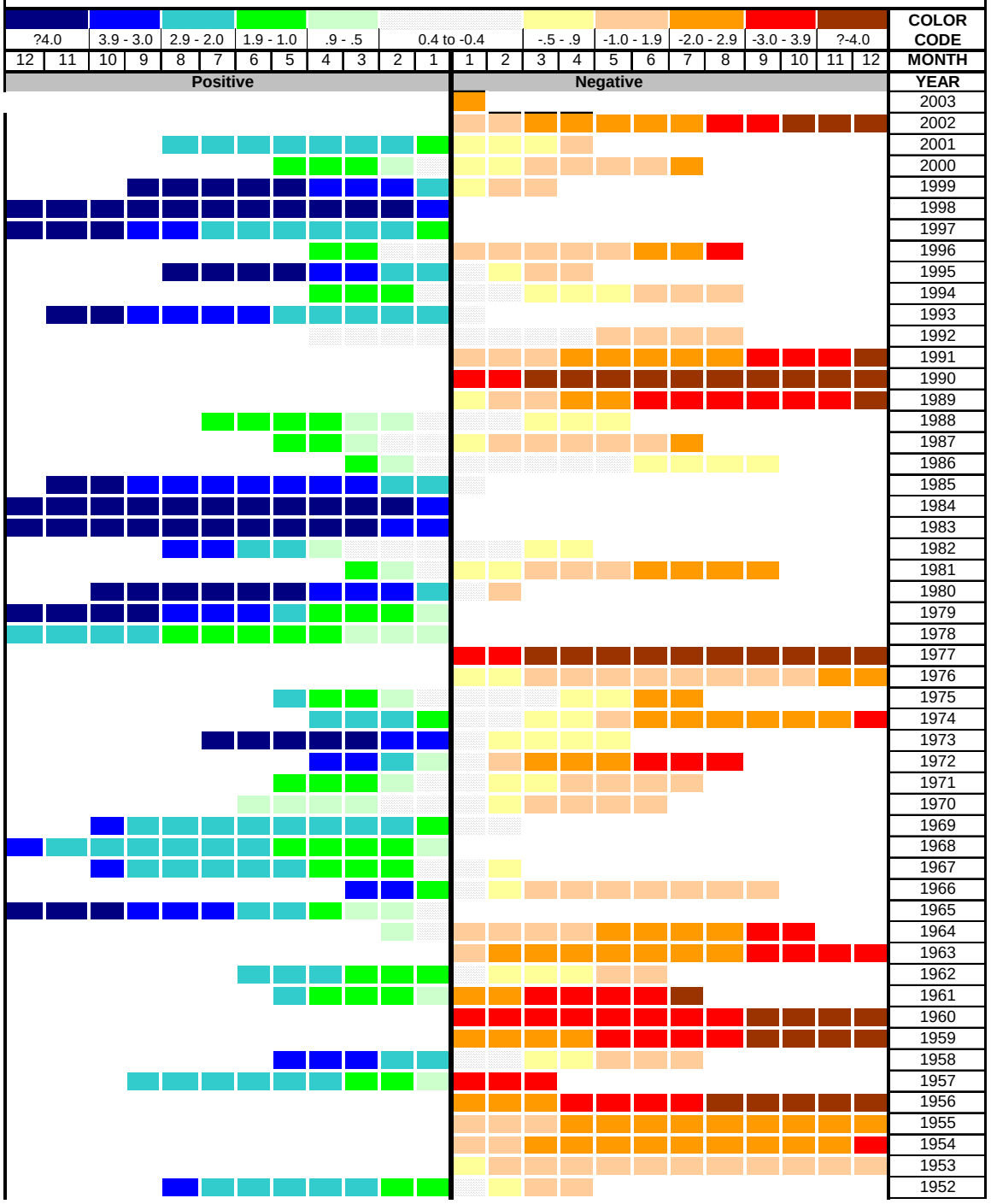
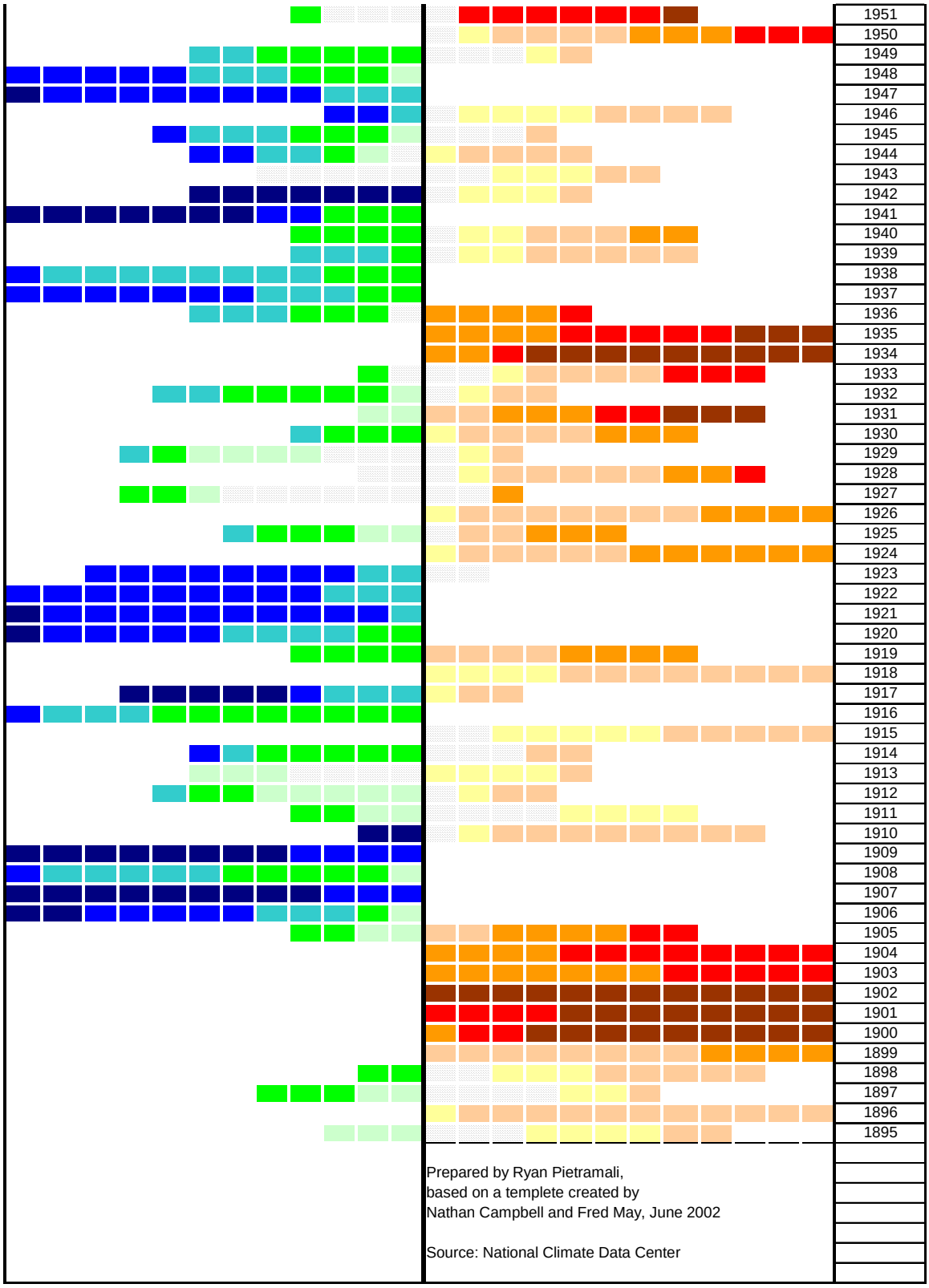
Prepared by Ryan Pietramali,
based on a templete created by
Nathan Campbell and Fred May, June 2002
Source: National Climate Data Center

PALMER DROUGHT SEVERITY INDEX CHART
UTAH CLIMATE DIVISION 4
1895 - 2001

Chart depicts numbers of positive and negative months for each year.

Extremely Moist	Very Moist Spell	Unusual Moist Spell	Near Normal	Moderate Drought	Severe Drought	Extreme Drought

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Prepared by Ryan Pietramali,
based on a templete created by
Nathan Campbell and Fred May, June 2002
Source: National Climate Data Center

Identifying Vulnerable Assets

Identifying assets vulnerable to regional hazards is problematic. There is a limited GIS data for regional hazards, limiting GIS analysis methods employed through out this plan. Certain locations are more vulnerable to regional hazards as addressed above; examples include avalanche, high wind, and lightning. Yet humans have built very little in these areas. Over the last 100 years lightning and avalanches have caused a number of deaths in the planning area but resulted in very little property damage. For the hazards of drought, tornadoes, and winter storm the risk is virtually the same over the entire planning area. Discussion among planning team members resulted in the conclusion of extreme inaccuracy in suggested methods for identifying vulnerable assets in regional hazard areas.

Annex 2 -- Juab County

In order to effectively identify and mitigate natural hazards in Juab County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix P* of this plan.

Table 1: Juab County Pre-Disaster Mitigation Planning Team

Name	Representing:
Fred Smalley, Emer. Mgr.	Juab County
Wm. Boyd Howarth, Commissioner	Juab County
Robert Steele, Commissioner	Juab County
Neil Cook, Commissioner	Juab County
Lloyd Conder, Mayor	Eureka
Robert Shepherd, Mayor	Levan
Bryce Lynn, Mayor	Mona
Chad Brough, Mayor	Nephi
Darrell Allred, Mayor	Rocky Ridge
Kelly Allen	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Juab County

Understanding the past is often the key to discovering what the future hold, this is especially true when planning for natural disasters. The fact that cities within Juab County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Juab County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Juab County Natural Disaster History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Avalanche	February 8, 1899	Near Eureka	Property damage	No loss of life
Flood	July 31, 1936	Eureka/Tintic	Considerable flood damage to roads and streets. Mud covered rail tracks.	

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	August 10, 1941	Mona/Jericho	Damaged railroad tracks, property and road network	
Flood	July 21, 1943	Nephi	Property, roads, and bridges damaged	Salt Creek Canyon
Flood	August 15, 1955	Nephi	Business establishments, farms and irrigation ditches. 7,000 turkeys were killed.	Bigelow Canyon Cloudburst
Flood	August 4 1961	Jericho, Nephi, and Eureka	Utah Highways 11, 36, and 132 and U.S. 6 covered with water and debris	Heavy rains
Flood	July 18, 1964	Eureka	Homes and streets	Worst storm in many years
Flood	July 22, 1968	Tintic	Homes, roads, electric, and telephone lines.	
Flood	August 2, 1968	Levan	City streets and irrigation ditches	Pigeon Creek Canyon over $15,000 in damages
Flood Presidential	1984	County Wide	Creek channels filled with sediment, damaged bridges, culverts, roads, water lines	Public assistance total $1,310,566
Earthquake	August 1, 1900	Eureka	Unknown	Richter Magnitude 5.7
Earthquake	November 28, 1958	Nephi	Unknown	Richter Magnitude 4.3
Earthquake	July, 7 1963	Levan	Unknown	4.4 two miles west of Levan

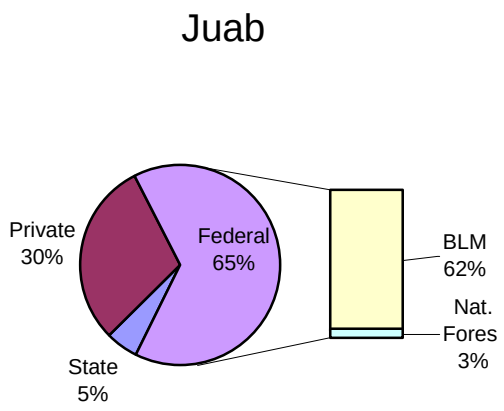
Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Landslide	Unknown	Pole Canyon	Unknown	Base of Mt. Nebo
Landslide	Unknown	York landslide	Unknown	
Landslide	Unknown	Crouch Creek	Unknown	Manning Canyon
Severe Weather	September 23, 1992	Callao	2 deaths	Lightning Geologists working on barren ridge
Wildfire	1999	Sand Mountain Fire	Unknown	6,000 Acres
Wildfire	1999	Rail Road Fire	Unknown	61,009 Acres
Wildfire	2000	West Mona Fire	Unknown	6,692 Acres

(Source: History of Juab County, Utah State Historical Society.)

Development Trends

Approximately 733,971 acres or 30% of the total land area in Juab County is privately held and outside the incorporated areas is almost entirely vacant. The other 70% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure1 helps explain Juab County's development trends.

Figure 1: Juab County Land Ownership



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water and county zoning requirements of water access and a minimum of 160 acres per house. Other limitations to development include steepness of the terrain, flash flood plains and accessibility. There is still plenty of infill within city limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. Juab County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Since most of the privately held land is along the relatively safe and accessible I-15 corridor, development is occurring in this general area. A railroad spur extending southward into Sanpete and Sevier Counties is in the planning stage of development. A major grain receiving station has been completed and is located south of Nephi. A large animal rendering plant will open soon southwest of Nephi at the intersection of I-15 and the Union Pacific Railroad. The area west of Mona will have an operating electrical grid station in the near future.

Historically, Eureka, Mammoth, Silver City and other mining towns were prospering in their heyday of the early 20th Century. Most of the mines are no longer functioning. Now, of the many mining towns, only Eureka is incorporated and is smaller today than at its peak in the 1920s. However, Eureka has been steadily growing for the past decade. The largest city, Nephi, had its start in agriculture, which still plays an important part in the economy of the city and county. Founded in 1851 as an important way station for those traveling to the Territorial Capitol of Fillmore, Nephi is located approximately halfway between Salt Lake City and Fillmore. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. Later roads and the Union Pacific Railroad followed this north-south route and finally I-15 was built roughly using this same corridor. This corridor is where future development is likely to happen because of the private lands along this major transportation artery. Except for lands on the alluvial fans to the east and adjacent to the creeks, this corridor is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Juab County

Frequency	Possible
Severity	Catastrophic
Location	A large magnitude earthquake would produce ground shaking felt throughout the entire region. Surface fault rupture is expected in areas of known historic fault movements, for earthquakes with a magnitude 6.5 or greater.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for several weeks after.
Speed of Onset	No warning

Description of Location and Extent

The Six County region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is high; although there is limited risk to population due to the large areas of undeveloped lands those living in the region are at an elevated risk. During historic times the largest recorded earthquake in Juab County has not reached above 5.7 on the Richter magnitude scale, yet geologic investigation has determined much larger events have happened in the recent geologic past and could happen in the future. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or the last 1.6 million years: These faults are listed in Table 4:

Table 4: Fault Line Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Wasatch fault zone - Nephi section	Latest Quaternary (<15,000 years)	1 - 5 mm/yr	Sectioned
Wasatch fault zone - Levan section	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Sectioned
Wasatch fault zone - Levan section	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Sectioned
Lime Mountain fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Deep Creek Range (east side) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Fish Springs fault	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Fish Springs fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Simpson Mountains faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Sheeprock Mountains fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple

NAME	MOVEMENT	SLIPRATE	STRUCTURE
East Tintic Mountains (west side) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
East Tintic Mountains (west side) faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Long Ridge (west side) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Long Ridge (west side) faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Juab Valley (west side) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Suspected
Drum Mountains fault zone	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Crater Bench faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Little Valley faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Little Valley faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Little Valley faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Sage Valley fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Gunnison fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple

HAZUS-MH Vulnerability Assessment

HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Juab County HAZUS MH run is available in *Appendix O.*

Number of people

Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	50
	Nighttime –Major	1
	Nighttime -Fatalities	3
	Daytime –Minor	61
	Daytime –Major	2
	Daytime- Fatalities	4
	Commute –Minor	49
	Commute –Major	2
	Commute-Fatalities	3

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures	Total Cost in millions of dollars **
Residential	164	42.63
Commercial	5	8.24
Industrial	8	13.96
Totals	947*	65.82**

*****Includes all building categories with moderate to complete damage.
** Structural, non-structural, content, inventory.

Infrastructure Types and Amounts
Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	1	1	0	0
Schools	6	1	0	0
EOCs	1	0	0	1
Police Stations	2	0	0	0
Fire Stations	1	0	0	1

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.

A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 8: Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	42
Loads (25 tons per load)	1,680

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	3
Value Exposed (thous. $)	168

2. Floods

Table 10: FEMA Hazard Profile for Floods in Juab County

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Juab County's main flooding threat is from snowmelt runoff during spring months.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours whereas flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent
Based on the flooding which occurred during the spring of 1983 and 1984 both as a result of rapid snow melt events, experience would suggest these events would appear to be a greater hazard than cloudburst storms. Yet serious hazards could result from either storm. The entire county can experience flooding near the low-lying areas along streams and around lakes. Flooding is of particular concern along Eureka Creek, Willow Creek, Salt Creek, Chicken Creek, and Pigeon Creek. The potential for debris flows exists for all new development along the foothills of the Wasatch Range. This treat needs to be evaluated on know alluvial fans.

Description of Type
Precipitation in Juab County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains.

Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather.

Note on Vulnerability Assessment
At this time, data was insufficient to conduct a risk analysis for flood events in Juab County. Flood Insurance Studies were study were applicable to aid in determining risk.

However, the current mapping projects being led by the county and state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters. One of these tools is the new HAZUS MH flood model. Unfortunately at the current time this model does not work well enough to complete loss numbers for each jurisdiction in the county.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in *Annex 8* and *Appendix P* of this plan. This study looks predominately at jurisdictions which are unmapped or mapped as D zones by the National Flood Insurance Program.

3. Landslides

Table 11: FEMA Hazard Profile for Landslides in Juab County

Frequency	Likely
Severity	Negligible
Location	Mass wasting in Juab County is located predominately along Salt Creek Canyon (see Map 3.1 on p.20 of this Annex).
Seasonal Pattern	Landslides most often occur within Juab County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent
The map "Juab County Landslide Map 3.1" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

Several areas in the county are at risk to landslides. Rocky Ridge is the only jurisdiction to have historic landslide activity within its boundaries. Yet Nephi and Rocky Ridge both have areas of known landslide risk outside of their boundaries. This should be given consideration before jurisdictions annex land.

Structure loss
Our analysis, using best available data, only found two acres and one household in Rocky Ridge Town (see Table 12) vulnerable to landslides within Juab County. The extent and cost of damage to roads and electric infrastructure are shown in Tables 13 and 14, respectively.

Table 12: Structure Loss and Value as a Percentage of Total Acreage.

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost*
Rocky Ridge	2	1/95,000

*Includes value of land.

Table 13: Roads

Name	**Miles**	**Estimated Cost**
Local Neighborhood/local/city street	94.2	227,351,700
State Route 132	.7	1,689,450
Interstate I-15	4.8	11,584,800

Table data represents total length of roads, which overlay historically active landslides.

Railroads

This analysis shows no railroads vulnerable to landslides, yet railroad track east of Rocky Ridge Town is very near an area of known landslide activity.

Table 14: Electric Infrastructure

Name	Description	Estimated Cost
KV-46 lines	.5 Miles	24,140
KV-138 Lines	1.7 Miles	82,077
KV-345	1.1 Miles	53,108

4. Wildfire Risk

Table 15: FEMA Hazard Profile for Wildfire in Juab County

Frequency	Likely
Severity	High in the Wildland Urban Interface
Location	Entire county except cultivated grounds and sand dunes.
Seasonal Pattern	Most wildfires affecting Juab County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	0 to 6 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Juab County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Eureka, Rocky Ridge, and Nephi all have a large amount of high wildfire risk acreage in or around their city. The mitigation section of this plan addresses this through education and Living with Fire participation.

See Map 4.1 on p. 21 of this Annex for a visual display of location and severity of wildfire risk in Juab County. Tables 16-19 show the number of acres and households at different levels of wildfire risk in Juab County.

Table 16: Acres in Wildfire Area

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Juab	85	160,430	391,656	1,629,077

Table 17: Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Juab	1/76,000	208/15,808,000	506/38,456,000

Table 18: Incorporated Juab County

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Eureka	None	532	366
Levan	None	None	None
Mona	None	None	None
Nephi	24	428	18
Rocky Ridge	None	None	337

Table 19: Structures in Wildfire Area

City Name	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Eureka	No known risk	194/14,744,000	133/10,108,000
Levan	No known risk	No known risk	No known risk
Mona	No known risk	No known risk	No known risk
Nephi	12/912,000	248/18,848,000	9/684,000
Rocky Ridge	No known risk	No known risk	20/1,520,000

*Excludes content value, which would result in, and increase of 50% to the values listed.

Tables 20-22 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Juab County.

Table 20: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	1,785	4,308,097,500
State Route 28	23	55,510,500
State Route 36	8.8	21,238,800
State Route 41	.37	892,995
State Route 67	1.1	2,654,850
State Route 78	25	60,337,500
State Route 91	6.6	15,929,100
State Route 132	43.4	104,745,900
US Highway 6	56.2	135,638,700
Interstate I-15	90.6	326,160,000

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 21: Railroads

Railroad	Miles	Estimated Cost
Railroad	50.2	121,050,000

Table 22: Electric Substations

Name	Description	Estimated Cost
Eureka	115 KV	10,000,000
Mona	230 KV	20,000,000
Martin Marietta	115 KV	10,000,000
Ockey	115 KV	10,000,000
Mills	115 KV	10,000,000
Coastal States Energy	PacifiCorp/115 KV	10,000,000
KV-46 lines	59.1 Miles	2,853,000
KV-138 Lines	30.7 Miles	1,482,000
KV-345	64.5 Miles	3,114,000

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5. Problem Soils

Table 23: FEMA Hazard Profile for Problem Soils in Juab County

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Typically occur at the valley's boundary with foothills.
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent
The silica dunes are expanding in the west desert, but are not threatening any incorporated areas in Juab County. Soils with expansive characteristics exist east of Nephi manly on US Forest Service Land. See Map 5.1 on p.22 of this Annex.

6. Dam Failure

Table 24: FEMA Hazard Profile for Dam Failure in Juab County

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

Description of Location and Extent

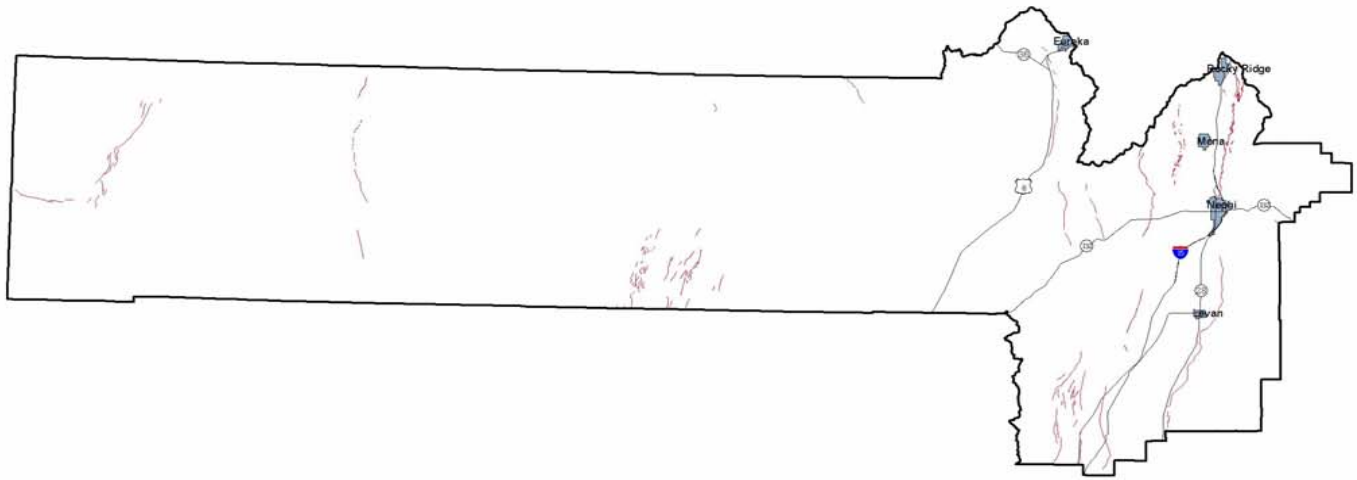
Of the dams located in Juab County only two dam are considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. All dams, regardless of rating should be monitored. It should be noted, dam safety hazard classifications are in the event of dam failure and are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure. The areas of greatest danger to dam failure are north of Mona Dam (southwest of Rocky Ridge Town) and west of Sevier Bridge Dam (about 15 miles southwest of Levan Town). These areas are virtually uninhabited at the present time. See Map 6.1 on p.23 of this Annex.

The high risk dams in Millard County are the following (see Table 25):

- Mona
- Sevier Bridge

Table 25: High Risk Dams

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Mona	1895	Earth Fill	19190	15000
Sevier Bridge	1914	Earth Fill	236145	185000



Quaternary Faults 1.1

Juab County Quaternary Faults

Major Roads
Cities
County Boundary

Explanation

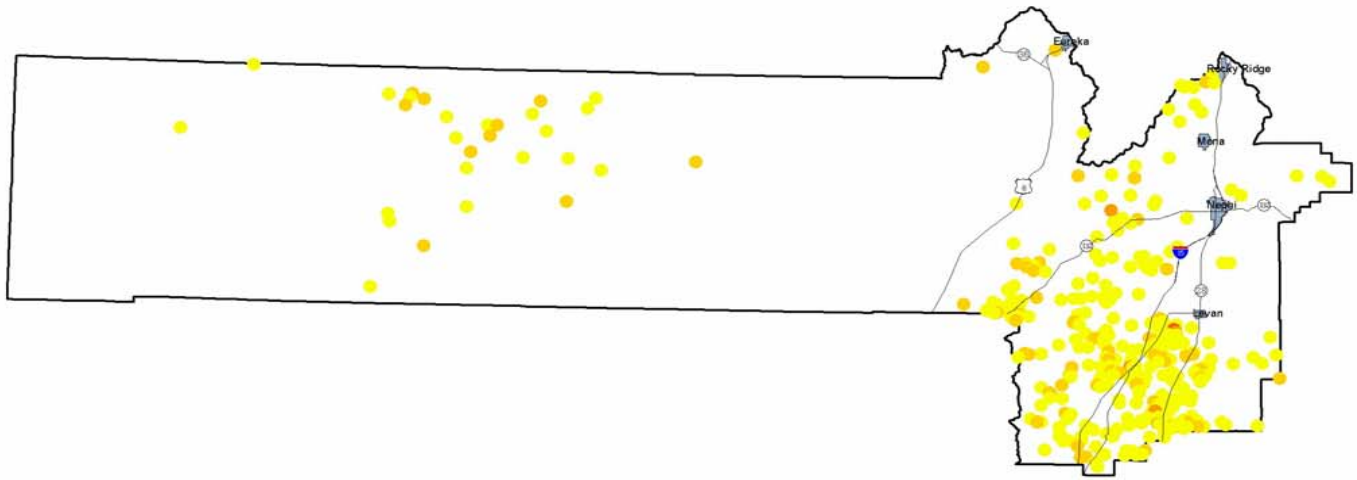
Quaternary Faults

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

10 0 10 20 Miles

N
W E
S

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Epicenters 1.2

Juab County Epicenters

Major Roads
Cities
County Boundary

Explanation

Epicenters by Magnitude

- 5 - 7
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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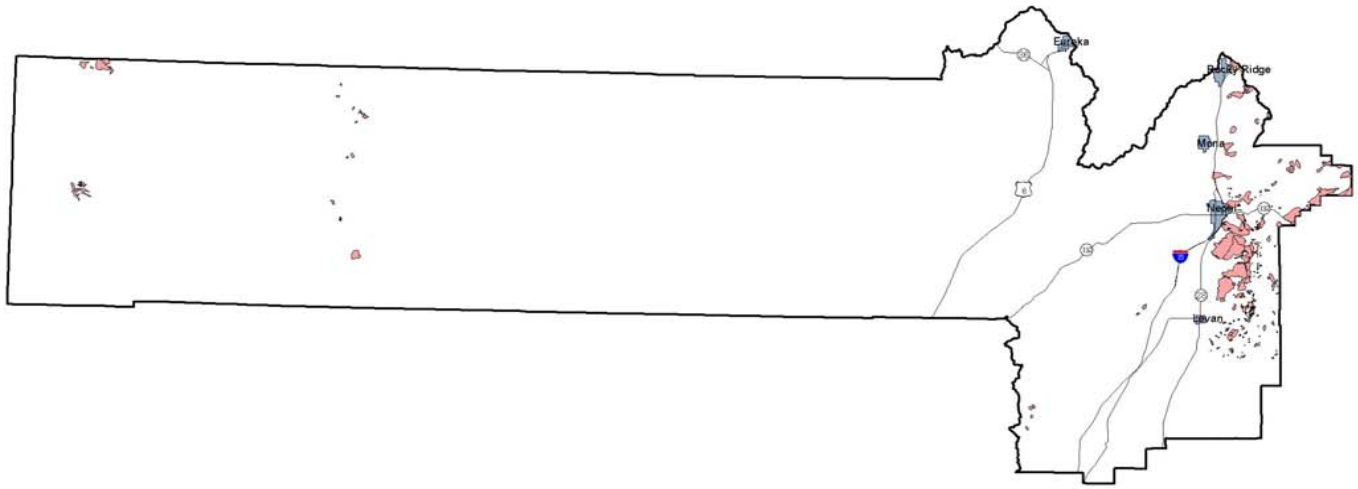

Landslides 3.1

Juab County Landslides

Major Roads
Cities
County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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Wildfire Map 4.1

Juab County Wildfire Risk

Major Roads
Cities
County Boundary

Fire Risk Explanation

Extreme
High
Moderate

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

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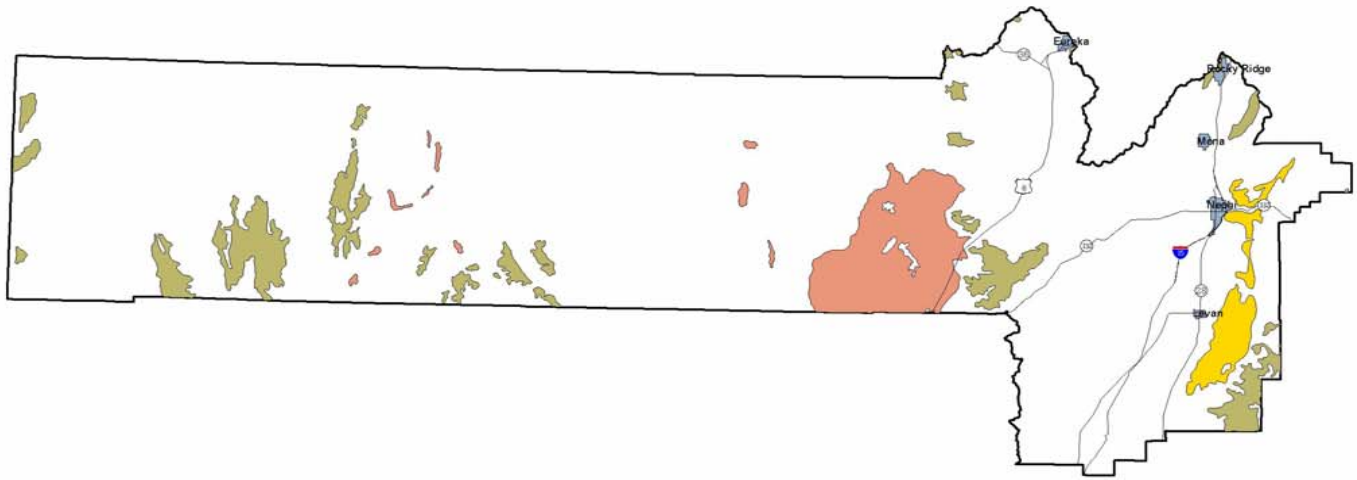

Problem Soil Map 5.1

Juab County
Problem Soil Risk

Major Roads
Cities
County Boundary

Problem Soil Explanation

Expansive Soils
Limestone
Silica Dunes
Gypsum Dunes

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC

10 0 10 20 Miles

N
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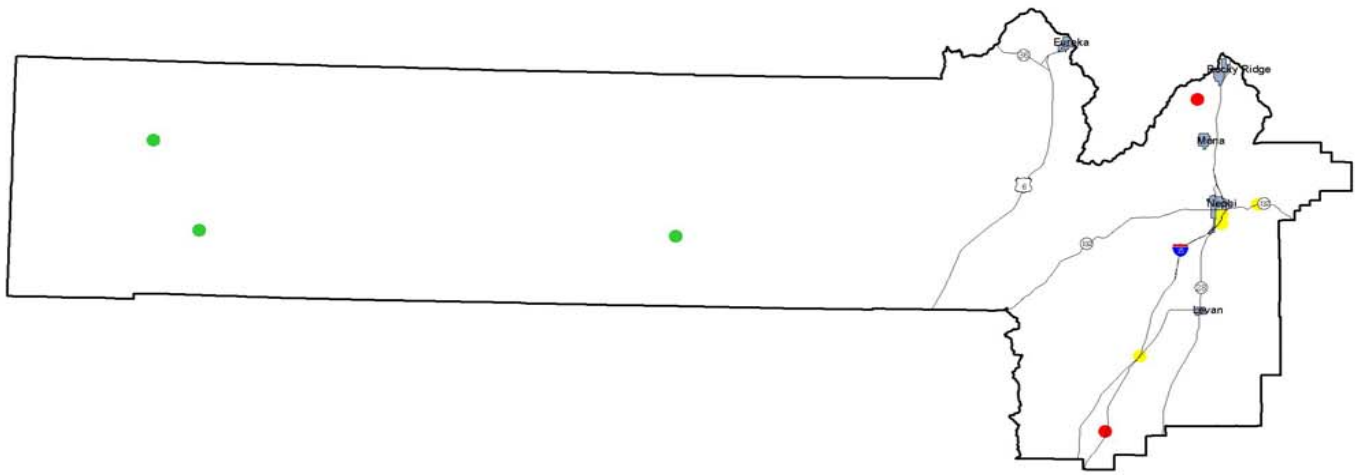


Dams and Impoundment Structures 6.1

Juab County Dams and Impoundment Structures

Major Roads
Cities
County Boundary

Explanation

Dams and Impoundment Structures by Hazard Classification

- HIGH
- MOD
- LOW

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

N W E S

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Juab County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Responsible for everyday operations of the county's Emergency Operations Center and 911 communications.

    c. Update and exercise emergency operations and mitigation plans.

    d. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    e. Coordinate the county's Tier Two reporting. (Hazardous materials)

    f. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    g. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    h. Responsible for timely and effective public information releases during emergency situations.

    i. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

    j. Have verbal mutual aid agreements with Millard, Piute, Sanpete, Sevier, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

    k. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

l. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the Army Corp of Engineers.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Juab County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Juab County Commissioners, Juab County Road Department, Juab County Sheriff Department, and various other law enforcement, fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Juab County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, and Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Warning systems and sirens are outdated and inadequate. At this time, funding is not available for improvements.

   c. Juab County is constantly striving to improve planning and exercise activities and response capabilities. However, with the county growing and becoming more industrial, the threat of potential hazards increases, which increases the need for resources, training, and awareness.

d. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Based on funding, Six County Planning Staff will work with the county to update the General Plan and the zoning ordinances to reflect natural hazard mitigation. Existing zoning requirements for flood plain management need to be enforced.

B. <u>Juab County Highway Department</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Highway Department follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Department of Transportation on various projects since the DOT dispenses federal funding. While the DOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

   c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

   a. <u>Local Agencies</u>: The County Highway Department has little interaction with other county agencies concerning roads and bridges. They do, however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way purchasing is overseen by the States

Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Highway Department coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Juab County Highway Department should assist local government with floodplain management and water development permitting.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Juab County Emergency Management, local law enforcement agencies (city and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse.

D. Juab County Sheriff's Department

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in unincorporated areas of the county and in smaller towns that do not have police departments.

   b. Provide standard law enforcement manpower and equipment.

   c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

   d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

   e. Have verbal mutual aid agreements with all surrounding counties and the Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of law enforcement, the Juab County Sheriff's Department coordinates with various local agencies. These agencies include Juab County Emergency Management and various local police departments.

   b. Non-local Agencies: Juab County Sheriff's Department coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

   a. None

E. Juab Fire District

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

   b. Respond to accidents in order to provide rescue assistance.

   c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (First responders)

   d. Provide standard firefighting manpower and equipment.

   e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

   f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of city fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow.

l. Inspections and preplanning within the fire district to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the Juab Fire District coordinates with various local agencies. These agencies include Juab County Emergency Management, Nephi City Police Department, Juab County Sheriff's Department, Eureka Fire Department, Levan Fire Department, Mona Fire Department, Rocky Ridge Fire Department, local Public Works, and local Emergency Medical Services.

   b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   Our district has seen an increase in number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each

added type of response increases the need for equipment and the time our volunteers need to spend in training. With the recent decrease in population in our district, volunteer retention and recruitment is also a concern.

a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

b. Explore training options to cover the expanding variety of responses in our district.

c. Look into recruitment and retention programs that will work in our district.

F. Utah State University Extension Service

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

   b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural resources, horticulture, family and consumer sciences, 4-H and youth community development.

   c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

   d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

   e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Juab County Emergency Management and Central Utah Public Health.

   b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

   a. None.

G. Nephi City Police Department

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Provide general law enforcement services that are designed to efficiently prevent crime and promote concepts of community policing. These services include traffic control, criminal and accident investigations, neighborhood policing, animal control, and neighborhood and business watches.

   b. Provide standard law enforcement manpower and equipment.

   c. Provide public awareness and training programs including: Drug Abuse Resistance Education (DARE), juvenile diversion programs, Crime Stoppers, gang awareness, Citizen Police Academy, Jr. Police Academy, and a ride along program.

   d. In disaster situations, provide: warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

e. Involved in the county's local Tier Two reporting (Hazardous Materials).

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. Provide input to and enforce city ordinances regarding public safety.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of law enforcement, the Nephi City Police Department coordinates with various local agencies. These agencies include: Juab County Emergency Management, Juab County Sheriff's Department, and the Juab Fire District.

   b. Non-local Agencies: Nephi City Police Department coordinates with appropriate state and federal agencies including: Utah Highway Patrol, Federal Bureau of Investigation (FBI), Bureau of Alcohol, Tobacco, and Firearms (ATF), and Federal Emergency Management Agency (FEMA).

4. General recommendations/Emergency Management concerns:

   a. Explore funding alternatives to upgrade outdated and inadequate warning systems (sirens). At this time, federal funding is not available.

   b. Intensify awareness and training in regard to civil disorder and terrorism incidents.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Juab County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; hazmat technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.
6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; hazmat technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 3 -- Millard County

In order to effectively identify and mitigate natural hazards in Millard County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix Q* of this plan.

Table 1: Millard County Pre-Disaster Mitigation Planning Team

Name	Representing:
Forrest Roper, Emer. Mgr.	Millard County
John Cooper, Commissioner	Millard County
Craig Greathouse, Commissioner	Millard County
Daren Smith, Commissioner	Millard County
Gayle Bunker, Mayor	Delta
V.B. "Sam" Starley, Mayor	Fillmore
Donald Brown, Mayor	Hinckley
Brent Bennett, Mayor	Holden
Terry Higgs, Mayor	Kanosh
Jim Rasch, Mayor	Leamington
Jese Ruiz, Mayor	Lynndyl
Jim Talbot, Mayor	Meadow
Winston Nielson, Mayor	Oak City
Burtis Quarnberg, Mayor	Scipio
Kelly Allen	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Millard County

Understanding the past is often the key to discovering what the future holds; this is especially true when planning for natural disasters. The fact that cities within Millard County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Millard County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Natural Hazard History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Dam Failure (Corn Creek)	Spring, 1983	Near Kanosh	Unknown	Unknown
Dam Failure (DMAD)	June 23, 1983	Near Delta	Unknown	16,000 acre feet of water inundated the town of Deseret killing one person attempting to cross the flood on a pipe.
Flood	1896	Meadow	Unknown	Unknown
Flood	1934	Meadow	Unknown	Unknown
Flood	1938	Meadow	Unknown	Unknown
Flood	1940	Meadow	Unknown	Unknown
Flood	August 4-6, 1945	Oak City	Homes and fields in Oak City.	Dry Creek and Oak Creek drainages.
Flood	July 18, 1951	Scipio	Damage to farms, crops, and residential areas.	$25,000.00 in damages.
Flood	August 25, 1958	Scipio	Damage to farmlands and Highway 63.	$3,000.00 in damages.
Flood	July 31, 1961	Fillmore	City homes and water lines	Chalk Creek
Flood Presidential	1983	Fillmore, Deseret, and Scipio	Loss of over 140 homes, rail lines, sewer lines, roads, etc.	Chalk Creek, Oak Creek, and the Sevier River; $1,000,000 in public assistance.
Flood Presidential	1984	County wide	All sectors	Public assistance total $492,204.
Flood	August 2000	Holden	Damage to 4 structures and municipal roadways.	Unknown

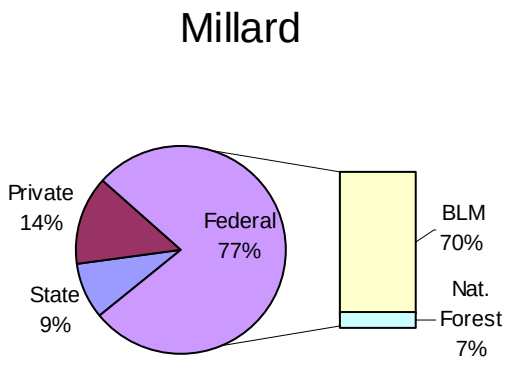
Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Earthquake	January 16, 1968	Scipio	Unknown	Richter Magnitude Scale 3.9; earthquake swarm in the area.
Severe Weather	August 4, 1916	Unknown	No damage	Tornado
Severe Weather	May 3, 1982	North of Milford	No Damage	Tornado
Severe Weather	June 7, 1989	Delta	No Damage	Tornado
Severe Weather	May 28, 1996	McCornick	No Damage	Tornado

(Source: History of Millard County, Utah State Historical Society.)

Development Trends

Approximately 618,409 acres or 14% of the total land area in Millard County is privately held and outside the incorporated areas is mostly vacant. The other 86% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure 1 helps explain Millard County's development trends.

Figure 1: Land Ownership



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water. Other limitations include steepness of the terrain and accessibility. Currently, Millard County zoning ordinances specify water access and a ½ acre minimum per house. There is still plenty of infill within city limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. Millard County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Most of the development is occurring along the relatively safe I-15 corridor and along US 6 by Delta since this is where most of the private lands are located. The Intermountain Power Plant (IPP) in Delta is considering in extending its life for another twenty years, by revamping the plant's infrastructure. The power plant is one of Millard County's major developments in the 1980's and will continue to remain a primary project into the 21st Century.

Historically, Fillmore was the capitol of the Territory of Utah until 1856 when it was moved to the more populated Salt Lake City. Delta had its start in 1906 further west along the Sevier River from agricultural settlements from the 1850s. Both Fillmore and Delta depended greatly on agriculture and still do today. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. The Union Pacific Railroad came to Millard County passing near Delta. US 6 and State Route 257 roughly follow this route. I-15 follows the old Highway 91, which connected Salt Lake City to St. George. Future development will likely occur along I-15 and US 6 near Delta due to the privately held lands in this area. Except for lands adjacent to the Sevier and Beaver Rivers and their tributaries, this area is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Millard County

Frequency	Possible
Severity	Catastrophic
Location	Ground shaking will be felt throughout the entire county if a large earthquake were to occur. Surface fault rupture could be expected in areas of known historic fault movements. Liquefaction is expected in areas of high to moderate liquefaction potential, which covers a vast portion of Millard County.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Description of Location and Extent

The Six County region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is high; although there is limited risk to population due to the large areas of undeveloped lands those living in the region are at an elevated risk. During historic time the largest recorded earthquake in Millard County has not reached above 3.9 on the Richter magnitude scale, yet geologic investigation has determined much larger events have happened in the recent geologic past and could happen in the future. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or the last 1.6 million years. These faults are listed in Table 4 (also, see Maps 1.1 and 1.2 starting on p.17 of this Annex).

Table 4: Fault Line Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Snake Valley (south end) faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Snake Valley (south end) faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
Snake Valley faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Snake Valley faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Foote Range fault	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
House Range (west side) fault	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Swasey Mountain (east side) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Drum Mountains fault zone	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Crater Bench faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Cricket Mountains (north end) faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Deseret faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Clear Lake fault zone	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Suspected
Sugarville area faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Pavant faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Pavant faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Little Valley faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Scipio Valley faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Scipio faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Scipio faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
Scipio faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Pavant Range fault	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Maple Grove faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Maple Grove faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
Maple Grove faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Japanese and Cal Valleys faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Japanese and Cal Valleys faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Little Rough Range faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
North of Wah Wah Mountains faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Cricket Mountains (west side) fault	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Black Rock area faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
Black Rock area faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Faults of Cove Creek Dome	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Beaver Ridge faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Beaver Ridge faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Tabernacle faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Meadow-Hatton area faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
White Sage Flat faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
White Sage Flat faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Red Canyon fault scarps	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Mountain Home Range (west side) faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Wah Wah Mountains faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
San Francisco Mountains (west side) fault	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
San Francisco Mountains (west side) fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Mineral Mountains (northeast side) fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Cove Fort fault zone	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Suspected

HAZUS-MH Vulnerability Assessment
HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Millard County HAZUS MH run is available in *Appendix O.*

Number of people
Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	29
	Nighttime –Major	8
	Nighttime -Fatalities	2
	Daytime –Minor	61
	Daytime –Major	19
	Daytime- Fatalities	5
	Commute –Minor	24
	Commute –Major	7
	Commute-Fatalities	2

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures	Value of Structures in Millions
Residential	1,034	25.7
Commercial	25	7.9
Industrial	8	2.1
Other	9	2.9
Totals	1,076	38.6

Infrastructure Types and Amounts
Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	0	0	0
Schools	9	0	0	0
EOCs	0	0	0	0
Police Stations	0	0	0	0
Fire Stations	4	0	0	0

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.
A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of one yard.

Table 8: Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	0.04
Loads (25 tons per load)	2,000

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

2. Floods

Table 10: FEMA Hazard Profile for Floods in Millard County

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Millard County's main flooding threat is from snowmelt runoff during spring months.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours whereas flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent
Based on the flooding which occurred during the spring of 1983 and 1984 both as a result of rapid snow melt events, experience would suggest these events would appear to be a greater hazard than cloudburst storms. Yet serious hazards could result from either storm. The entire county can experience flooding near the low-lying areas along streams and around lakes. Flooding is of particular concern along the Sevier River and its tributaries, Oak and Dry Creek, Corn Creek, Pine Creek, Chalk Creek, and Meadow Creek. As state population increases development also increases. This increase has resulted in somewhat of a new hazard canal failure. The following Canals in Millard County cross through populated areas: Central Utah and Abraham Canal.

Description of type
Precipitation in Millard County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains.

Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather.

Note on Vulnerability Assessment

At this time, data was insufficient to conduct a risk analysis for flood events in Millard County. Flood Insurance Studies were study were applicable to aid in determining risk. However, the current mapping projects being led by the county and state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters. One of these tools is the new HAZUS MH flood model. Unfortunately at the current time this model does not work well enough to complete loss numbers for each jurisdiction in the county.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in Annex 8 and *Appendix Q* of this plan. This study looks predominately at jurisdictions, which are unmapped or mapped as D zones by the National Flood Insurance Program.

3. Landslides

Table 11: FEMA Hazard Profile for Landslides in Millard County

Frequency	Likely
Severity	Negligible
Location	Mass wasting in Millard County is located predominately along the canyons east of the Pahvant Valley (see Map 3.1 on p.19 of this Annex).
Seasonal Pattern	Landslides most often occur within Millard County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent
The map "Millard County Landslide Map 3.1" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

GIS analysis, using best available data, found no active landslides within or abutting, current boundaries of incorporated municipalities within Millard County. However, the extent and cost of damage to roads and electric infrastructure are shown in Tables 12 and 13, respectively.

Table 12: Roads

Name	**Miles**	**Estimated Cost**
Local Neighborhood/local/city street	15.7	37,891,950

Table data represents total length of roads, which overlay historically active landslides.

Railroads
This vulnerability analysis using best available data found no railroad track at risk in Millard County.

Table 13: Electric Infrastructure

Name	Description	Estimated Cost
KV-46 lines	1.7 Miles	82,077
KV-138 Lines	2 Miles	96,561

4. Wildfire Risk

Table 14: FEMA Hazard Profile for Wildfire in Millard County

Frequency	Likely
Severity	High in the Wildland Urban Interface
Location	Entire county except cultivated grounds.
Seasonal Pattern	Most wildfires affecting Millard County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	0 to 6 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Millard County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

No land surrounding or abutting the jurisdictions within Millard County received wildfire classifications of extreme or high.

See Map 4.1 on p. 20 of this Annex for a visual display of location and severity of wildfire risk in Millard County. Tables 15-18 show the number of acres and households at different levels of wildfire risk in Millard County.

Table 15: Wildfire Acres

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Millard	None	105,081	307,482	3,956,751

Table 16: Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Millard	None/0	109/6,278,400	317/18,259,200

Table 17: Incorporated Millard County*

City Name	Acres of High	Acres of Moderate
Delta	None	87
Fillmore	None	504
Hinckley	None	34
Holden	None	None
Kanosh	None	None
Leamington	None	180
Lynndyl	None	None
Meadow	None	None
Oak City	None	20
Scipio	None	21

*No Extreme wildfire risk within Millard County

Table 18: Structures in Wildfire Area

City Name	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Delta	None/0	None/0	47/2,707,200
Fillmore	None/0	None/0	112/6,451,200
Hinckley	None/0	None/0	2/115,200
Holden	None/0	None/0	None/0
Kanosh	None/0	None/0	None/0
Leamington	None/0	None/0	13/748,800
Lynndyl	None/0	None/0	None/0
Meadow	None/0	None/0	None/0
Oak City	None/0	None/0	8/460,800
Scipio	None/0	None/0	5/288,000

*Excludes content value, which would result in an increase of 50% to the values listed.

Tables 19-21 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Millard County.

Table 19: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	1,226	2,958,951,000
State Route 99	.37	892,995
State Route 100	.05	120,675
State Route 125	19	45,856,500
State Route 132	5.7	13,756,950
US Highway 6	3.3	7,964,550
US Highway 50	13	31,375,500
Interstate I-15	61.6	147,464,850
Interstate I-70	7.5	18,101,250

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 20: Railroads

Railroad	Miles	Estimated Cost
Railroad	3.6	8,550,000

Table 21: Electric Infrastructure

Name	Description	Estimated Cost
North Fields	115 KV	10,000,000
Fillmore SW. RK	115 KV	10,000,000
KV-46 lines	33.1 Miles	1,599,000
KV-138 Lines	3.6 Miles	174,000
KV-230 Lines	21.7 Miles	1,047,000

5. Problem Soils

Table 22: FEMA Hazard Profile for Problem Soils in Millard County

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Typically occur at the valley's boundary with the foothills.
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent

The areas of greatest threat are west of Hinckley, Leamington, Lynndyl, and Oak City where silica dunes are encroaching on the municipalities. See Map 5.1 on p.21 of this Annex.

6. Dam Failure

Table 23: FEMA Hazard Profile for Dam Failure in Millard County

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

Description of Location and Extent
Of the dams located in Millard County only three dam are considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. All dams, regardless of rating should be monitored. It should be noted that dam safety hazard classifications are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

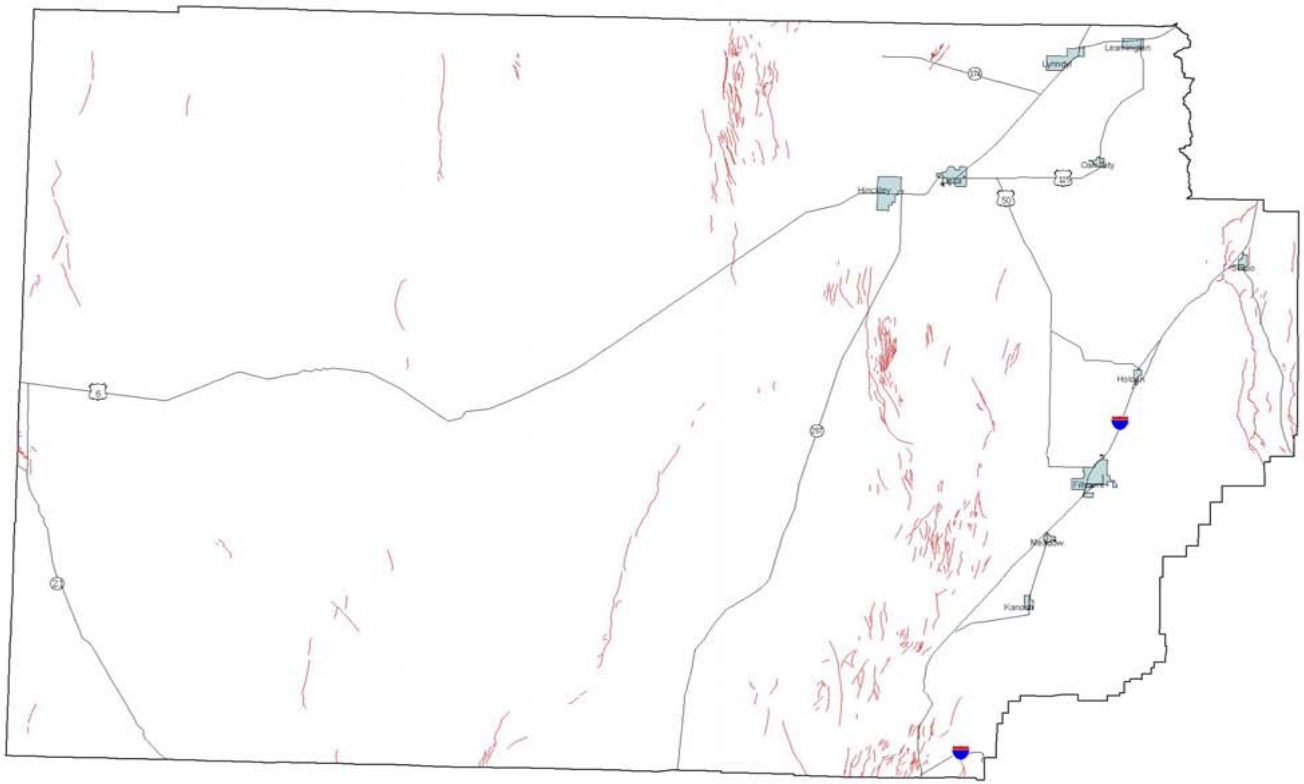
The areas of greatest danger to dam failure are west of Corn Creek (near Kanosh), Gunnison Bend (near Hinckley), and DMAD (near Delta) dams. See Map 6.1 on p.22 of this Annex.

The high risk dams in Millard County are the following (see Table 24):

- Corn Creek
- Gunnison Bend
- DMAD

Table 24: High Risk Dams

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Corn Creek	1985	Earth Fill	89	5000
DMAD	1959	Earth Fill	7500	12000
Gunnison Bend	1895	Earth Fill	5000	5000



Quaternary Faults 1.1

Millard County Quaternary Faults

Major Roads
Cities
County Boundary

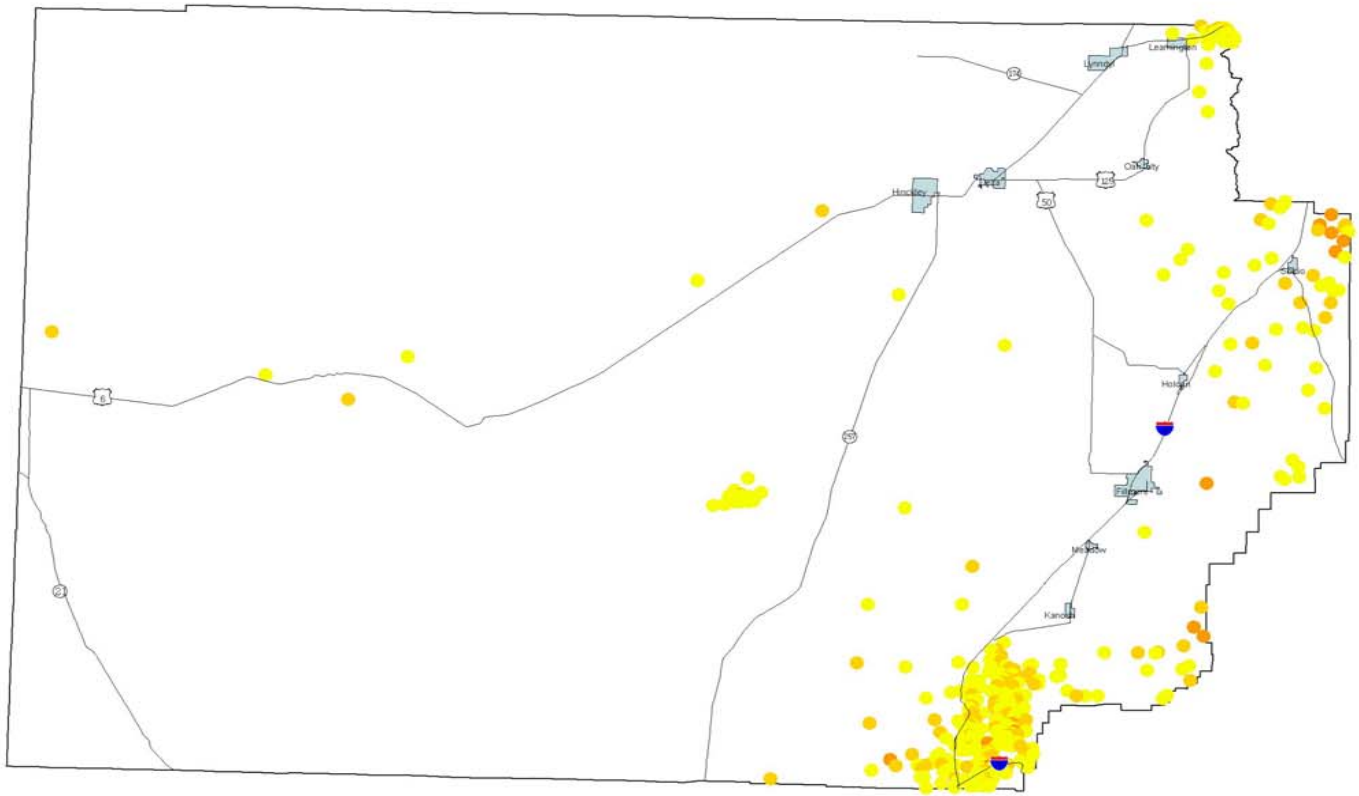
Explanation

Quaternary Faults

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Epicenters 1.2

Millard County Epicenters

Major Roads
Cities
County Boundary

Explanation

Epicenters by Magnitude

- 5 - 7
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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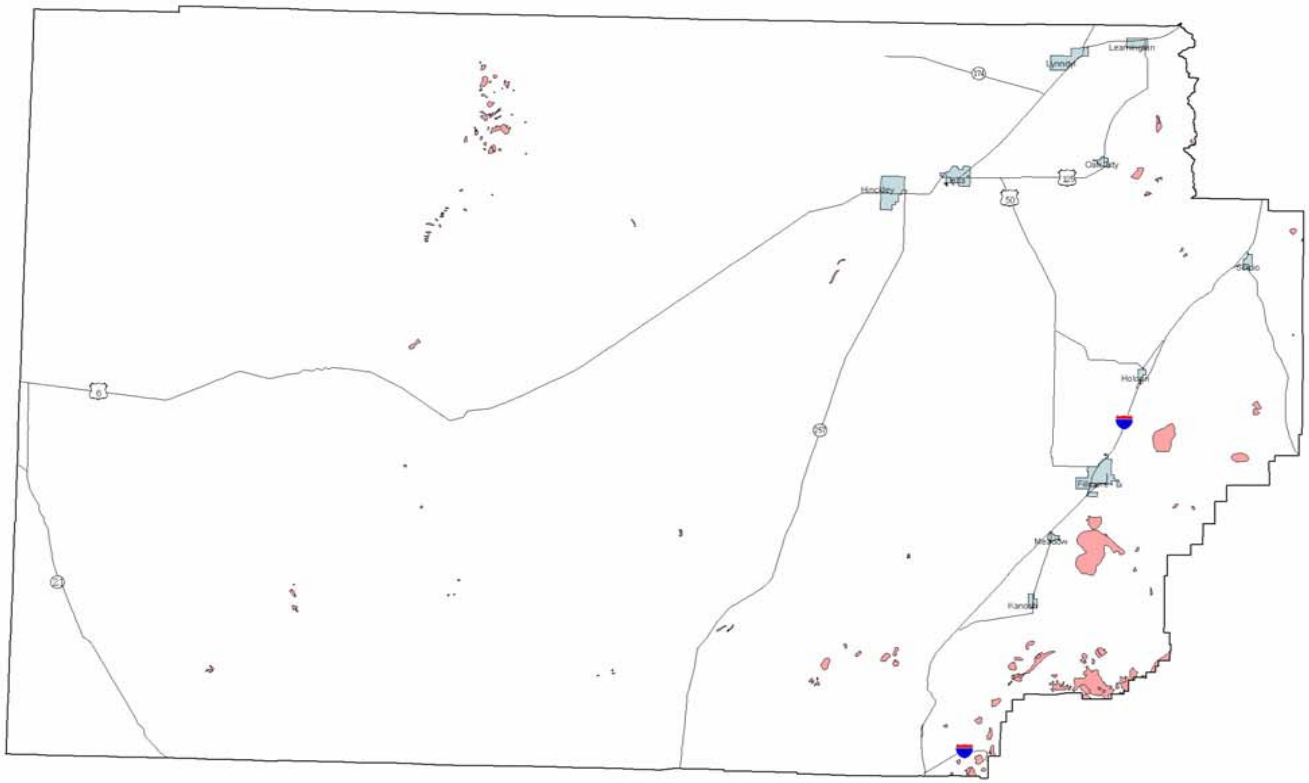
N W E S



Landslides 3.1

Millard County Landslides

Major Roads
Cities
County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

N
W E
S

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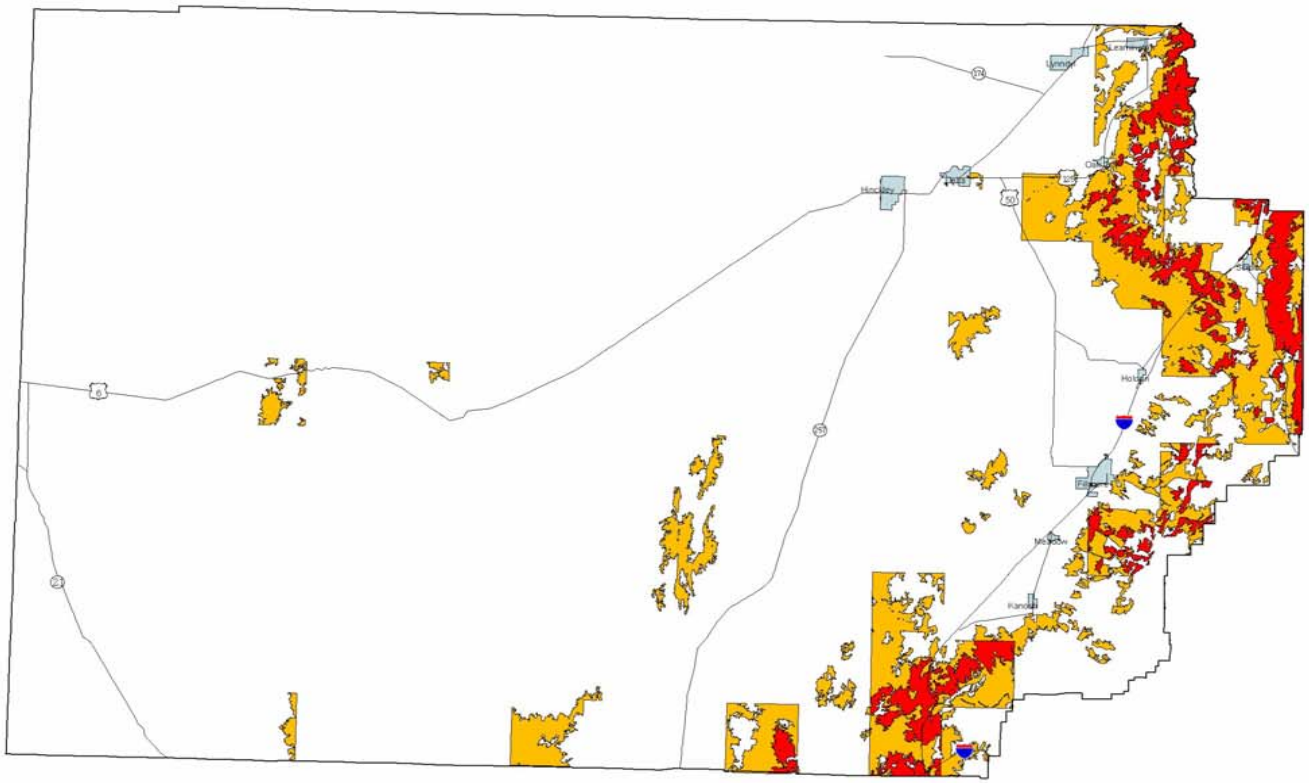

Wildfire Map 4.1

Millard County Wildfire Risk

Major Roads
Cities
County Boundary

Fire Risk Explanation

Extreme
High
Moderate

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

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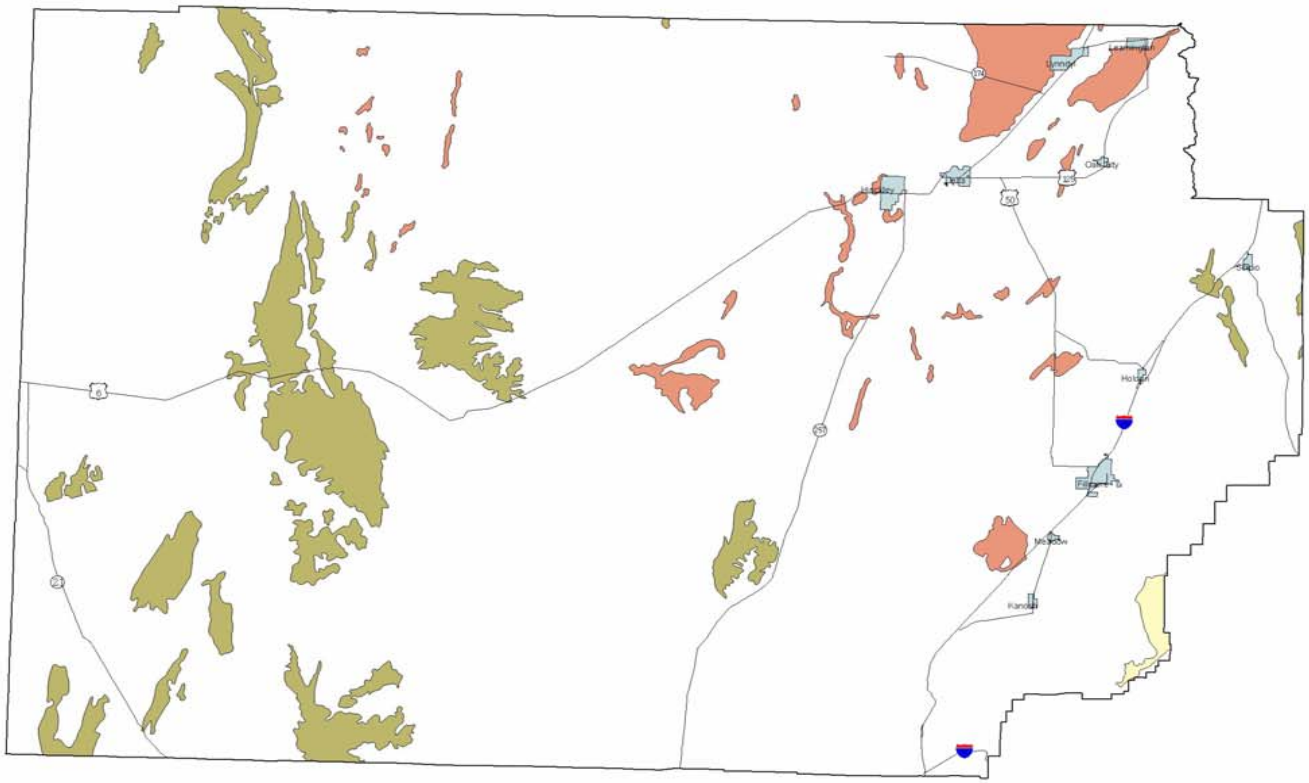


Problem Soil Map 5.1

Millard County
Problem Soil Risk

Major Roads
Cities
County Boundary

Problem Soil Explanation

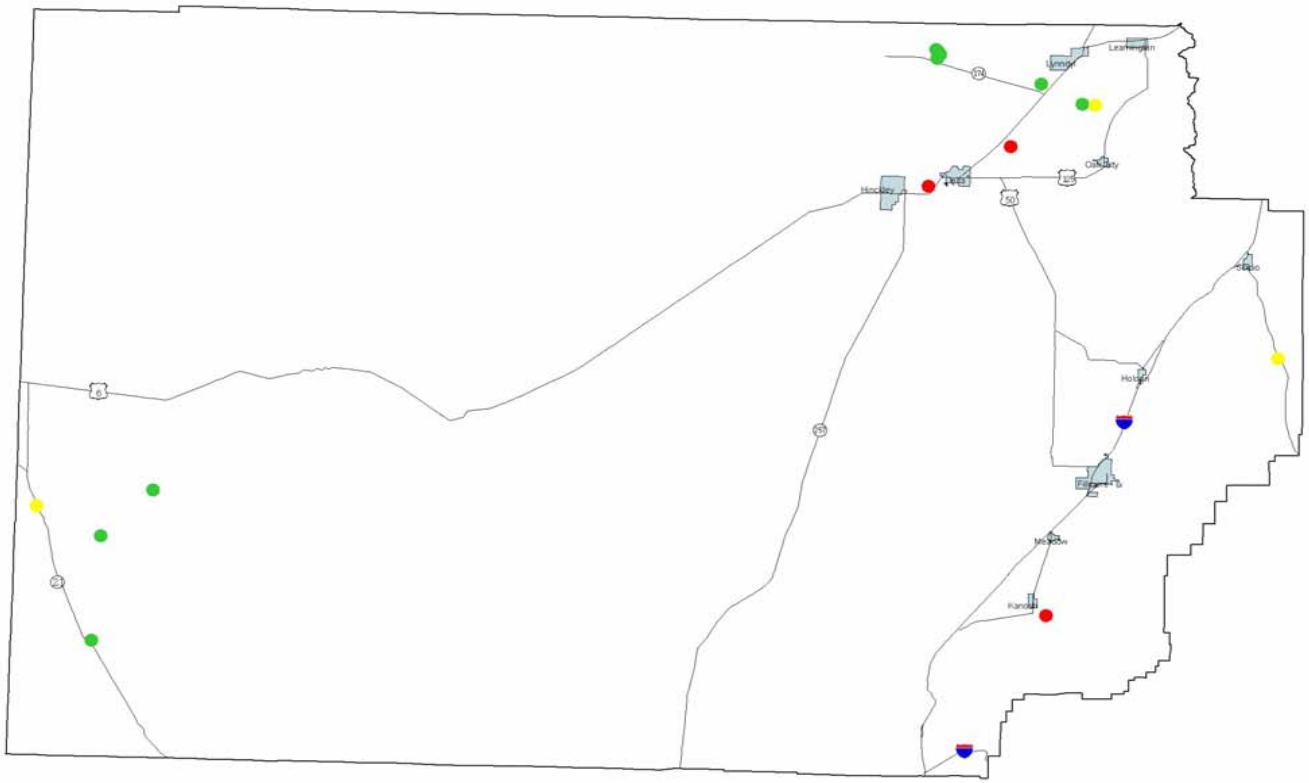
Expansive Soils
Limestone
Silica Dunes
Gypsum Dunes

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC

10 0 10 20 Miles

N
W E
S

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Dams and Impoundment Structures 6.1

Millard County Dams and Impoundment Structures

Major Roads
Cities
County Boundary

Explanation

Dams and Impoundment Structures by Hazard Classification

- HIGH
- MOD
- LOW

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Millard County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Responsible for everyday operations of the county's Emergency Operations Center.

    c. Update and exercise emergency operations and mitigation plans.

    d. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    e. Coordinate the county's Local Emergency Planning Committee (meets every odd-numbered month).

    f. Coordinate the county's Tier Two reporting. (Hazardous materials)

    g. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    h. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    i. Responsible for timely and effective public information releases during emergency situations.

    j. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

    k. Have verbal mutual aid agreements with Juab, Piute, Sanpete, Sevier, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

l. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

m. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the Army Corp of Engineers.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Millard County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Millard County Commissioners, Millard County Road Department, Millard County Sheriff's Office, and various other fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Millard County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, and Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Warning systems and sirens are outdated and inadequate. At this time, funding is not available for improvements.

   c. Millard County is constantly striving to improve planning and exercise activities and response capabilities. However, with the county growing and becoming more industrial, the threat of potential hazards

increases, which increases the need for resources, training, and awareness.

d. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Based on funding, Six County Planning Staff will work with the county to update the General Plan and the zoning ordinances to reflect natural hazard mitigation. Existing zoning requirements for flood plain management need to be enforced.

B. <u>Millard County Highway Department</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Highway Department follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Department of Transportation on various projects since the DOT dispenses federal funding. While the DOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

   c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

   a. <u>Local Agencies</u>: The County Highway Department has little interaction with other county agencies concerning roads and bridges. They do,

however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way purchasing is overseen by the States Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Highway Department coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Millard County Highway Department should assist local government with floodplain management and water development permitting.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the

Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Millard County Emergency Management, local law enforcement agencies (city and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse. For example, radio equipment that belongs to FEMA is based at county emergency management offices; the same could be done with air sampling equipment or other instruments/kits etc., which could be used by public health agencies both for daily work and at a time of emergency or disaster.

D. Millard County Sheriff's Office

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in the county.

   b. Provide standard law enforcement manpower and equipment.

   c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

e. Have mutual aid agreements with all surrounding counties and Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

a. None

3. Leadership and coordination with other government agencies:

a. Local Agencies: Within the scope of law enforcement, the Millard County Sheriff's Office coordinates with various local agencies. These agencies include Millard County Emergency Management.

b. Non-local Agencies: Millard County Sheriff's Office coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

a. None

E. Millard Fire District

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

a. Fund local city fire departments enabling them to respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

b. Enable local fire departments to respond to accidents in order to provide rescue assistance.

c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (first responders)

d. Provide standard firefighting manpower and equipment.

e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of city fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow. Millard Fire District has mutual aid agreements with Juab, Piute, Sanpete, Sevier and Wayne Counties.

l. Inspections and preplanning within the fire district to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the Millard Fire District coordinates with various local agencies. These agencies include Millard County Emergency Management, Millard County Sheriff's Office, Fillmore Fire Department, Delta Fire Department, other local fire departments, local Public Works, and local Emergency Medical Services.

b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

Our district has seen an increase in number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each added type of response increases the need for equipment and the time our volunteers need to spend in training. With the recent decrease in population in our district, volunteer retention and recruitment is also a concern.

a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

b. Explore training options to cover the expanding variety of responses in our district.

c. Look into recruitment and retention programs that will work in our district.

F. Utah State University Extension Service

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural resources, horticulture, family and consumer sciences, 4-H and youth community development.

c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Millard County Emergency Management and Central Utah Public Health.

   b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

   a. None.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Millard County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.

6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 4 -- Piute County

In order to effectively identify and mitigate natural hazards in Piute County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix R* of this plan.

Table 1: Piute County Pre-Disaster Mitigation Planning Team

Name	Representing:
Ryan Horton, Emer. Mgr.	Piute County
Paul Morgan, Commissioner	Piute County
Tarval Torgersen, Commissioner	Piute County
W. Kay Blackwell, Commissioner	Piute County
Joe Dalton, Mayor	Circleville
Rick Dalton, Mayor	Junction
Carlos Jessen, Mayor	Kingston
Gerald James, Mayor	Marysvale
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Piute County

Understanding the past is often the key to discovering what the future hold, this is especially true when planning for natural disasters. The fact that cities within Piute County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Piute County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Piute County Natural Hazard History

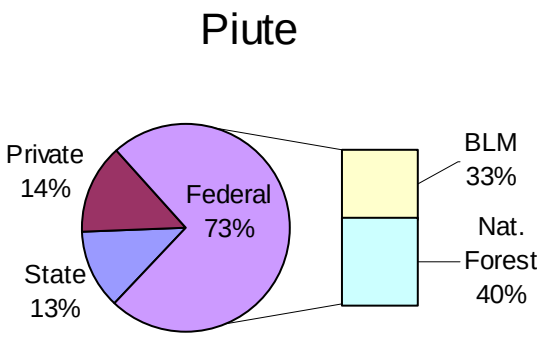
Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	July 7, 1949	Marysvale	Extensive flood damage to highway in Marysvale Canyon.	
Flood	July 18, 1965	Marysvale	U.S. 89 damaged	
Flood	August 6, 1967	Kingston	Highway 22 damaged	Source: Kingston Canyon

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	July 24, 1968	Marysvale	Damage to homes, crops, and U.S. 89.	
Flood Presidential	1983	Marysvale	Damaged roads, bridges, culverts, and agricultural interests.	Source: Kingston, Bullion, and Cottonwood Canyons.
Flood	August 22, 1997	Kingston Canyon	Damage to roads, waterlines, and stream channel.	Source: Monsoonal thunderstorm in Kingston Canyon.
Earthquake	October 4, 1967	Marysvale	Limited damage. U.S. 89 blocked by rock slide in Marysvale Canyon.	Richter Magnitude Scale 5.2.
Earthquake	November 4, 1974	Marysvale	Unknown	Richter Magnitude Scale 3.8
Severe Weather	August 19, 1984	Otter Creek	No Damage	Tornado
Severe Weather	June, 5 1977	Otter Creek Res.	1 death	Lightning Fishing from a small boat

Development Trends

Approximately 67,015 acres or 14% of the total land area in Piute County is privately held and outside the incorporated areas is almost entirely vacant. The other 86% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure 1 helps explain Piute County's development trends.

Figure 1: Land Ownership



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water and county zoning requirements of water access and a minimum of 5 acres per house. Other limitations include steepness of the terrain, flash flood plains and accessibility. There is still plenty of infill within town limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. For example, Marysvale (population, 370) has one of the largest geographic areas within its boundaries in the state. Piute County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Since most of the privately held land is along the relatively safe and accessible US 89 corridor, development is occurring in this general area.

Historically, Marysvale and Kimberly further west were mining towns cashing in on the gold found in the area in the late 19th and early 20th centuries. Kimberly is now a ghost town and Marysvale survives on Agriculture, tourism and services. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. US 89 follows these original trails and serves as a major historical corridor in the state running through the county north to south. This corridor is where future development is likely to happen because of the private lands along this highway. Except for lands adjacent to the Sevier River and Otter Creek and their tributaries, this corridor is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Piute County

Frequency	Possible
Severity	Catastrophic
Location	Ground shaking will be felt throughout the entire county if a large earthquake were to occur. Surface fault rupture could be expected in areas of known historic fault movements. Liquefaction is expected in areas of high to moderate liquefaction potential, which covers a vast portion of Piute County.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Description of Location and Extent

The Six County region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is high; although there is limited risk to population due to the large areas of undeveloped lands those living in the region are at an elevated risk. During historic time the largest recorded earthquake in Piute County has not reached above 5.2 (Marysvale event) on the Richter magnitude scale, yet geologic investigation has determined much larger events have happened in the recent geologic past and could happen in the future. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or the last 1.6 million years. These faults are listed in Table 4 (see Maps 1.1 and 1.2 starting on p.16 of this Annex).

Table 4: Fault Line Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Sevier fault (northern portion)	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Sevier Valley - Marysvale - Circleville area faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Sevier Valley - Marysvale - Circleville area faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Tushar Mountains (east side) fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Sevier Valley fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Paunsaugunt fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Aquarius and Awapa Plateaus faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple

HAZUS MH Vulnerability Assessment

HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Piute County HAZUS MH run is available in *Appendix O.*

Number of people

Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	0
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	0
	Daytime –Major	0
	Daytime- Fatalities	0
	Commute –Minor	0
	Commute –Major	0
	Commute-Fatalities	0

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures	Total Cost in millions of dollars **
Residential	0	0
Commercial	0	0
Industrial	0	0
Totals	0*	0**

*****Includes all building categories with moderate to complete damage

** Structural, non-structural, content, inventory

Infrastructure Types and Amounts

Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	3	3	0	0
EOCs	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	0	0	0	0

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.
A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of one yard.

Table 8: Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	0
Loads (25 tons per load)	0

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	0
People Displaced	0
Value Exposed (mill. $)	0

2. Floods

Table 10: FEMA Hazard Profile for Floods in Piute County

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Piute County's main flooding threat is from snowmelt runoff during spring months.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours where as flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent
Based on the flooding which occurred during the spring of 1983 and 1984 both as a result of rapid snow melt events, experience would suggest these events would appear to be a greater hazard than cloudburst storms. Yet serious hazards could result from either storm. Lands most at risk to flood are adjacent to the Sevier River and Otter Creek and their tributaries, Pine Creek, City Creek, and Rocky Ford Creek. West Canal runs along the western boundary of Circleville and could result in a flood if failure occurs.

Description of type
Precipitation in Piute County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains.

Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather.

Note on Vulnerability Assessment
At this time, data was insufficient to conduct a risk analysis for flood events in Piute County. Flood Insurance Studies were study were applicable to aid in determining risk. However, the current mapping projects being led by the county and state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards

and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters. One of these tools is the new HAZUS MH flood model. Unfortunately, at the current time this model does not work well enough to complete loss numbers for each jurisdiction in the county.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in *Annex 8* and *Appendix R* of this plan. This study looks predominately at jurisdictions which are unmapped or mapped as D zones by the National Flood Insurance Program.

Table 11 is the result of a rough estimate of structures at risk to flooding based on survey results from officials in the area.

Table 11: Structures in Flood Plain

Town Name	**Households in Flood Plain/Cost**
Circleville	40/3,200,000
Junction	No known risk
Kingston	50/4,000,000
Marysvale	40/3,200,000

3. Landslides

Table 12: FEMA Hazard Profile for Landslides in Piute County

Frequency	Likely
Severity	Negligible
Location	Mass wasting in Piute County is located predominately along the canyons along the Tushar Mountains (see Map 3.1 on p.18 of this Annex).
Seasonal Pattern	Landslides most often occur within Piute County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent
The map "Piute County Landslide Map 3.1" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

A large percentage of the landmass within Piute County is historically active landslides. The same can be stated for the four incorporated towns of Marysvale, Junction, Kingston, and Circleville.

Tables 13 and 14 show the number of acres and households at risk from landslides. The extent and cost of damage to roads, railroads, and electric infrastructure are shown in Tables 15, 16, and 17, respectively.

Table 13: Landslide Acres

County Name	Acres of Active landslides	Historically Active Landslides 1847 to Present
Piute	None	180,780

Table 14: Structure Loss and Value as a Percentage of Total Acreage.

Piute County Name	**Acres of Historically Active Landslides 1847 to Present**	**Households Vulnerable to Landslide/Cost***
Circleville	443	17/1,275,000
Junction	2,561	29/2,175,000
Kingston	978	17/1,275,000
Marysvale	1251	29/2,175,000

*Includes value of land.

Table 15: Roads

Name	**Miles**	**Estimated Cost**
Local Neighborhood/local/Piute County street	165.2	398,710,200
State Route 24	3.2	7,723,200
State Route 25	1.9	4,585,650
State Route 62	.7	1,689,450
State Route 153	6.2	14,963,700
US Highway 89	1.6	3,861,600

Table data represents total length of roads, which overlay historically active landslides.

Table 16: Railroads

Railroad	**Miles**	**Estimated Cost**
Railroad	.8	1,930,800

Table 17: Electric Infrastructure

Name	Description	Estimated Cost
KV-46	2.9 Miles	138,000
KV-69	1.5 Miles	72,000
KV-230	9.5 Miles	456,000
KV-345	8 Miles	384,000

4. Wildfire Risk

Table 18: FEMA Hazard Profile for Wildfire in Piute County

Frequency	Likely
Severity	High in the Urban-Wildland Interface.
Location	Entire county except cultivated fields.
Seasonal Pattern	Most wildfires affecting Piute County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	0 to 6 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Piute County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

A moderate fire risk is located around the cities with the only high fire risk located in the northwest section of the county. This fire risk is primarily on federally managed land.

See Map 4.1 on p. 19 of this Annex for a visual display of location and severity of wildfire risk in Piute County. Tables 19-22 show the number of acres and households at different levels of wildfire risk in Piute County.

Table 19: Acres of Wildfire Risk Categories

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Piute	None	2,638	191,489	295,296

Table 20: Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Piute	None/0	4/240,000	291/17,460,000

Table 21: Acres at Risk in Incorporated Piute County*

Town Name	Acres of High	Acres of Moderate
Circleville	None	2638
Junction	None	3367
Kingston	None	1912
Marysvale	None	6626

*No Extreme wildfire risk within Piute County

Table 22: Structures in Wildfire Area

Town Name	Households in Extreme/Cost*	Households in High/Cost*	Households in Moderate/Cost*
Circleville	None/0	None/0	101/6,060,000
Junction	None/0	None/0	37/2,220,000
Kingston	None/0	None/0	33/1,980,000
Marysvale	None/0	None/0	152/9,120,000

*Excludes content value, which would result in an increase of 50% to the values listed.

Tables 23-25 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Piute County.

Table 23: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/Piute County street	74	178,599,000
State Route 62	5	60,337,500
State Route 153	1	2,413,500
US Highway 89	4	9,654,000
US Highway Main	.9	2,172,150

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 24: Railroads

Railroad	Miles	Estimated Cost
Railroad	3.5	8,400,000

Table 25: Electric Substations

Name	Description	Estimated Cost
Circleville	115 KV	10,000,000
Mineral Products	115 KV	10,000,000
Marysvale	115 KV	10,000,000
Dear Trail	PacifiCorp/115 KV	10,000,000
KV-46	25.7 Miles	1,239,000
KV-69	15.8 Miles	762,000
KV-230	16.1 Miles	777,000
KV-345	8.4 Miles	405,000

5. Problem Soils

Table 25: FEMA Hazard Profile for Problem Soils in Piute County

Frequency	Unlikely
Severity	None (0% of jurisdiction affected)
Location	None
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent
Using best available data, there is no hazard relating to problem soils in Piute County (see Map 5.1 on p.20 of this Annex).

6. Dam Failure

Table 26: FEMA Hazard Profile for Dam Failure in Piute County

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

Description of Location and Extent

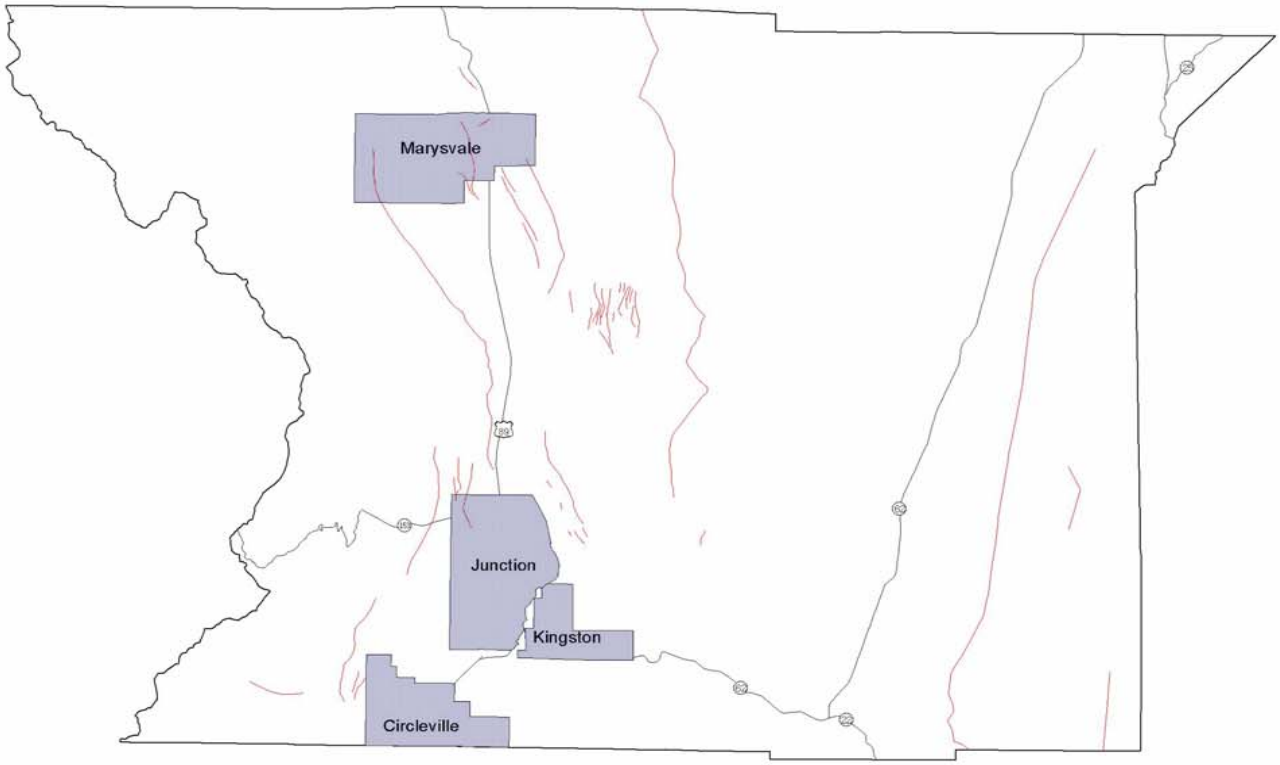
Of the dams located in Piute County only four dam are considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. All dams, regardless of rating should be monitored. It should be noted, dam safety hazard classifications are in the event of dam failure and are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

The State Division of Water Resources, Dam Safety Section indicates there are four high hazard dams within Piute County. Although Piute County is small in both area and population size standards the majority of population lives below and within about thirty miles of the Otter Creek or Piute Dams both of which are considered high hazard (see Map 6.1 on p.21 of this Annex). High hazard dams within Piute County are the following (see Table 27):

- Otter Creek
- Piute
- Upper Beaver Creek
- Lower Beaver Creek

Table 27: High Risk Dams

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Otter Creek	1897	Earth Fill	52660	69000
Piute	1938	Earth Fill	71826	132000
Beaver Creek Upper	1953	Earth Fill	1401	47000
Beaver Creek Lower	1925	Earth Fill	231	15000



Quaternary Faults 1.1

Piute County Quaternary Faults

Major Roads
Cities
County Boundary

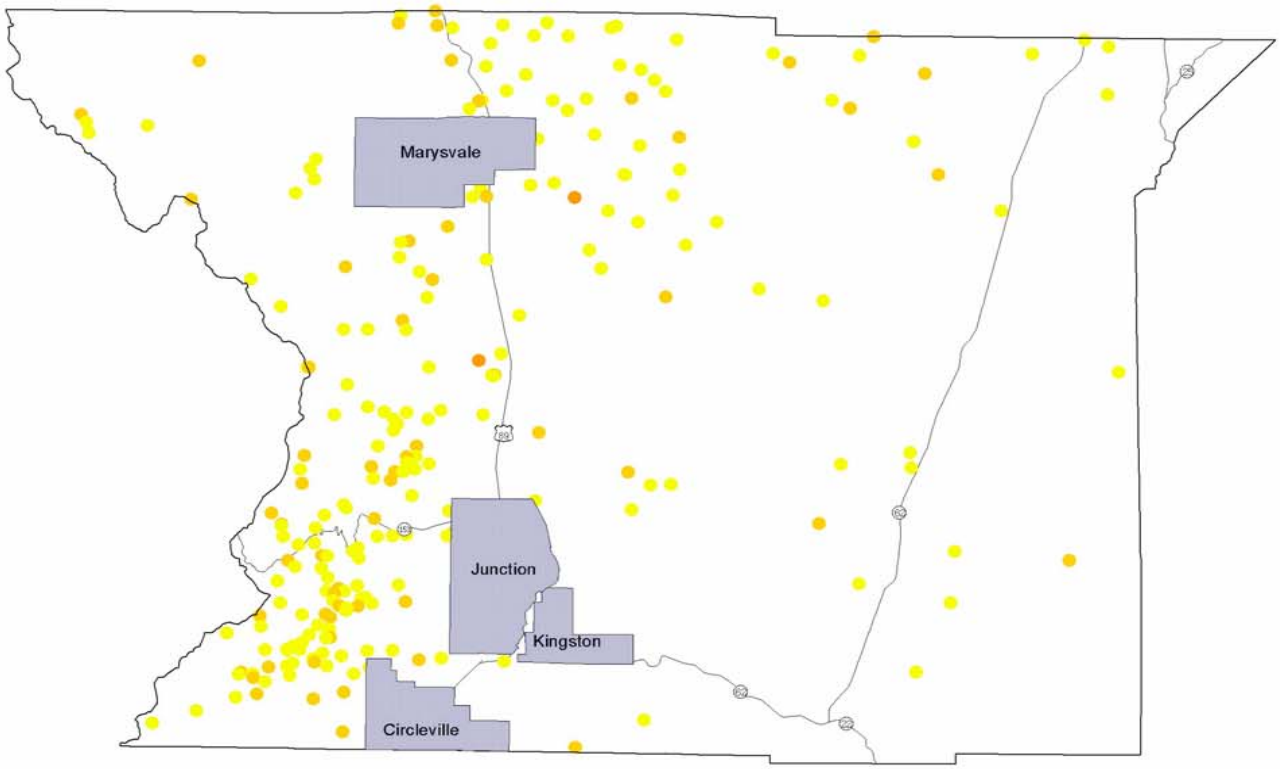
Explanation

Quaternary Faults

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Epicenters 1.2

Piute County Epicenters

Major Roads
Cities
County Boundary

Explanation

Epicenters by Magnitude

- 5 - 7
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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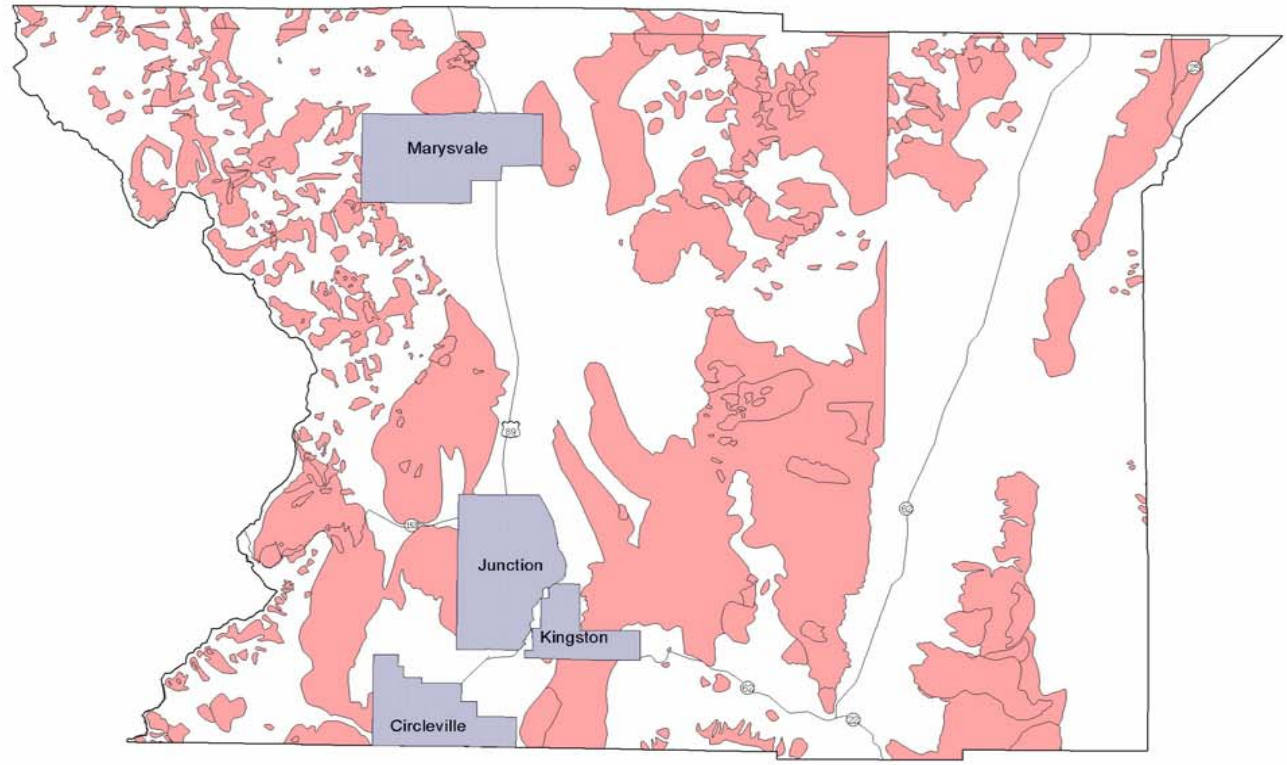

Landslides 3.1

Piute County Landslides

Major Roads
Cities
County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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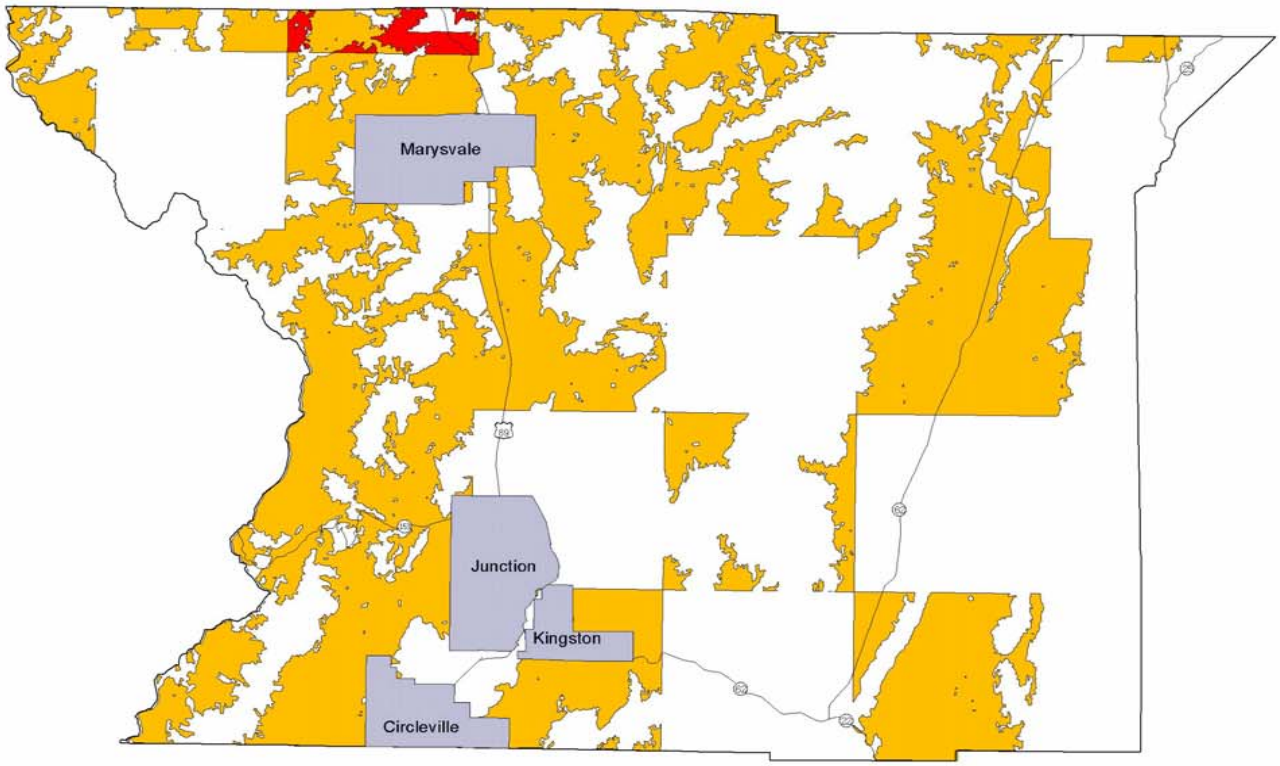
Wildfire Map 4.1

Piute County Wildfire Risk



Major Roads
Cities
County Boundary

Fire Risk Explanation

Extreme
High
Moderate

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

N
W E
S

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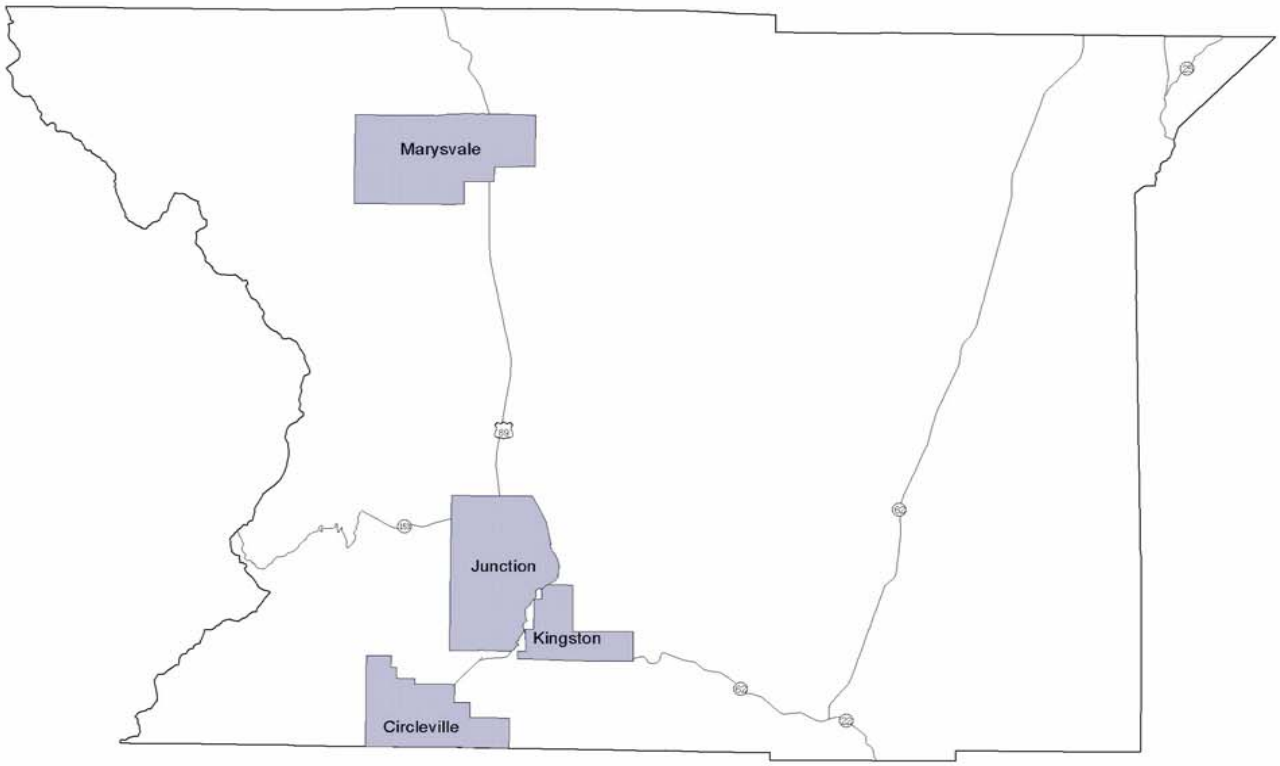


Problem Soil Map 5.1

Piute County
Problem Soil Risk

Piute has no mapped problem soils

Major Roads
Cities
County Boundary

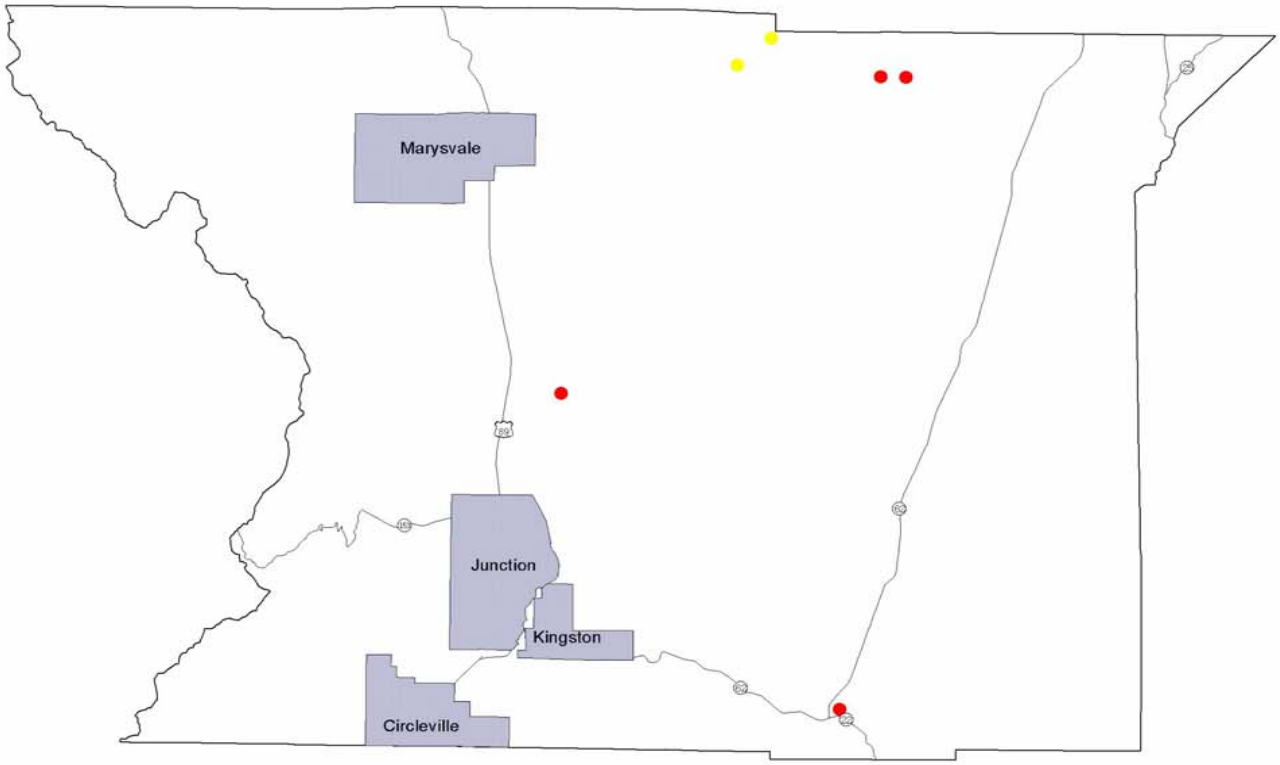
Problem Soil Explanation

Expansive Soils
Limestone
Silica Dunes
Gypsum Dunes

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.



Dams and Impoundment Structures 6.1

Piute County Dams and Impoundment Structures

Major Roads
Cities
County Boundary

Explanation

Dams and Impoundment Structures by Hazard Classification
- HIGH
- MOD
- LOW

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Piute County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Responsible for everyday operations of the county's Emergency Operations Center.

    c. Update and exercise emergency operations and mitigation plans.

    d. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    e. Coordinate the county's Local Emergency Planning Committee. (meets quarterly)

    f. Coordinate the county's Tier Two reporting. (hazardous materials)

    g. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    h. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    i. Responsible for timely and effective public information releases during emergency situations.

    j. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

    k. Have verbal mutual aid agreements with Juab, Millard, Sanpete, Sevier, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

l. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

m. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the Army Corp of Engineers.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Piute County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Piute County Commissioners, Piute County Road Department, Piute County Sheriff Department, and various other law enforcement, fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Piute County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, and Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Warning systems and sirens are outdated and inadequate. At this time, funding is not available for improvements.

   c. Piute County is constantly striving to improve planning and exercise activities and response capabilities.

d. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Based on funding, Six County Planning Staff will work with the county to update the General Plan and the zoning ordinances to reflect natural hazard mitigation. Existing zoning requirements for flood plain management need to be enforced.

B. <u>Piute County Highway Department *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Highway Department follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Utah Department of Transportation (UDOT) on various projects since the UDOT dispenses federal funding. While the UDOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

   c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

   a. <u>Local Agencies</u>: The County Highway Department has little interaction with other county agencies concerning roads and bridges. They do, however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way

purchasing is overseen by the States Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Highway Department coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Piute County Highway Department should assist local government with floodplain management and water development permitting.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Piute County Emergency Management, local law enforcement agencies (Piute County and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse. For example, radio equipment that belongs to FEMA is based at county emergency management offices; the same could be done with air sampling equipment or other instruments/kits etc., which could be used by public health agencies both for daily work and at a time of emergency or disaster.

D. Piute County Sheriff's Department

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in unincorporated areas of the county and in smaller towns that do not have police departments.

   b. Provide standard law enforcement manpower and equipment.

   c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

   d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

e. Have mutual aid agreements with all surrounding counties and the Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of law enforcement, the Piute County Sheriff's Department coordinates with various local agencies. These agencies include Piute County Emergency Management and various local police departments.

   b. Non-local Agencies: Piute County Sheriff's Department coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

   a. None

E. Piute Fire District

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

   b. Respond to accidents in order to provide rescue assistance.

   c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (first responders)

   d. Provide standard firefighting manpower and equipment.

   e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of Piute County fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow. Piute Fire District has mutual aid agreements with Juab, Millard, Sanpete, Sevier and Wayne Counties.

l. Inspections and preplanning within the fire district to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the Piute Fire District coordinates with various local agencies. These agencies include Piute County Emergency Management, Piute County Sheriff's Department, Circleville Fire Department, Marysvale Fire Department, Junction Fire Department, local Public Works, and local Emergency Medical Services.

   b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   Our district has seen an increase in number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each added type of response increases the need for equipment and the time our volunteers need to spend in training. With the recent decrease in population in our district, volunteer retention and recruitment is also a concern.

   a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

   b. Explore training options to cover the expanding variety of responses in our district.

   c. Look into recruitment and retention programs that will work in our district.

F. <u>Utah State University Extension Service *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

   b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural resources, horticulture, family and consumer sciences, 4-H and youth community development.

   c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

   d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

   e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and

wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Piute County Emergency Management and Central Utah Public Health.

   b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

   a. None.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Piute County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.

6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 5 -- Sanpete County

In order to effectively identify and mitigate natural hazards in Sanpete County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix S* of this plan.

Table 8: Sanpete County Pre-Disaster Mitigation Planning Team

Name	Representing:
Kevin Holman, Emer. Mgr.	Sanpete County
Bruce Blackham, Commissioner	Sanpete County
Greg Dettinger, Commissioner	Sanpete County
Claudia Jarrett, Commissioner	Sanpete County
Darwin Jensen, Mayor	Centerfield
Morris Casperson, Mayor	Ephraim
Don Worley, Mayor	Fairview
Shawn Crane, Mayor	Fayette
Scott Collard, Mayor	Fountain Green
Scott Hermansen, Mayor	Gunnison
Kim Anderson, Mayor	Manti
Doug Bjerregaard, Mayor	Mayfield
L. Scott Robertson, Mayor	Moroni
Chesley Christensen, Mayor	Mt. Pleasant
John Thomas, Mayor	Spring City
Steven Thomas, Mayor	Sterling
Byron Davis, Mayor	Wales
Fred Johnson	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Sanpete County

Understanding the past is often the key to discovering what the future holds. This is especially true when planning for natural disasters. The fact that cities within Sanpete County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated, the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Sanpete County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Sanpete County Natural Hazard History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	July 24, 1946	Mount Pleasant	Devastated city damaging homes, businesses, railroad tracks, water lines, livestock, and streets	$500,000 in damage. Flood originated from Mount Pleasant Canyon.
Flood	August 7, 1952	Mount Pleasant	Irrigation systems and farmlands	$10,000 dollars in damage. Flooding from Birch Creek and North Creek
Flood	July 30, 1956	Manti	Farms, irrigation canals, and roads.	Willow Creek
Flood	August 5, 1961	Fountain Green	Farmlands, crops, and fish hatchery.	$31,000 in damage. Flood from Tidds and Log Canyons
Flood	July 17-19, 1965	Ephraim	Damage to roads, canals, and a flood control dam.	Willow Creek
Flood	July 31, 1965	Mount Pleasant/Wales/ Spring City	Roads and culinary water system	$10,000 in damage. Pleasant Creek and Twin Creek.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Presidential	1983	Centerfield, Ephraim, Fairview, Fountain Green, Gunnison, Manti, Mayfield, Moroni, Mount Pleasant, Sterling, and Spring City.	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Source Twelve-mile, Cottonwood, Creeks, Pole Gamit, and Log Canyons, Peacock springs, San Pitch River. Public road damage amounted to $650,000.
Flood Presidential	1984	County wide	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Public assistance totals $1,382,136.
Flood	July 22, 1998	Spring City	Damage to road, bridges, water supply, diversion structures, and 12 homes.	$2.5 million est. damage from Canal and Oak Creeks.
Flood	2002-2003	Clarion, Lone Cedar Road	Damage to structures and road.	Two years in a row.
Earthquake	March 22, 1876	Moroni	Unknown	Richter Magnitude Scale 5.0 with Aftershocks.
Earthquake	November 23, 1904	Manti	Unknown	Richter Magnitude Scale 3.7 with Aftershocks.
Earthquake	November 25, 1904	Manti	Unknown	Richter Magnitude Scale 3.7

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Earthquake	June 4, 1942	Moroni	Unknown	Richter Magnitude Scale 4.3
Earthquake	November 4, 1948	Manti	Unknown	Richter Magnitude Scale 4.3
Earthquake	April 16, 1961	Ephraim	Limited damage	Richter Magnitude Scale 5.0 with Aftershocks.
Earthquake	January 16, 1968	Fayette	Unknown	Richter Magnitude Scale 3.5 with Aftershocks.
Severe Weather	August 25, 1963	Manti/Ephraim	Crop damage	Heavy rain, hail, and wind damage.
Severe Weather	June 16, 1955	Fayette	Roof, tree, and crop damage	Tornado $5,000 in damage
Severe Weather	June 16, 1955	Fayette	No Damage	Tornado
Severe Weather	August 28, 1964	Gunnison	Broken windows, chicken coop destroyed, and two automobiles damaged	Tornado $2,000 in damage
Severe Weather	August 15, 1984	Manti	Broken fence	Tornado
Severe Weather	May 24, 2000	Gunnison	Minor damage	Tornado F0
Severe Weather	August 8, 2001	Fairview	No Damage	Tornado
Severe Weather	September 8, 2002	Centerfield	No Damage	Tornado F0
Severe Weather	September 8, 2002	Manti	Large amount of damage to homes, trees, and automobiles.	Tornado F2 (see Picture 1 below table) estimated damage $2,000,000.
Severe Weather	August 25, 1956	Manti	1 death	Lightning Bailing straw

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Severe Weather	August, 1957	Mount Pleasant	1 death	Lightning Herding sheep
Severe Weather	June 1, 1963	Indianola	1 death	Herding sheep

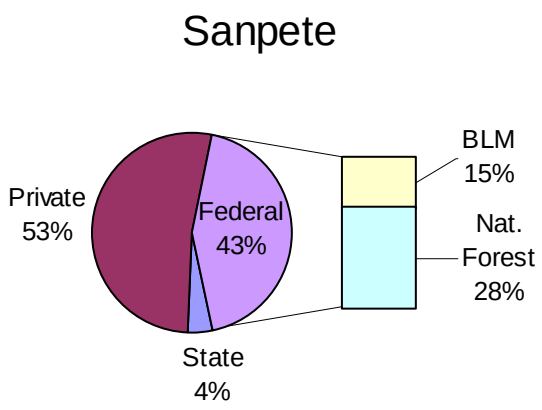
(Source: History of Sanpete County, Utah State Historical Society.)

Picture 1, September 8, 2002--Manti, Utah

Development Trends

Approximately 727,057 acres or 53% of the total land area in Sanpete County is privately held and outside the incorporated areas is almost entirely vacant. The other 47% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure 1 helps explain Sanpete County's development trends.

Figure 1: Land Ownership



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water and county zoning requirements of water access and a minimum of 5 acres per house. Other limitations include steepness of the terrain, flash flood plains and accessibility. There is still plenty of infill within city limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. Sanpete County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Since most of the privately held land is along the relatively safe US 89 corridor, development is occurring in this general area. The railroad spur from Juab County will go through Sanpete County as it is routed into Sevier County. This will be a major development adjacent to Gunnison and Fayette when it is completed.

Historically and today, agriculture plays a huge part in the economy of Sanpete County. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. Later roads and US 89 followed this north-south route, which is an important historical corridor in the state and nation. This corridor is where future development is likely to happen because of the private lands along this major highway. Except for lands adjacent to the San Pitch and Sevier Rivers and their tributaries, this corridor is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Sanpete County

Frequency	Possible
Severity	Catastrophic
Location	Ground shaking will be felt throughout the entire county if a large earthquake were to occur. Surface fault rupture could be expected in areas of known historic fault movements. Liquefaction is expected in areas of high to moderate liquefaction potential, which covers a vast portion of Sanpete County.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Description of Location and Extent

The Six County region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is high; although there is limited risk to population due to the large areas of undeveloped lands those living in the region are at an elevated risk. During historic time the largest recorded earthquake in Sanpete County has not reached above 5.0 on the Richter magnitude scale, yet geologic investigation has determined much larger events have happened in the recent geologic past and could happen in the future. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or the last 1.6 million years: These faults are listed in Table 4 (see Maps 1.1 and 1.2 starting on p.23 of this Annex).

Table 4: Fault Line Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Wasatch fault zone - Levan section	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Sectioned
Wasatch fault zone - Fayette section	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Sectioned
Wasatch fault zone - Fayette section	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Sectioned
Gooseberry graben	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Gunnison fault	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Gunnison fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Japanese and Cal Valleys faults	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Japanese and Cal Valleys faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Valley Mountains monocline	Quaternary (<1,600,000 years)	NA	Suspected

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Wasatch monocline	Quaternary (<1,600,000 years)	NA	Suspected
White Mountain area faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Snow Lake graben	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Joes Valley fault zone west fault	Latest Quaternary (<15,000 years)	0.2 - 1 mm/yr	Simple
Joes Valley fault zone west fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Joes Valley fault zone intragraben faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple

HAZUS MH Vulnerability Assessment

HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Sanpete County HAZUS MH run is available in *Appendix O.*

Number of people

Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	143
	Nighttime –Major	3
	Nighttime -Fatalities	7
	Daytime –Minor	140
	Daytime –Major	5
	Daytime- Fatalities	9
	Commute –Minor	128
	Commute –Major	4
	Commute-Fatalities	8

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures	Total Cost in millions of dollars **
Residential	558	125.59
Commercial	18	19.44
Industrial	5	8.76
Totals	2,911*	167.39**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Infrastructure Types and Amounts
Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	2	2	0	0
Schools	13	0	0	0
EOCs	0	0	0	0
Police Stations	5	0	0	0
Fire Stations	1	0	0	1

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 8: Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	110
Loads (25 tons per load)	4,400

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

2. Floods

Table 10: FEMA Hazard Profile for Floods in Sanpete County

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Sanpete County's main flooding threat is from flash floods from heavy monsoonal rains.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours where as flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent
The population of Sanpete County is primarily located within the Sanpete Valley, which is boarded on the east by the Wasatch Plateau and to the west by the San Pitch Mountains. Thus the Sanpete Valley is topographically low heightening residents risk to spring snowmelt flooding, coming from high mountain snow pack. Typical western settlement patterns exist through Sanpete County mean people originally settled along area water sources at the mouths of mountain canyons. Thus streams running through population centers and alluvial fan development are quite common.

Incorporated areas within Sanpete County and the streams, which cause flooding problems, are listed below.

Manti:
Manti Creek (floods on occasion)
Ephraim:
Ephraim Creek (floods on occasion)
Mt. Pleasant:
Pine Creek/Twin Creeks (floods often)
Pleasant Creek (floods on occasion)
Fairview:
Cottonwood Creek (moderate, unless blocked by landslide)
San Pitch River (minor)
Fountain Green:
Log Canyon Creek
Uinta Creek
Gemmett Creek
Gunnison:
San Pitch (Moderate to Major)

Spring City:
Oak Creek
Canal Creek (floods often)
Sterling:
Six Mile Creek (minor)
Wales:
Wales Canyon Creek (minor)
Mayfield:
1997. Twelve Mile Creek (moderate through The Order, is part of Mayfield) otherwise minor. Landslides or logjams could aggravate the flood threat.
Centerfield:
1997. No main stream. Sevier and San Pitch River are closest, not threatening.
No serious flood threat, local runoff could be a problem.
Moroni:
1997. San Pitch River (just the corner of town; moderate).
Fayette:
There is a wash (Warm Creek, where a spring is located; minor) (Fayette Creek runs through the middle of town and is generally dry; small watershed; minor) that comes through Fayette that has some flood potential. It may not be named. The Sevier River is nearby but generally poses no flood threat to Fayette.

History
The floods of 1983 and 1984 were especially devastating for Sanpete County residents. Total economic loss to cities and the county exceeded $1 million in 1983 and nearly $500,000 in 1984. Floodwaters from these events destroyed many bridges, culverts, water lines, and sewer lines with in Sanpete County.
Spring City
Historic Spring City has faced floods since its earliest times, but the "old timers" describe floods of their memories back to 1934, when a severe snowmelt flood inundated Spring City for about two weeks. Another snowmelt flood struck the city in 1952 and again in 1983. A flash flood on Canal Creek just two years ago destroyed a county bridge. Numerous landslides formed above both Canal Creek and Oak Creek in 1983 and continue to threaten Spring City.

THE FLASH FLOODS OF JULY 22 - 27, 1998:
Monsoonal storms concentrated on Sanpete County, Utah, from July 22 through July 27, 1998, producing flash flooding that resulted in an estimated $2.5 million in damages at historic Spring City (pop. 900; additional affected county pop. 200). Evacuations were implemented for both main events. The flood of July 22 began on Canal Creek at about 5:00 p.m. and began to subside at about 10:00 p.m. The flood of July 27 occurred on both Canal and Oak Creeks about 7:00 p.m. and lasted into the morning hours. Long-time residents indicate that this was the greatest flooding experienced to-date by the community. Two main flood events occurred five days apart, with numerous lesser but frightening intervening events. For example, on July 24, a storm settled again into the Canal Creek watershed. It began raining on Horseshoe Mountain about 6:00 p.m. The city was filling sandbags at 7:00 p.m. and residents of the south end of town were

evacuated. About 7:30 p.m., residents of the alluvial fan had to “scatter the water” to different ditches because the water had already risen. Fortunately, the storm passed rapidly across and damaging flooding was alleviated.

No storm frequencies could be determined for these events because the area lies on the fringes of both the Salt Lake City and Cedar City Doppler Radar systems. At nearby Manti, one storm on July 24 dropped 0.81 inches of rain in 45 minutes equaling a 100-year storm event (State Climatologist data). Still, in contrast, on July 22, only 0.26 inches of rain was measured in Spring City, when the main Canal Creek Flood occurred; no figures are available for rainfall in the that watershed. High water marks and stream gradients allowed for estimates of flash flood surges (possibly not sustained flows), which reached discharges of about 2,500 cfs on Canal Creek, which flows across the south side of Spring City, and of 2,400 - 4,000 cfs on Oak Creek, which passes across the north side of Spring City. The causes of such amazing flows, likely surges, seems to have been major log jams within each canyon which left “debarked” logs perched 15 feet above stream banks high in Canal Creek Canyon (Temple Fork). Canal Creek has never had a stream gage, and, therefore, very little is known about historic discharges there. A U.S. Geological Survey stream gage at the mouth of Spring City Canyon (Oak Creek), abandoned in 1992 due to State funding cutbacks, suggests that a 100-year flood should produce some 400 cfs, which could have been equivalent to the sustained flows.

The floods of July 22nd and 27th on Canal Creek and then on the 27th on Oak Creek were described in similar terms by local residents as coming in viscous muddy surges that filled the channel immediately to a depth of four feet, then spread laterally across fields toward the city. The muddy mix had the consistency of soupy concrete or cake mix. Moving across the fields, the thick mud tumbled a debris-front of logs and boulders, stacking frequently to a depth of four or five feet, then shifting to other directions of flow. Mud depths of 10-12 feet were reported during the forward movement of the flood. Through this process, the debris flood spread across a width of about 1,000 feet, causing the emergency evacuation of the south end of town on the 22nd (Canal Creek), and then evacuations of both the south and north ends of town on the 27th (both Canal Creek and Oak Creek). On the 27th, twelve homes were reported damaged, the cities water supply system was damaged, losing two of three sources, causing restricted culinary water use throughout the community. Two county bridges were destroyed by major log jams and impacts from massive amounts of large boulders and two main diversion structures also used historically for flood control purposes, a hydro-diversion, and other diversions were destroyed or damaged. The city lost its only flood control systems on Canal Creek in both floods, causing a rush to restore flood control before the next storm. The city is repeating, for the second time in two weeks, spending an average of $25,000 per day for emergency cleanup and repairs; more monsoonal storms are forecast for the coming week.

At the present time, channel capacities are greatly diminished in both Canal and Oak Creeks. The historic city of Spring City is presently at much risk and the next monsoonal storm over the area could cause substantial additional damage to the city. While cities across the nation make great efforts to protect historic structures, efforts must be made

here to protect an entire historic community. This requires special considerations at all levels of government, not only for disaster recover, but also for flood hazard mitigation.

Note on Vulnerability Assessment

At this time, except for the Spring City area, data was insufficient to conduct a full risk analysis for flood events in Sanpete County. However, the current mapping projects being led by the county and by the state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in *Annex 8* and *Appendix S* of this plan. This study looks predominately at jurisdictions which are unmapped or mapped as D zones by the National Flood Insurance Program.

3. Landslides

Table 11: FEMA Hazard Profile for Landslides in Sanpete County

Frequency	Likely
Severity	Moderate
Location	Mass wasting in Sanpete County is located predominately along the Canyon's east of the Sanpete Valley and in the mountains and foothills between Fairview and Fountain Green (see map 3.1 on p.25 of this Annex; No data available south of Spring City in Sanpete County).
Seasonal Pattern	Landslides most often occur within Sanpete County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent
The map "Sanpete County Landslide Map 3.1" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

Very little land in Sanpete County is affected by landslides according to the GIS data layer a composite of landslide maps put together by Kimm M. Harty of the Utah Geologic and Mineral Survey in 1991. Yet this map exhibits features suggesting the southern half of Sanpete County has not been mapped. Thus, the results that follow most likely are low estimates.

Tables 12 and 13 show the number of acres and households at risk from landslides. The extent and cost of damage to roads and electric infrastructure are shown in Tables 14 and 15, respectively.

Table 12: Acres of Landslides

County Name	Acres of Active landslides	Historically Active Landslides 1847 to Present
Sanpete	997	65,398

Table 13: Structure Loss and Value as a Percentage of Total Acreage

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost*
Fountain Green	1	1/95,000

*Includes value of land.

Table 14: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	153.3	369,989,550
State Route 31	4.8	11,584,800
State Route 132	.2	482,700

Table 14 data represents total lengths of roads, which overlay historically active landslides.

Railroads

This vulnerability analysis using best available data found no railroad track at risk in Sanpete County.

Table 15: Electric Infrastructure

Name	Description	Estimated Cost
KV-46 Line	3.8 Miles	183,000
KV-138 Line	.3 Miles	14,400
KV-345 Line	1.5 Miles	72,000

4. Wildfire Risk

Table 16: FEMA Hazard Profile for Wildfire in Sanpete County

Frequency	Likely
Severity	High in the Urban-Wildland Interface.
Location	Entire county except cultivated grounds.
Seasonal Pattern	Most wildfires affecting Sanpete County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	0 to 6 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Sanpete County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Wildfire Risk per the GIS data details an area of high wildfire risk along the north east boundary of Manti City. The North Sanpete Fire Council gave additional input on wildfire risk in Sanpete County. This council came together because of a high wildfire risk in the subdivisions of Hideaway Valley, Blackhawk Estates, Indian Ridge, Panorama Woods, Fairview Ranchos, and Indianola. The Council produced the North Sanpete County Regional Fire Plan for the wildland/urban interface. This document containing a detailed look at risk as well as mitigation can be found in *Appendix F*.

See Map 4.1 on p. 26 of this Annex for a visual display of location and severity of wildfire risk in Sanpete County. Tables 17-20 show the number of acres and households at different levels of wildfire risk in Sanpete County.

Table 17: Acres at Risk in Unincorporated County

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Sanpete	None	25,521	221,920	777,393

Table 18: Households at Risk in Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Sanpete	None/0	197/14,972,000	1,710/129,960,000

Table 19: Acres at Risk in Incorporated Sanpete County*

City Name	Acres of High	Acres of Moderate
Centerfield	None	None
Ephraim	None	298
Fairview	None	None
Fayette	None	None
Fountain Green	None	1
Gunnison	None	203
Manti	128	None
Mayfield	None	22
Moroni	None	2
Mt. Pleasant	None	3
Spring City	None	None
Sterling	None	None
Wales	None	48

*No Extreme wildfire risk within Sanpete County

Table 20: Structures in Wildfire Area

City Name	Households in Extreme/Cost*	Households in High/Cost*	Households in Moderate/Cost*
Centerfield	None/0	None/0	No known risk
Ephraim	None/0	None/0	166/12,616,000
Fairview	None/0	None/0	None/0
Fayette	None/0	None/0	None/0
Fountain Green	None/0	None/0	None/0
Gunnison	None/0	None/0	32/2,432,000
Manti	None/0	104/7,904,000	None/0
Mayfield	None/0	None/0	6/456,000
Moroni	None/0	None/0	1/76,000
Mt. Pleasant	None/0	None/0	2/152,000
Spring City	None/0	None/0	None/0
Sterling	None/0	None/0	None/0
Wales	None/0	None/0	21/1,596,000

*Excludes content value, which would result in an increase of 50% to the values listed.

Tables 21-23 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Sanpete County.

Table 21: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	1,310	3,161,685,000
State Route 28	4.8	11,584,800
State Route 29	15	36,202,500
State Route 31	1.6	3,861,600
State Route 132	1.5	3,620,250
State Route 137	.1	241,350
State Route 264	.3	724,050
US Highway 89	17.3	41,753,550

Table 21 data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 22: Railroads

Railroad	Miles	Estimated Cost
Railroad	.2	480,000

Table 23: Electric

Name	Description	Estimated Cost
Moroni Substation	115 KV	10,000,000
Interconnection Point	Near Mt. Pleasant	TBD
Interconnection Point	Near Ephraim	TBD
KV-46 Line	22.1 miles	1,068,000
KV-138 Line	1.2 miles	57,000
KV-345	28.6 miles	1,380,000

5. Problem Soils

Table 24: FEMA Hazard Profile for Problem Soils in Sanpete County

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Typically occur at the valley's boundary with foothills.
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent
The greatest hazard from problem soils is Limestone near Fairview, Ephraim, and Manti (see Map 5.1 on p.27 of this Annex).

6. Dam Failure

Table 25: FEMA Hazard Profile for Dam Failure in Sanpete County

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

Description of Location and Extent

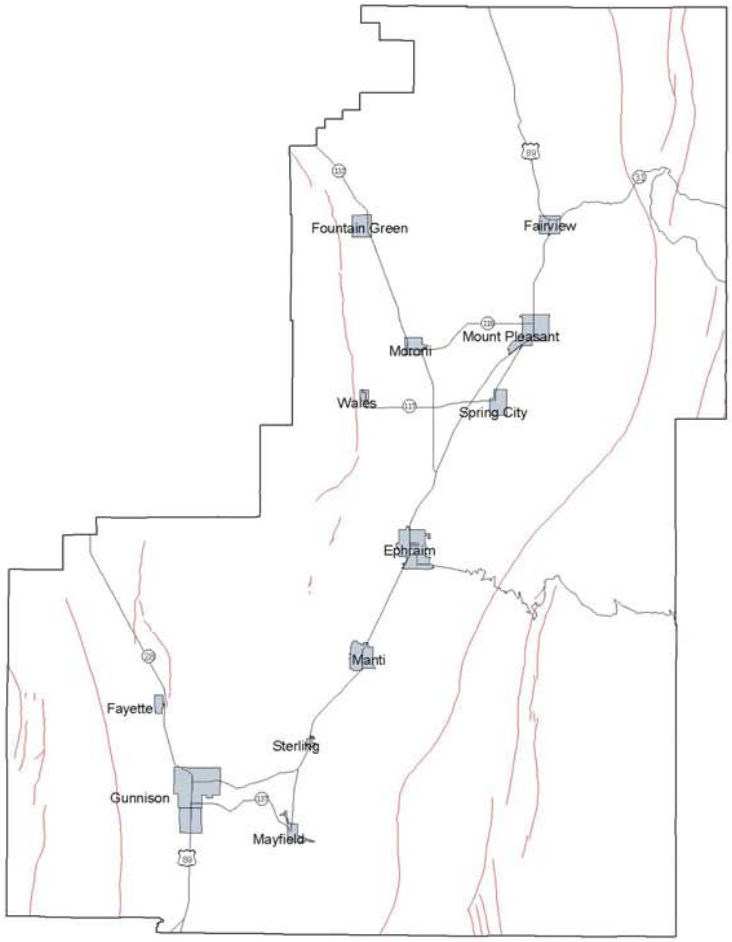
Of the dams located in Sanpete County seven dam are considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. All dams, regardless of rating should be monitored. It should be noted that dam safety hazard classifications are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

The areas of greatest danger to dam failure are south of Ninemile Dam (near Sterling), west of Dairy Dam and Palisades Lake Dam (both near Sterling), south of Fairview Lake Dam (in the mountains east of Fairview), east of Huntington and Rolfson Dams (both in the mountains east of Fairview), and north of Gunnison Dam (near Gunnison). See Map 6.1 on p.28 of this Annex. High hazard dams within Sanpete County are the following (see Table 26):

- Ninemile
- Dairy Dam
- Fairview Lake
- Palisades Lake
- Huntington
- Rolfson
- Gunnison

Table 26: High Risk Dams

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Dairy Dam	2000	Earth Fill	167	TBD
Fairview Lake	1869	Earth Fill	1949	18000
Ninemile	1900	Earth Fill	3500	57000
Palisades Lake	1899	Earth Fill	780	8000
Huntington	1949	Earth Fill	5616	60000
Rolfson	1934	Earth Fill	900	20000
Gunnison	1889	Earth Fill	18218	24000



Quaternary Faults 1.1

Sanpete County Quaternary Faults

Major Roads
Cities
County Boundary

Explanation

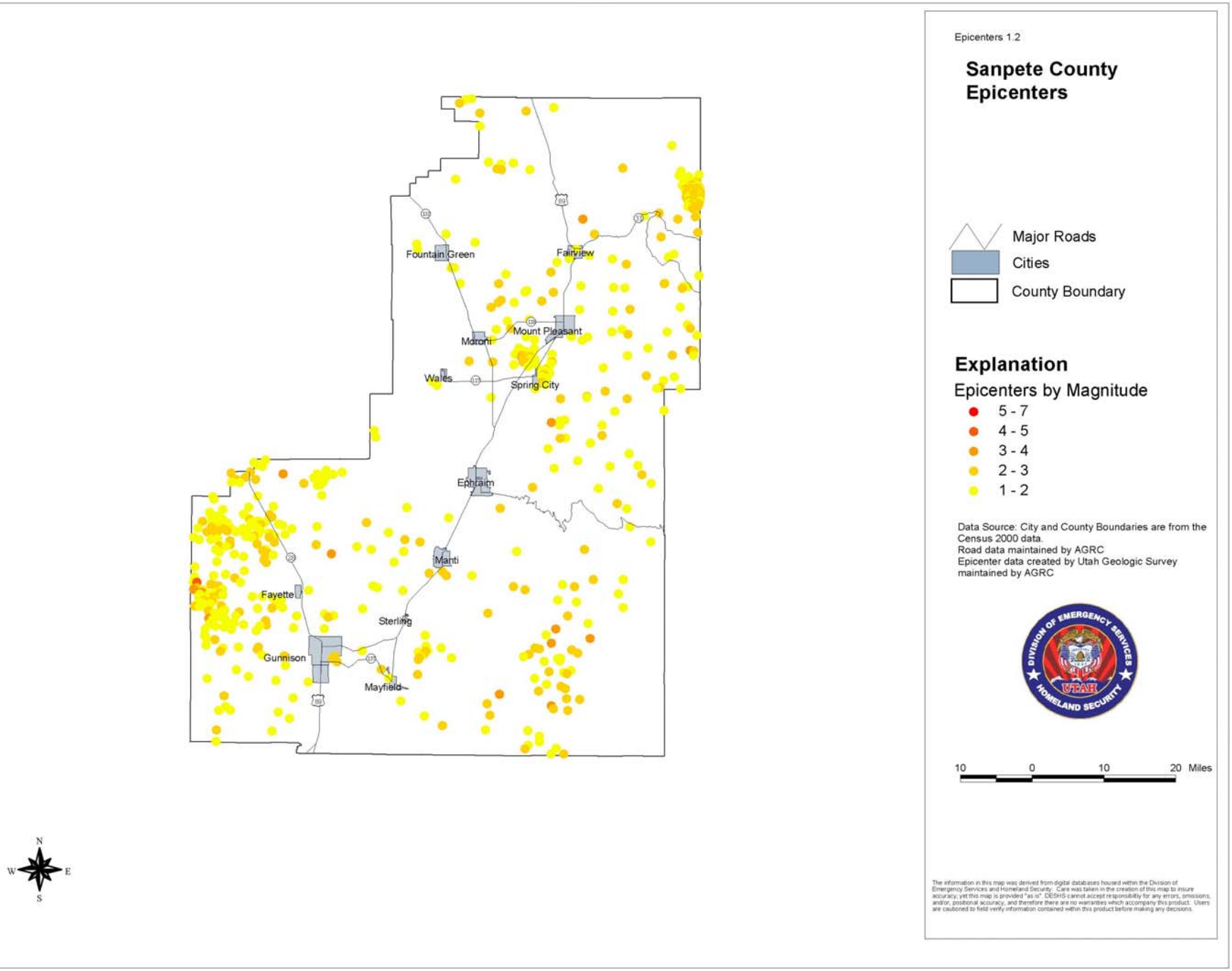
Quaternary Faults

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

N W E S


Epicenters 1.2
Sanpete County Epicenters
Fountain Green
Fairview
Mount Pleasant
Moroni
Wales
Spring City
Ephraim
Manti
Fayette
Sterling
Gunnison
Mayfield
Major Roads
Cities
County Boundary
Explanation
Epicenters by Magnitude
5 - 7
4 - 5
3 - 4
2 - 3
1 - 2
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES
UTAH
HOMELAND SECURITY
10 0 10 20 Miles
N
W
E
S
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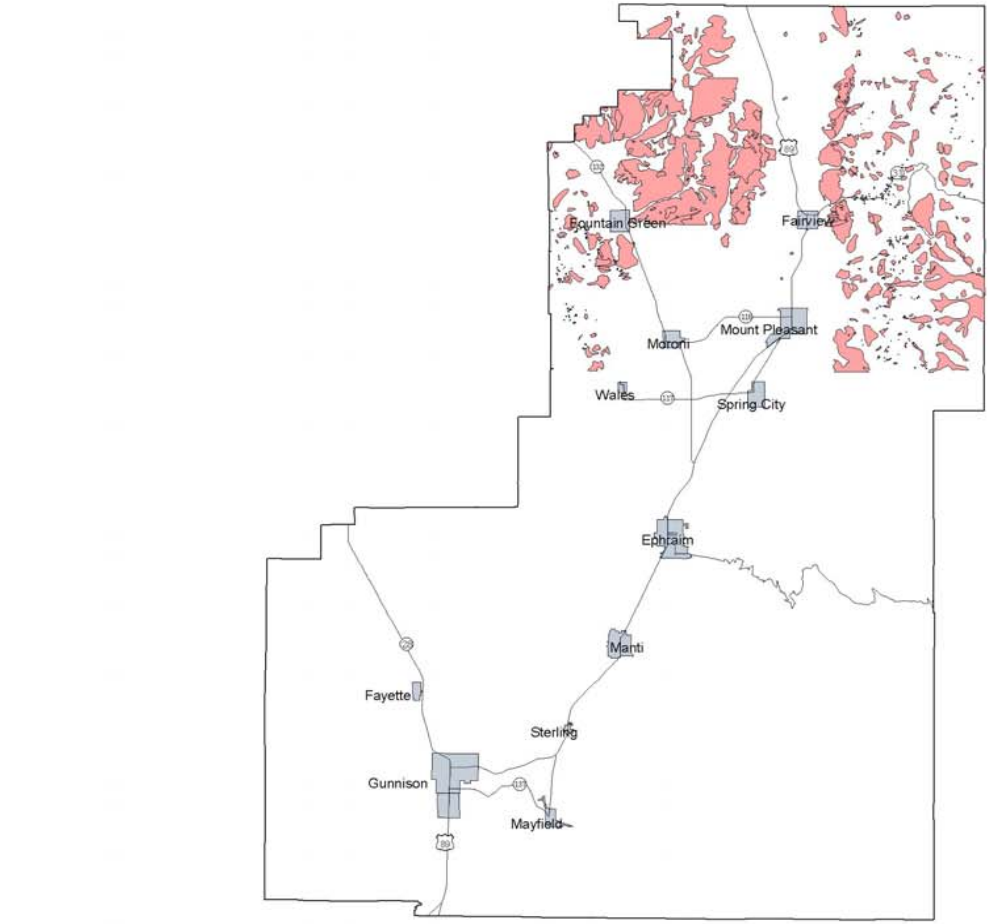

Landslides 3.1

Sanpete County Landslides

Major Roads
Cities
County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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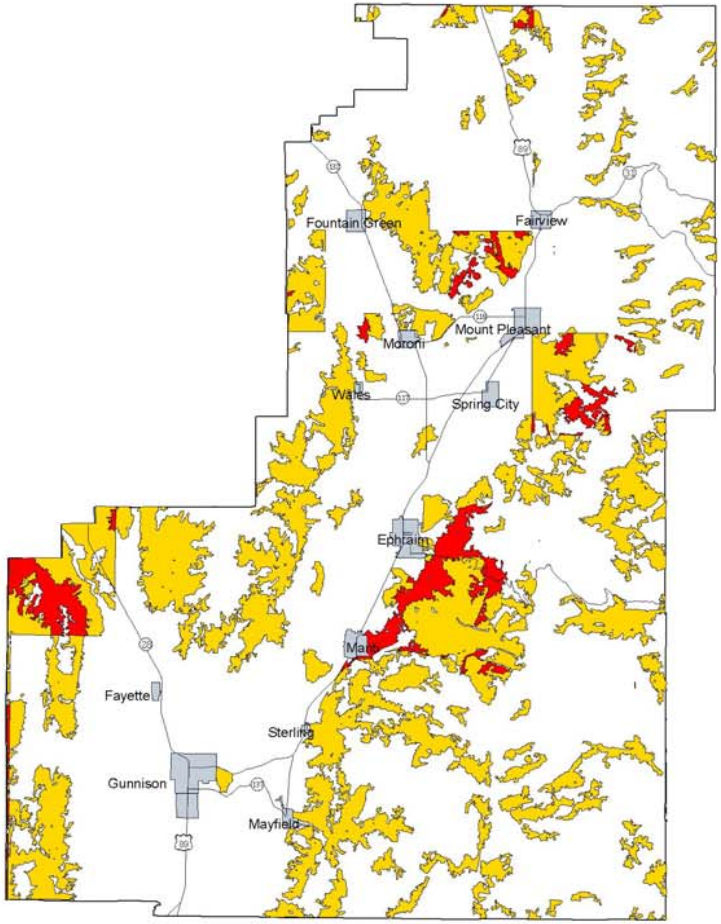
Wildfire Map 4

Sanpete County Wildfire Risk



Major Roads
Cities
County Boundary

Fire Risk Explanation

Extreme
High
Moderate

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

N
W E
S

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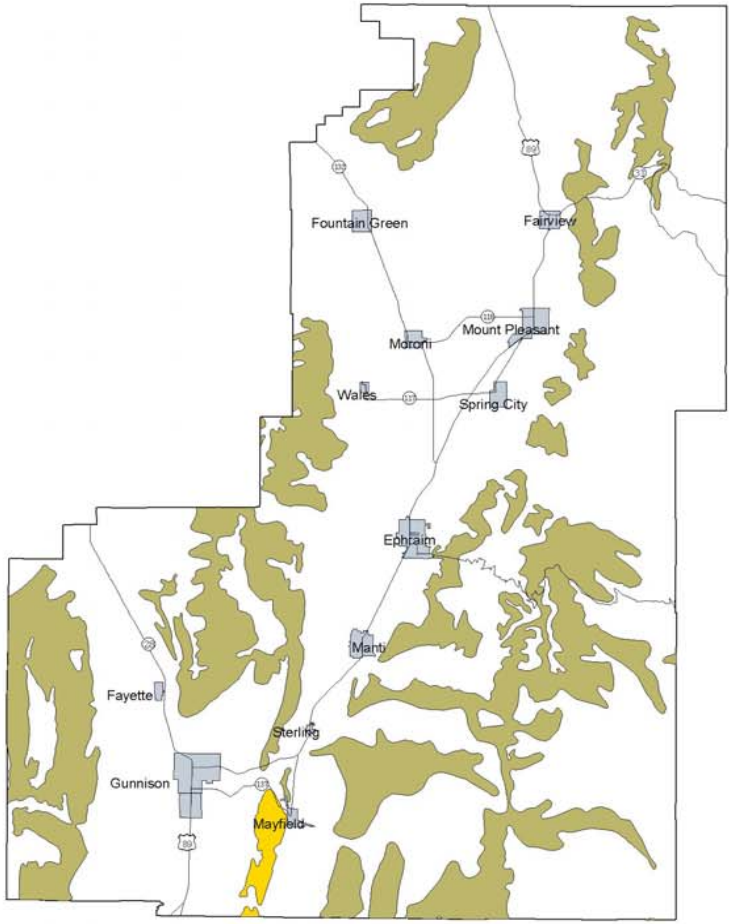

Problem Soil Map 5.1

Sanpete County Problem Soil Risk

Major Roads
Cities
County Boundary

Problem Soil Explanation

Expansive Soils
Limestone
Silica Dunes
Gypsum Dunes

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC

10 0 10 20 Miles

N W E S

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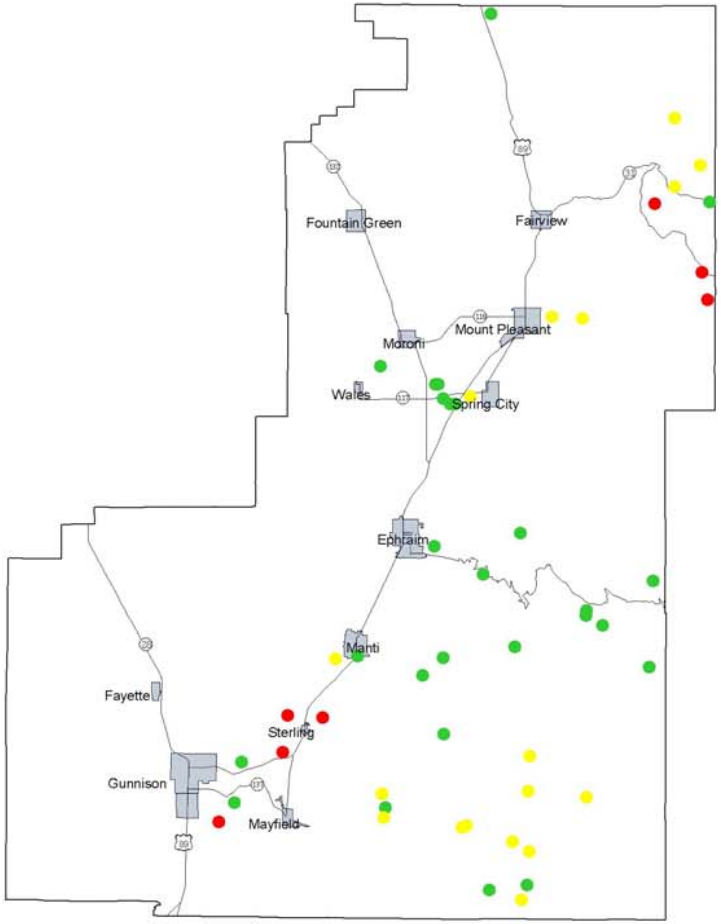


Dams and Impoundment Structures 6.1

Sanpete County Dams and Impoundment Structures

Major Roads
Cities
County Boundary

Explanation

Dams and Impoundment Structures by Hazard Classification
- HIGH
- MOD
- LOW

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Sanpete County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Responsible for everyday operations of the county's Emergency Operations Center.

    c. Update and keep Emergency Operations Center at operational readiness.

    d. Update and exercise emergency operations and mitigation plans.

    e. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    f. Coordinate the county's Local Emergency Planning Committee. (meets eight times annually)

    g. Coordinate the county's Tier Two reporting. (hazardous materials)

    h. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    i. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    j. Responsible for timely and effective public information releases during emergency situations.

    k. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

l. Have verbal and/or written mutual aid agreements with Juab, Millard, Piute, Sevier, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

m. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

n. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the Army Corp of Engineers.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Sanpete County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Sanpete County Commissioners, Sanpete County Road Operations, Sanpete County Sheriff's Office, Sanpete County Recorder, Sanpete County Clerk, Sanpete County Building Inspector Operations, Sanpete County Auditor, Emergency Medical Service, Sanpete County Fire Department, Sanpete County Economic Development Office and various other law enforcement, fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Sanpete County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, Federal Emergency Management Agency, and the Natural Resources Conservation Service.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Sanpete County is constantly striving to improve planning and exercise activities and response capabilities. However, with the county growing and becoming more industrial, the threat of potential hazards increases, which increases the need for resources, training, and awareness.

   c. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Based on funding, Six County Planning Staff will work with the county to update the General Plan and the zoning ordinances to reflect natural hazard mitigation. Existing zoning requirements for flood plain management need to be enforced.

B. <u>Sanpete County Road Operations *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Road Operations follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Department of Transportation on various projects since the DOT dispenses federal funding. While the DOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

a. Local Agencies: The County Road Operations has little interaction with other county agencies concerning roads and bridges. They do, however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way purchasing is overseen by the States Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Road Operations coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Sanpete County Road Operations should assist local government with floodplain management and water development permitting.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

   a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Sanpete County Emergency Management, local law enforcement agencies (city and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse. For example, radio equipment that belongs to FEMA is based at county emergency management offices; the same could be done with air sampling equipment or other instruments/kits etc., which could be used by public health agencies both for daily work and at a time of emergency or disaster.

D. Sanpete County Sheriff's Office

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in unincorporated areas of the county and in smaller towns that do not have police departments.

b. Provide standard law enforcement manpower and equipment.

c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

e. Have mutual aid agreements with all surrounding counties and the Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of law enforcement, the Sanpete County Sheriff's Office coordinates with various local agencies. These agencies include Sanpete County Emergency Management and various local police departments.

   b. Non-local Agencies: Sanpete County Sheriff's Office coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

   a. None

E. Sanpete Fire District

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

   b. Respond to accidents in order to provide rescue assistance.

c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (first responders)

d. Provide standard firefighting manpower and equipment.

e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of city fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow. Sanpete Fire District has mutual aid agreements with Juab, Millard, Piute, Sevier and Wayne Counties.

l. Inspections and preplanning within the fire district to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the Sanpete Fire District coordinates with various local agencies. These agencies include Sanpete County Emergency Management, Mt Pleasant Police Department, Moroni Police Department, Sanpete County Sheriff's Office, Mt Pleasant Fire Department, Manti Fire Department, Ephraim Fire Department, Gunnison Fire Department, other local police and fire departments, local Public Works, and local Emergency Medical Services.

   b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   Our district has seen an increase in number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each added type of response increases the need for equipment and the time our volunteers need to spend in training. With the recent decrease in population in our district, volunteer retention and recruitment is also a concern.

   a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

   b. Explore training options to cover the expanding variety of responses in our district.

   c. Look into recruitment and retention programs that will work in our district.

F. Utah State University Extension Service *

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural resources, horticulture, family and consumer sciences, 4-H and youth community development.

c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Sanpete County Emergency Management and Central Utah Public Health.

   b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

   a. None.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Sanpete County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.

6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 6 -- Sevier County

In order to effectively identify and mitigate natural hazards in Sevier County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix T* of this plan.

Table 1: Sevier County Pre-Disaster Mitigation Planning Team

Name	Representing:
Jim Porter, Emer. Mgr.	Sevier County
Doug Peterson, Commissioner	Sevier County
Gary Mason, Commissioner	Sevier County
Ralph Okerlund, Commissioner	Sevier County
Dale Albrecht, Mayor	Annabella
Lawrence Mason, Mayor	Aurora
Valerie Hopper, Mayor	Elsinore
Jake Albrecht, Mayor	Glenwood
Robert Owen, Mayor	Joseph
Harlow Brown, Mayor	Koosharem
Craig Mathie, Mayor	Monroe
Linda Mickelsen, Mayor	Redmond
Woody Farnsworth, Administrator	Richfield
Marilyn Anderson, Mayor	Salina
James Freeby, Mayor	Sigurd
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Sevier County

Understanding the past is often the key to discovering what the future hold, this is especially true when planning for natural disasters. The fact that cities within Sevier County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Sevier County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Sevier Natural Hazard History

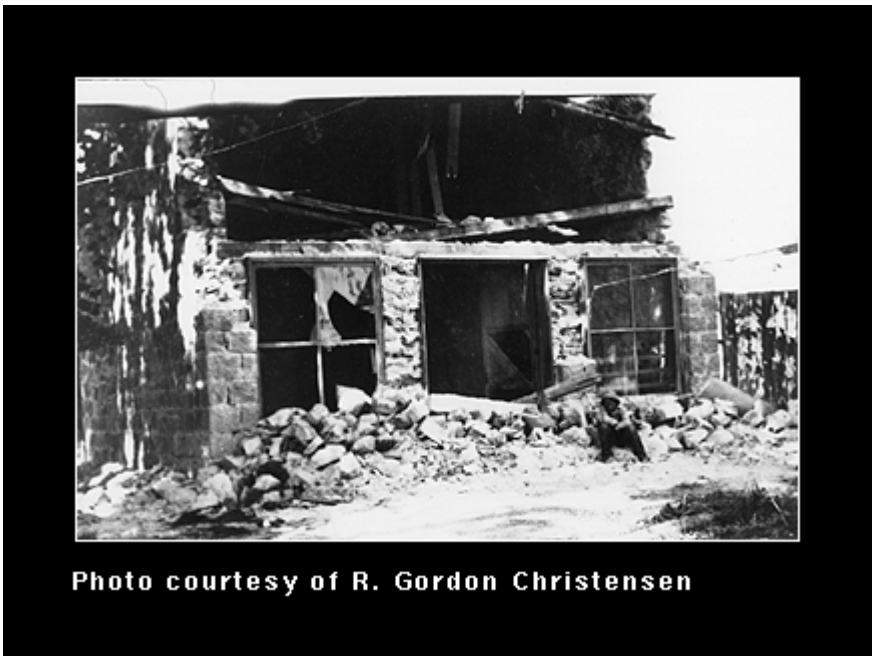
Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	July 11-17, 1896	Koosharem, Annabella, Elsinore, Joseph, Monroe, Richfield, Sevier, and Sigurd.	Widespread damage	Koosharem inundated.
Flood	1896-1929	Monroe	Unknown	13 floods impacted Monroe over 33-year timeframe.
Flood	July 31, 1943	Monroe	Homes farmlands, crops, and livestock	$80,000 in damage. Canyon on East Mountain
Flood	August 5, 1943	Monroe	Extremely heavy rains damage homes, highways, canals, crops, city pipelines, and power plant.	$120,000 in damage city without power for two weeks
Flood	July 27, 1951	Salina	Property and residential areas	Source was East Canyon.
Flood	September 5, 1960	Glenwood/Sigurd	Roads, bridges, and property	$15,000 plus. Highway 119 and 24 extensively damaged
Flood	July, 31, 1961	Richfield	U.S. 89 damaged along with irrigation canal	Source: Cottonwood Canyon
Flood	August 11, 1961	Richfield	Property damage in northeast section of city.	Source: Cottonwood Canyon. Damage $3,700.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	August 15, 1964	Sigurd/Aurora	Crops and irrigation system.	Anderson Wash and Lost Creek, $1,600
Flood	August 17, 1965	Annabella/Glenwood	Crops, farms, roads, and fences.	$38,000 in damage
Flood	August 6, 1967	Richfield/Central	Damage to homes, farms, and crops.	Source: Flat and Cottonwood Canyons. $30,000 in damage.
Flood	July 24, 1968	Richfield	Damage to homes	
Flood	July 30, 1968	Richfield/Elsinore	U.S. 89 covered with debris and water. Farmlands and buildings damaged.	Source: Flat and Cottonwood Canyons.
Flood	August 8, 1968	Richfield	Farmlands and buildings	Source: Cottonwood Creek. $2,000+ in damages.
Flood	July 24, 1969	Redmond/Sigurd	Farmlands and irrigation canals.	
Flood Presidential	1983	Monroe, Richfield, and Salina	Damage in all sectors.	Source Sevier River, Monroe, Cottonwood, and Salina Creek.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Presidential	1984	County wide	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Public assistance totals $185,545 (1984 dollars)
Earthquake	November 13, 1901	Richfield	Considerable damage to city of Richfield.	Richter Magnitude Scale 6.5 with Numerous Aftershocks.
Earthquake	January 10 & 12, 1910	Elsinore	Limited damage.	Richter Magnitude Scale 5.0 with Several Aftershocks.
Earthquake	September 29, 1921	Elsinore	Considerable damage within the region. Damaged Monroe City Hall.	Richter Magnitude Scale 6.3 with Several Aftershocks (see Picture 1 below table).
Earthquake	September 30, 1921	Elsinore	Considerable damage within the region damaged Monroe City Hall.	Richter Magnitude Scale 5.7 with Several Aftershocks (see Picture 1 below table).
Earthquake	October 1, 1921	Elsinore	Considerable damage within the region. Damaged Monroe City Hall.	Richter Magnitude Scale 6.0 with Several Aftershocks (see Picture 1 below table).

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Earthquake	October 27, 1921	Elsinore	Limited damage.	Richter Magnitude Scale 4.3 with Several Aftershocks.
Earthquake	November 18, 1945	Glenwood		Richter Magnitude Scale 5.0
Earthquake	October 4, 1967	Sevier-Piute Boundary near Marysvale	Limited damage. U.S. 89 blocked by rock slide in Marysvale Canyon.	Richter Magnitude Scale 5.2
Earthquake	January 3, 1972	Richfield	Cracked walls and ceilings and broke dishes and light fixtures.	Richter Magnitude Scale 4.4
Earthquake	June 2, 1972	Monroe		Richter Magnitude Scale 4.0
Severe Weather	August 7, 1957	Salina	Damage to turkey farm roof, uprooted trees, downed power lines, and telephone lines	Tornado
Severe Weather	April 18, 1970	Annabella	Home damage	Tornado
Wildfire	1997	Flat Fire		5,505 Acres

(Source: History of Sevier County, Utah State Historical Society.)

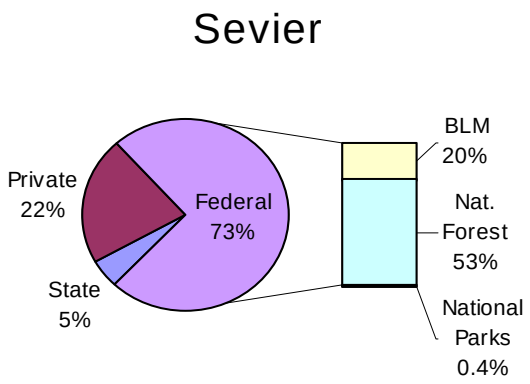


Picture 1: Elsinore Earthquake, 1921

Development Trends

Approximately 294,902 acres or 22% of the total land area in Sevier County is privately held and outside the incorporated areas is mostly vacant. The other 78% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure 1 helps explain Sevier County's development trends.

Figure 1: Sevier Land Ownership



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water and county zoning requirements of water access and a minimum of 40 acres per house in much of the county. Other limitations to development include steepness of the terrain, flash flood plains and accessibility. There is still plenty of infill within city limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. Sevier County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Since most of the privately held land is along the relatively safe I-70 corridor from Salina to Joseph, development is occurring in this general area. Currently, a rail road spur is being considered for development in the county adjacent to the town of Redmond and Salina City. A power plant south of Sigurd is also in planning and feasibility stages of development. A large box retail development within the Richfield's jurisdiction is in its final phase of completion. These projects are construed as large and major developments within the county.

Historically and today, agriculture plays a huge part in the economy of the county. As the largest city in the region and due to its central location, Richfield (pop. 7,020) plays host to several state and federal agencies. Situated along I-70 and US 89, Richfield has seen most of the county's recent growth. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. Later roads and US 89 followed this north-south route. I-70 partially follows this corridor in the populated areas of the county, but essentially runs east to west on the fringes. This corridor is where future development is likely to happen because of the private lands along this major transportation artery. Except for lands adjacent to the Sevier River and its tributaries, this corridor is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Sevier County

Frequency	Possible
Severity	Catastrophic
Location	Ground shaking will be felt throughout the entire county if a large earthquake were to occur. Surface fault rupture could be expected in areas of known historic fault movements. Liquefaction is expected in areas of high to moderate liquefaction potential, which covers a vast portion of the Sevier Valley.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Description of Location and Extent

The Six County region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is high; although there is limited risk to population due to the large areas of undeveloped lands those living in the region are at an elevated risk. During historic time the largest recorded earthquake in Sevier County has reached 6.7 on the Richter magnitude scale. Several large events have occurred in the recent past in the 5.5 to 6.3-magnitude range. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or the last 1.6 million years. These faults are listed in Table 4 (see Maps 1.1 and 1.2 starting on p.22 of this Annex).

Table 4: Fault Lines Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Sevier fault (northern portion)	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Maple Grove faults	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Maple Grove faults	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Simple
Japanese and Cal Valleys faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Valley Mountains monocline	Quaternary (<1,600,000 years)	NA	Suspected
Wasatch monocline	Quaternary (<1,600,000 years)	NA	Suspected
White Mountain area faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Southern Joes Valley fault zone	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Southern Joes Valley fault zone	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Joseph Flats area faults and syncline	Late Quaternary (<130,000 years)	< 0.2 mm/yr	Suspected
Joseph Flats area faults and syncline	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Suspected
Elsinore fault (fold)	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Red Canyon fault scarps	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Annabella graben	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Simple
Annabella graben	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Dry Wash fault and syncline	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Dry Wash fault and syncline	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Koosharem fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Thousand Lake fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple

HAZUS MH Vulnerability Assessment

HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Sevier County HAZUS MH run is available in *Appendix O.*

Number of people

Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	119
	Nighttime –Major	3
	Nighttime -Fatalities	5
	Daytime –Minor	135
	Daytime –Major	5
	Daytime- Fatalities	9
	Commute –Minor	115
	Commute –Major	4
	Commute-Fatalities	7

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures*	Total Cost in millions of dollars **
Residential	490	118.04
Commercial	35	30.25
Industrial	4	6.37
Totals	2,815*	158.59**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Infrastructure Types and Amounts
Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	1	0	0	1
Schools	17	0	0	0
EOCs	0	0	0	0
Police Stations	3	0	0	0
Fire Stations	2	0	0	0

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 8: Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	102
Loads (25 tons per load)	4,080

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	2
People Displaced	0
Value Exposed (thous. $)	23

2. Floods

Table 10: FEMA Hazard Profile for Floods in Sevier County

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Sevier County's main flooding threat is from snowmelt runoff during spring months.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours where as flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent
Based on the flooding which occurred during the spring of 1983 and 1984 both as a result of rapid snow melt events, experience would suggest these events would appear to be a greater hazard than cloudburst storms. Yet serious hazards could result from either storm. Sevier County is vulnerable to flooding from the Sevier River and its tributaries, Peterson Creek, Cottonwood Creek, and Monroe Creek. In addition to the natural stream channels a plethora of canals have been constructed for irrigation. As county populations continue to grow farmlands near the cities are being converted to residential development. The following canals present a problem for current and future development: Rocky Ford Canal, Spring Ditch, West View Canal, Richfield Canal, Venice Canal, and Koosharem Canal. Several canals such as the Richfield Canal cross alluvial fans. There has been discussion of a debris flow damaging the canal which in turn could cause damage to homes and the freeway.

Description of type
Precipitation in Sevier County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains.

Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather.

Note on Vulnerability Assessment

At this time, data was insufficient to conduct a risk analysis for flood events in Sevier County. Flood Insurance Studies were study were applicable to aid in determining risk. However, the current mapping projects being led by the county and state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters. One of these tools is the new HAZUS MH flood model. Unfortunately at the current time this model does not work well enough to complete loss numbers for each jurisdiction in the county.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in *Annex 8* and *Appendix T* of this plan. This study looks predominately at jurisdictions which are unmapped or mapped as D zones by the National Flood Insurance Program.

3. Landslides

Table 11: FEMA Hazard Profile for Landslides in Sevier County

Frequency	Likely
Severity	Negligible
Location	Mass wasting in Sevier County is located predominately along the canyons east and west of the Sevier Valley (see map 3.1 on p.24 of this Annex).
Seasonal Pattern	Landslides most often occur within Sevier County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent
The map "Sevier County Landslide Map 3.1" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

Several areas in the county are at risk to landslides. The cities of Elsinore, Glenwood, Monroe, and particularly Richfield have a significant amount of land classified as historically active.

Tables 12 and 13 show the number of acres and households at risk from landslides. The extent and cost of damage to roads and electric infrastructure are shown in Tables 14 and 15, respectively.

Table 12: Landslide Acres

County Name	Acres of Active landslides	Historically Active Landslides 1847 to Present
Sevier	1,394	373,643

Table 13: Structure Loss and Value as a Percentage of Total Acreage

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost*
Elsinore	81	29/2,610,000
Glenwood	23	10/900,000
Monroe	68	21/1,890,000
Richfield	708	488/43,920,000
Salina	23	5/450,000

*Includes value of land.

Table 14: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	368.5	889,374,750
State Route 25	.6	1,448,100
State Route 70	.5	1,206,750
State Route 72	4.7	11,343,450
State Route 119	2.2	5,309,700
State Route 263	.2	482,700
US Highway 89	.3	724,050
Interstate I-70	8.6	20,756,100

Table 13 data represents total lengths of roads, which overlay historically active landslides.

Railroads

This vulnerability analysis using best available data found no railroad track at risk in Sevier County.

Table 15: Electric Infrastructure

Name	Description	Estimated Cost
Sevier Substation	115 KV	10,000,000
Richfield Substation	115 KV	10,000,000
Elsinore Substation	115 KV	10,000,000
Winkleman Substation	115 KV	10,000,000
KV-46	35.3 Miles	1,704,000
KV-138	18.3 Miles	885,000
KV-230	10.6 Miles	510,000
KV-345	22.6 Miles	1,092,000
County lines	3.3 Miles	159,0000

4. Wildfire Risk

Table 16: FEMA Hazard Profile for Wildfire in Sevier County

Frequency	Likely
Severity	High in the Urban-Wildland Interface.
Location	Entire county except cultivated grounds.
Seasonal Pattern	Most wildfires affecting Sevier County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	0 to 6 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Sevier County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Annabella, Glenwood, Monroe, and Richfield all have areas in or around them classified as having extreme wildfire risk. Glenwood and Annabella are adjacent to large amounts of extreme wildfire risk area on there eastern boundaries. Both towns are aware of the risk and are working with high-risk neighborhoods.

See Map 4.1 on p. 25 of this Annex for a visual display of location and severity of wildfire risk in Sevier County. Tables 17-20 show the number of acres and households at different levels of wildfire risk in Sevier County.

Table 17: Acres at Risk in Unincorporated County

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Sevier	11,705	107,647	336,698	772,398

Table 18: Households at Risk in Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Sevier	67/4,824,000	617/44,424,000	1,929/138,888,000

Table 19: Acres at Risk in Incorporated Sevier County

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Annabella	53	None	None
Aurora	None	None	None
Elsinore	None	127	None
Glenwood	56	None	None
Joseph	None	None	None
Koosharem	None	None	72
Monroe	35	690	70
Redmond	None	None	None
Richfield	54	763	27
Salina	None	None	1383
Sigurd	None	1	None

Table 20: Structures in Wildfire Area

City Name	Households in Extreme/Cost*	Households in High/Cost*	Households in Moderate/Cost*
Annabella	30/2,160,000	None/0	None/0
Aurora	None/0	None/0	None/0
Elsinore	None/0	45/3,240,000	None/0
Glenwood	25/1,800,000	None/0	None/0
Joseph	None/0	None/0	None/0
Koosharem	None/0	None/0	27/1,944,000
Monroe	11/792,000	216/15,552,000	21/1,512,000
Redmond	None/0	None/0	None/0
Richfield	37/2,664,000	526/37,872,000	19/1,368,000
Salina	None/0	None/0	308/22,176,000
Sigurd	None/0	None/0	None/0

*Excludes content value, which would result in an increase of 50% to the values listed.

Tables 21-23 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Sevier County.

Table 21: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	1,364.4	3,292,979,400
State Route 24	27.5	66,371,250
State Route 62	6.2	14,963,700
State Route 70	12.9	31,134,150
State Route 72	23.3	56,234,550

Name	Miles	Estimated Cost
State Route 119	6.5	15,687,750
State Route 263	.6	1,448,100
US Highway 89	.6	1,448,100
Interstate I-70	82.1	198,148,350

Table 21 data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 22: Railroads

Railroad	Miles	Estimated Cost
Railroad	.6	1,440,000

Table 23: Electric Infrastructure

Name	Description	Estimated Cost
Sigurd Substation	230 KV	20,000,000
Sevier Substation	115 KV	10,000,000
U.S. Gypsum Substation	115 KV	10,000,000
Richfield Substation	115 KV	10,000,000
Winkleman	115 KV	10,000,000
KV-46	62.8 miles	3,030,000
KV-69	2 miles	96,000
KV-138	27.6 miles	1,323,000
KV-230	23.1 miles	1,116,000
KV-345	39.7 miles	1,917,000
County lines	5 miles	240,000

5. Problem Soils

Table 24: Hazard Profile for Problem Soils in Sevier County

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Typically occur at the Valley's boundary with foothills.
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent

The greatest hazards from problem soils are Gypsum Dunes north of Richfield and Expansive Soils south of Salina (see Map 5.1 on p.26 of this Annex). Most problems soils in the area have been mitigated for during construction of buildings.

6. Dam Failure

Table 25: Hazard Profile for Dam Failure

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

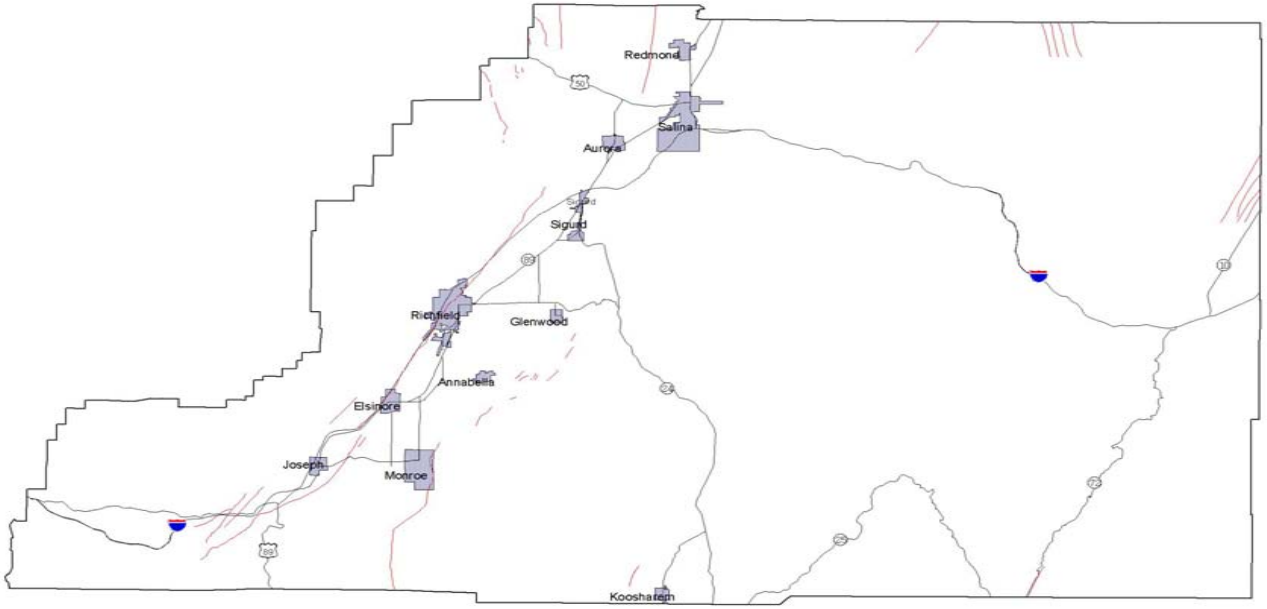
Description of Location and Extent

Of the dams located in Sevier County only nine dams are considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. All dams, regardless of rating should be monitored. It should be noted that dam safety hazard classifications are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure. The areas of greatest danger to dam failure are east of Cottonwood Wash Detention Basin and Dairy Canyon Detention Basin (both near Richfield), west of Glenwood Debris Dam (near Glenwood), east of Koosharem Dam (near Koosharem), north of Rocky Ford Dam (near Sigurd), and south of Forsyth, Johnson, Three Creeks, and Sand H Debris Dams (all in lightly populated eastern Sevier County). See Map 6.1 on p.27 of this Annex. High hazard dams within Sevier County are the following (see Table 26):

- Forsyth
- Cottonwood Wash Detention Basin
- Dairy Canyon Detention Basin
- Glenwood Debris
- Johnson
- Rocky Ford
- Three Creeks
- Koosharem
- Sand H Debris

Table 26: High Risk Dams

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Forsyth	1922	Earth Fill	3715	49000
Cottonwood Wash Detention Basin	1986	Earth Fill	695	24000
Dairy Canyon Detention Basin	1987	Earth Fill	110	6000
Glenwood Debris	1956	Earth Fill	200	12000
Johnson	1910	Earth Fill	10350	16000
Rocky Ford	1906	Earth Fill	1700	2000
Three Creeks	1884	Earth Fill	1000	7000
Koosharem	1919	Earth Fill	3858	11000
Sand H Debris	1971	Earth Fill	80	9000



Quaternary Faults 1.1

Sevier County Quaternary Faults

Major Roads
Cities
County Boundary

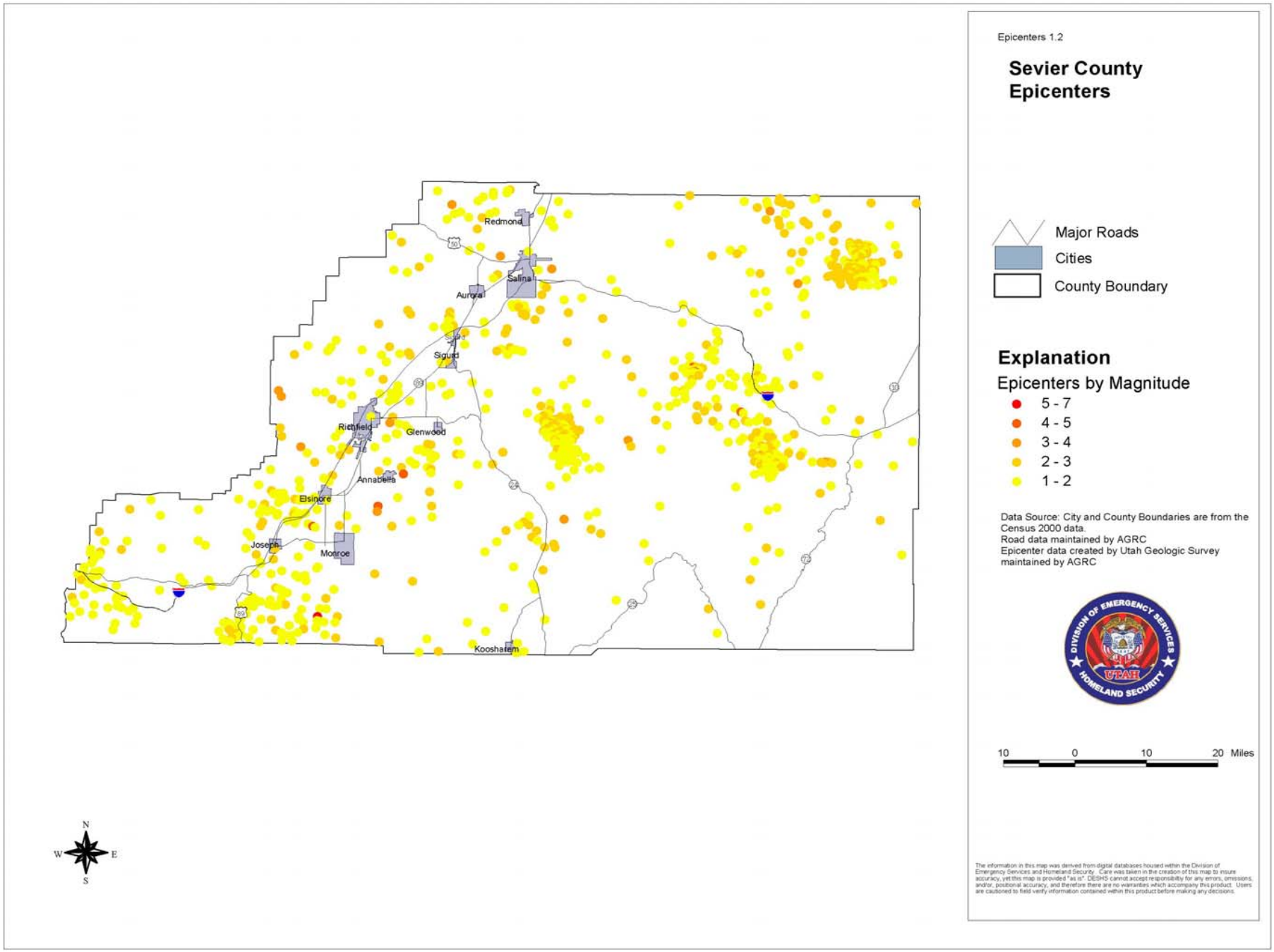
Explanation

Quaternary Faults

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

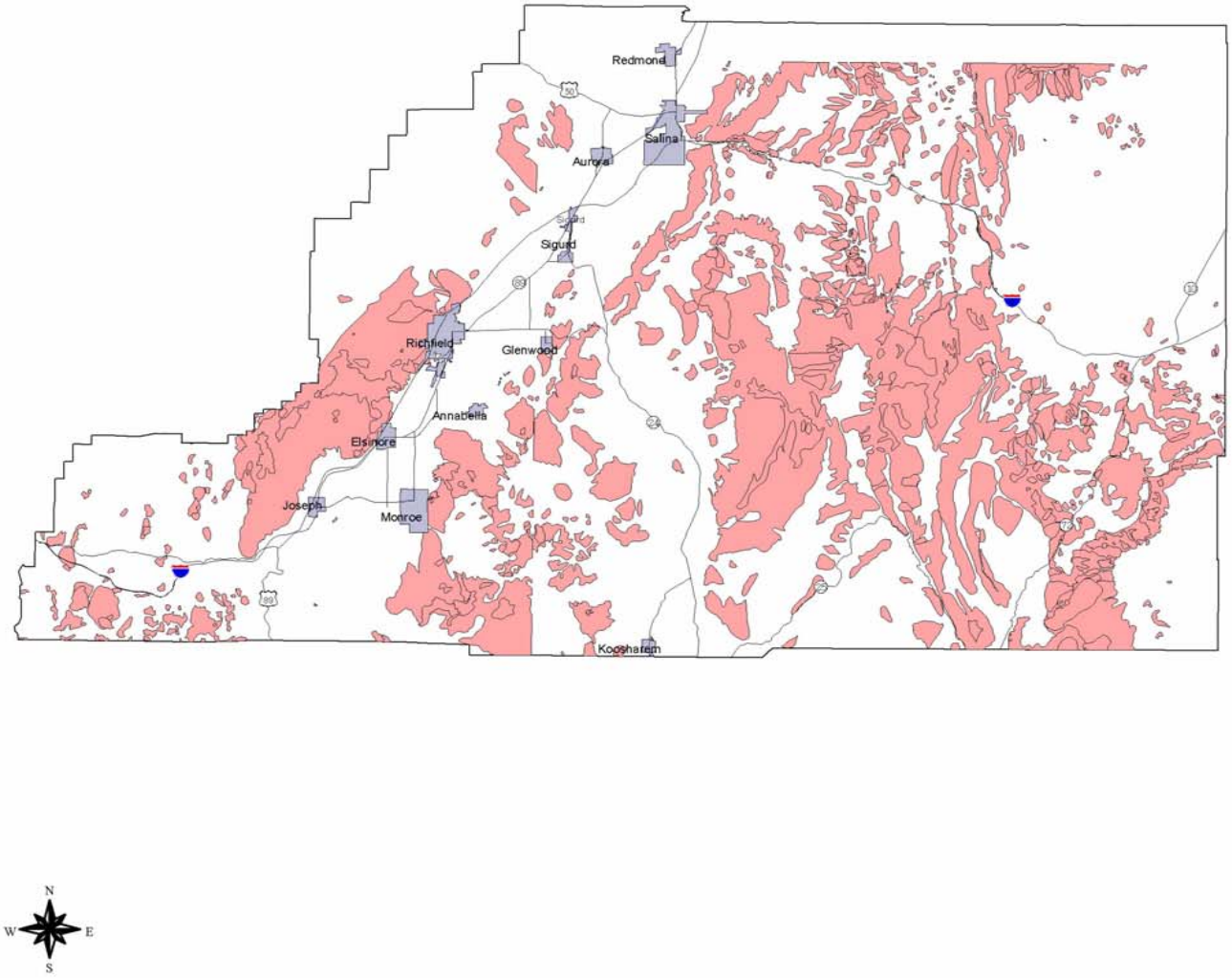
10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.


Epicenters 1.2
Sevier County Epicenters
Redmond
Salina
Aurora
Sigurd
Richfield
Glenwood
Annabella
Elsinore
Joseph
Monroe
Kooshaiem
Major Roads
Cities
County Boundary
Explanation
Epicenters by Magnitude
5 - 7
4 - 5
3 - 4
2 - 3
1 - 2
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES
UTAH
HOMELAND SECURITY
10 0 10 20 Miles
N
W
E
S

Landslides 3.1

Sevier County Landslides



Major Roads
Cities
County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

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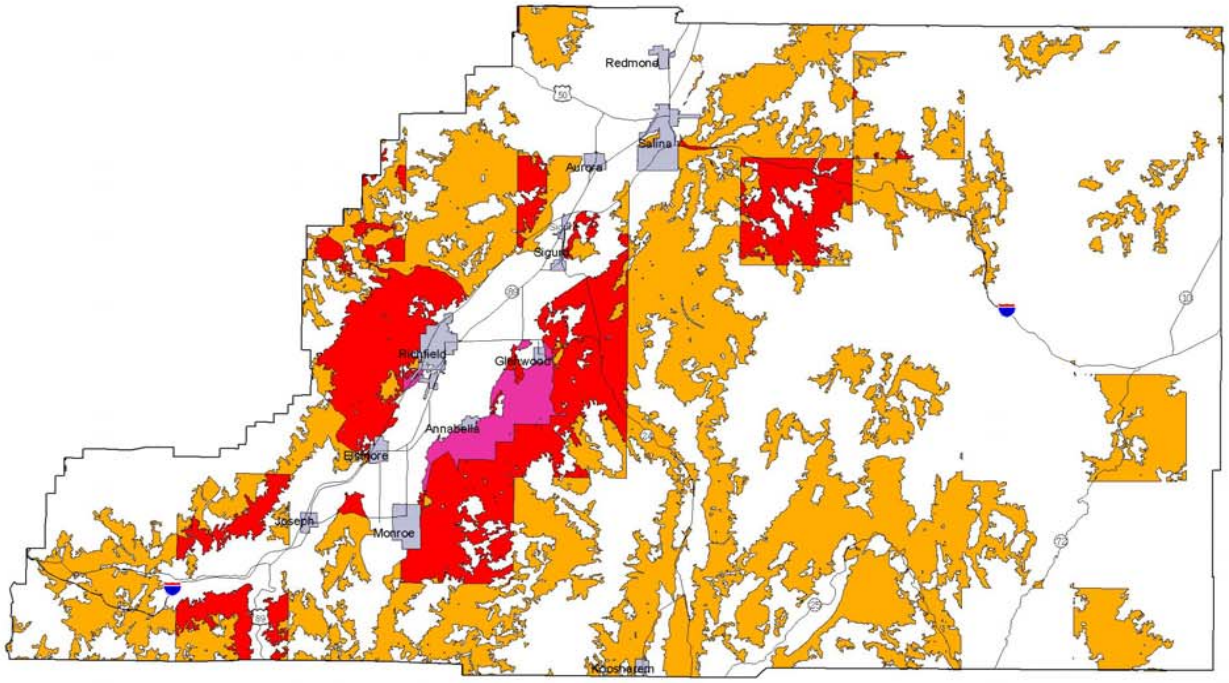
Wildfire Map 4.1

Sevier County Wildfire Risk



Major Roads
Cities
County Boundary

Fire Risk Explanation

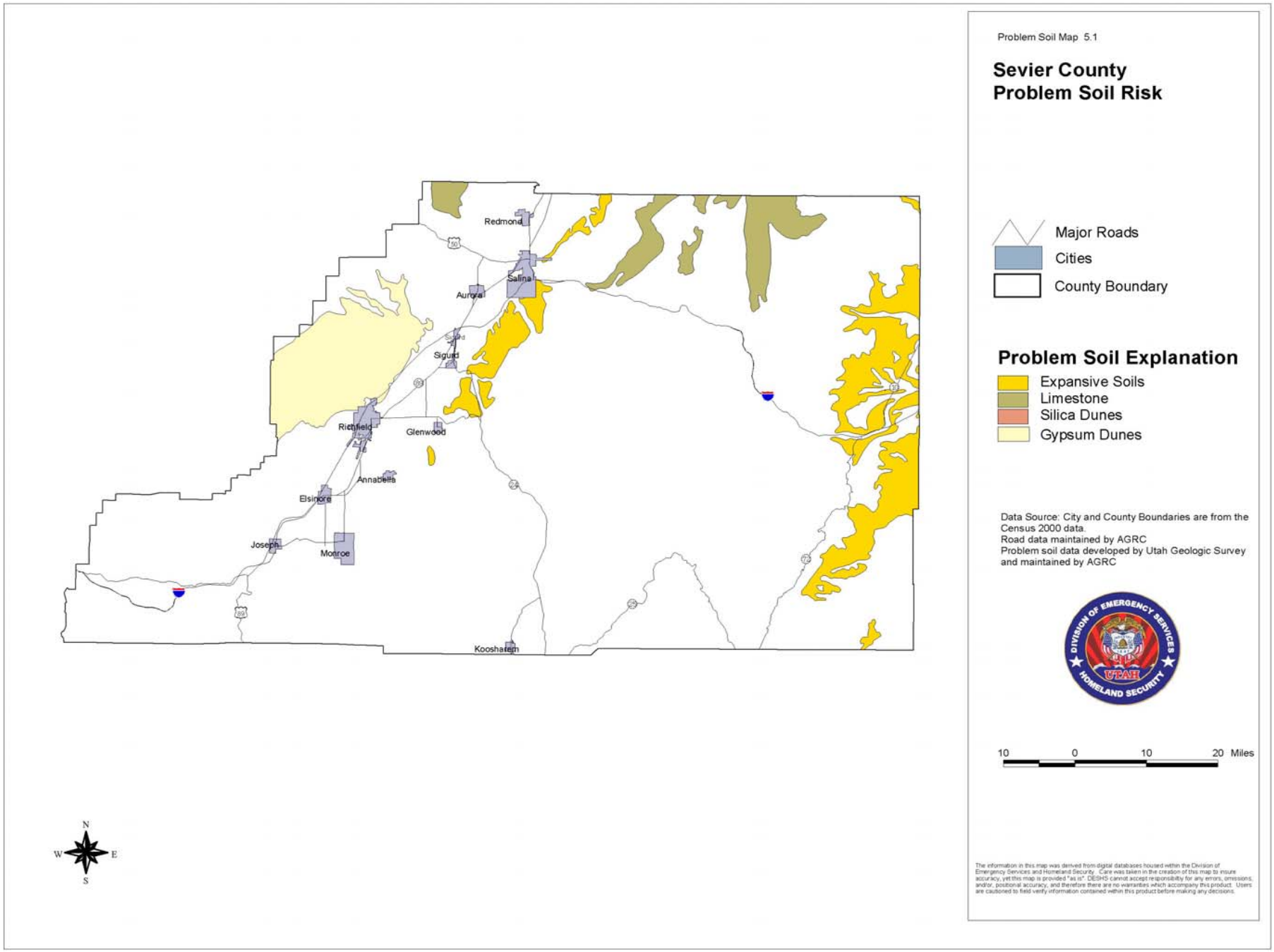
Extreme
High
Moderate

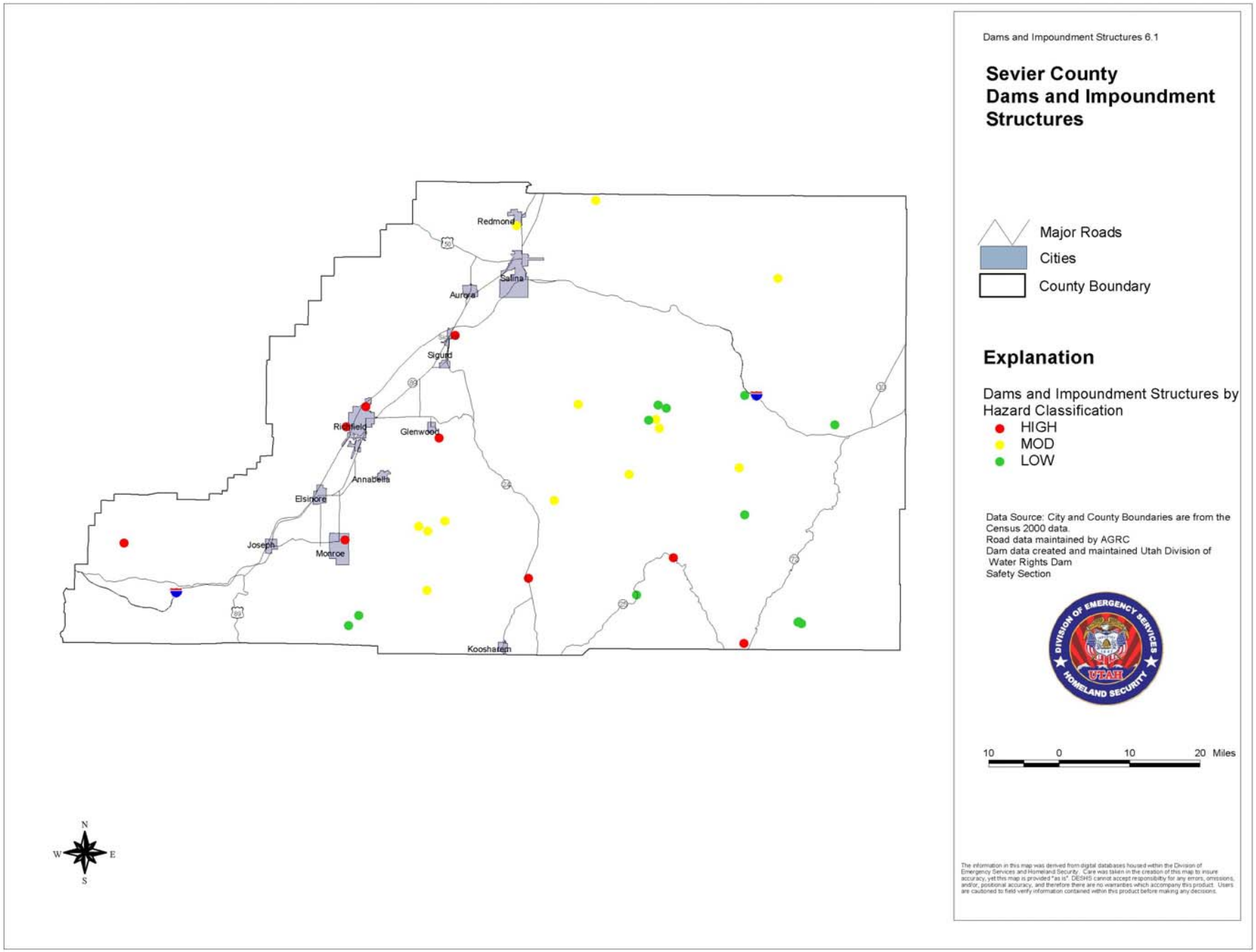
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

N W E S

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.


Problem Soil Map 5.1
Sevier County
Problem Soil Risk
Redmond
Salina
Aurora
Sigurd
Richfield
Glenwood
Annabella
Elsinore
Joseph
Monroe
Koosharem
Major Roads
Cities
County Boundary
Problem Soil Explanation
Expansive Soils
Limestone
Silica Dunes
Gypsum Dunes
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC
DIVISION OF EMERGENCY SERVICES
UTAH
HOMELAND SECURITY
10 0 10 20 Miles
N
W
E
S


Dams and Impoundment Structures 6.1
Sevier County
Dams and Impoundment Structures
Major Roads
Cities
County Boundary
Explanation
Dams and Impoundment Structures by Hazard Classification
HIGH
MOD
LOW
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section
10 0 10 20 Miles
Redmond
Salina
Aurora
Sigurd
Richfield
Glenwood
Annabella
Elsinore
Joseph
Monroe
Koosharem
N
W
E
S

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Sevier County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Update and exercise emergency operations and mitigation plans.

    c. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    d. Coordinate the county's Local Emergency Planning Committee. (meets quarterly)

    e. Coordinate the county's Tier Two reporting. (hazardous materials)

    f. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    g. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    h. Responsible for timely and effective public information releases during emergency situations.

    i. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

    j. Have verbal mutual aid agreements with Juab, Millard, Piute, Sanpete, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

    k. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

l. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the State Division of Water Resources.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Sevier County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Sevier County Commissioners, Sevier County Road Department, Sevier County Sheriff's Department, various other law enforcement, fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Sevier County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, and Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Warning systems and sirens are outdated and inadequate. At this time, funding is not available for improvements.

   c. Sevier County is constantly striving to improve planning and exercise activities and response capabilities. However, with the county growing and becoming more industrial, the threat of potential hazards increases, which increases the need for resources, training, and awareness.

d. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Based on funding, Six County Planning Staff will work with the county to update the General Plan and the zoning ordinances to reflect natural hazard mitigation. Existing zoning requirements for flood plain management need to be enforced.

B. <u>Sevier County Highway Department *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Highway Department follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Utah Department of Transportation (UDOT) on various projects since the UDOT dispenses federal funding. While the UDOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

   c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

   a. <u>Local Agencies</u>: The County Highway Department has little interaction with other county agencies concerning roads and bridges. They do, however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way

purchasing is overseen by the States Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Highway Department coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Sevier County Highway Department should assist local government with floodplain management and water development permitting.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Sevier County Emergency Management, local law enforcement agencies (city and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse. For example, radio equipment that belongs to FEMA is based at county emergency management offices; the same could be done with air sampling equipment or other instruments/kits etc., which could be used by public health agencies both for daily work and at a time of emergency or disaster.

D. Sevier County Sheriff's Department

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in unincorporated areas of the county and in smaller towns that do not have police departments.

   b. Provide standard law enforcement manpower and equipment.

   c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

   d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

e. Have mutual aid agreements with all surrounding counties and the Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of law enforcement, the Sevier County Sheriff's Department coordinates with various local agencies. These agencies include Sevier County Emergency Management and various local police departments.

   b. Non-local Agencies: Sevier County Sheriff's Department coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

   a. None

E. Koosharem, Monroe, Richfield, and Salina Fire Departments

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

   b. Respond to accidents in order to provide rescue assistance.

   c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (first responders)

   d. Provide standard firefighting manpower and equipment.

   e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of city fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow. The State Division of Forestry and Fire Control have a contract to fight wild land fires in Sevier County.

l. Inspections and preplanning within the county to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the city fire departments coordinate with various local agencies. These agencies include Sevier County Emergency Management, Richfield City Police Department, Salina City Police Department, Sevier County Sheriff's Department, local Public Works, and local Emergency Medical Services.

   b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   Our district has seen an increase in the number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each added type of response increases the need for equipment and the time our volunteers need to spend in training

   a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

   b. Explore training options to cover the expanding variety of responses in our district.

   c. Look into recruitment and retention programs that will work in our district.

F. <u>Utah State University Extension Service *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

   b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural resources, horticulture, family and consumer sciences, 4-H and youth community development.

   c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

   d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

   e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and

wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

a. Local Agencies: Sevier County Emergency Management and Central Utah Public Health.

b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

a. None.

G. Richfield and Salina Police Departments

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Provide general law enforcement services that are designed to efficiently prevent crime and promote concepts of community policing. These services include traffic control, 911 communications, criminal and accident investigations, neighborhood policing, animal control, and neighborhood and business watches.

b. Provide standard law enforcement manpower and equipment.

c. Provide public awareness and training programs including: Drug Abuse Resistance Education (DARE), juvenile diversion programs, Crime Stoppers, gang awareness, Citizen Police Academy, Jr. Police Academy, and a ride along program.

d. In disaster situations, provide: warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

e. Involved in the county's Local Emergency Planning Committee (LEPC) and tier two reporting (Hazardous Materials).

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

a. Provide input to and enforce city ordinances regarding public safety.

3. Leadership and coordination with other government agencies:

a. Local Agencies: Within the scope of law enforcement, the Richfield and Salina Police Departments coordinate with various local agencies. These agencies include: Sevier County Emergency Management, Sevier County Sheriff's Department, and the city fire departments.

b. Non-local Agencies: Richfield and Salina Police Departments coordinate with appropriate state and federal agencies including: Utah Highway Patrol, Federal Bureau of Investigation (FBI), Bureau of Alcohol, Tobacco, and Firearms (ATF), and Federal Emergency Management Agency (FEMA).

4. General recommendations/Emergency Management concerns:

a. Explore funding alternatives to upgrade outdated and inadequate warning systems (sirens). At this time, federal funding is not available.

b. Intensify awareness and training in regard to civil disorder and terrorism incidents.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Sevier County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.

6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 7 -- Wayne County

In order to effectively identify and mitigate natural hazards in Wayne County, a Pre-Disaster Mitigation Planning Team representing Emergency Management and each jurisdiction in the county was created. Table 1 names the members of this team. Input from the team was used in organizing hazard mitigation strategies outlined in *Annex 8* and *Appendix U* of this plan.

Table 1: Wayne County Pre-Disaster Mitigation Planning Team

Name	Representing:
Vicky Bower, Emer. Mgr.	Wayne County
Clenn Okerlund, Commissioner	Wayne County
Allen Jones, Commissioner	Wayne County
Scott Durfey, Commissioner	Wayne County
Sherwood Albrecht, Mayor	Bicknell
Stan Alvey, Mayor	Hanksville
Ellis Brown, Mayor	Loa
Vanor Okerlund, Mayor	Lyman
Fred Hansen, Mayor	Torrey
Terry Heath	FFSL
Emery Polelonema	SCAOG
Edwin Benson	SCAOG

Past Hazard Events in Wayne County

Understanding the past is often the key to discovering what the future hold, this is especially true when planning for natural disasters. The fact that cities within Wayne County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 2 provides a brief history of Wayne County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 2: Wayne County Natural Hazard History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	August 4, 1957	Caineville	Destroyed bridge west of town blocked Highway 24	Source: Fremont River
Flood	August 25, 1961	Torrey	Highway 24 damaged	Source: South Desert Wash

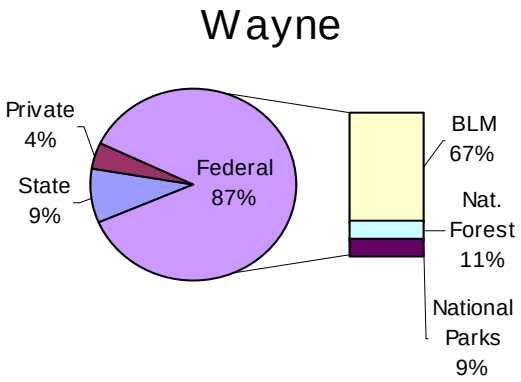
Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	July 31, 1965	Bicknell/Lyman/ Teasdale/ Loa	Damage to homes, crops, ranches, and Highway 24 and 117	Heavy rains flooded area creeks.
Flood	August 18, 1965	Bicknell	Farmland, crops, orchards, and Highway 68 all damaged	10,000 acres of farmland destroyed.
Severe Weather	August 29, 1957	Hanksville	Crop damage	Hail
Severe Weather	May 31, 1969	Hanksville area	No Damage	Tornado; Three separate tornados touched down in uninhabited area.
Severe Weather	July 24, 1981	Hanksville	No Damage	Tornado (see Picture 1)
Severe Weather	August 31, 1986	Canyonlands NP	No Damage	Tornado
Severe Weather	April 4, 1993	Caineville	Damage to an RV, boat, and restaurant	Tornado, Estimated damage $8,000.
Severe Weather	August 11, 1993	Bicknell	1 death	Lightning Standing under a tree
Severe Weather	September 12, 2002	Hanksville	No Damage	Tornado (see Picture 2)

Picture 1 – Hanksville, July 24, 1981.

Picture 2 – Hanksville, September 12, 2002.

Development Trends
Approximately 65,051 acres or 4% of the total land area in Wayne County is privately held and outside the incorporated areas is mostly vacant. The other 96% is owned by the state or federal governments and aside from extractive industry is beyond the reach of development. Since land ownership determines how and where development proceeds, Figure 1 helps explain Wayne County's development trends.

Figure 1



The vast majority of landslides, debris flows and wildfires occur on these public lands with virtually no impact on development. Of the privately held land, most is not developable due to a lack of water and county zoning requirements of water access and a minimum of 5 acres per house. Other limitations to development include steepness of the terrain, flash flood plains and accessibility. There is still plenty of infill within town limits that can be utilized for safe development without developing in unincorporated, sparsely populated, or hazardous areas. Wayne County requires UBC on all new or proposed buildings. New subdivisions require a grading and drainage plan to mitigate any flooding, which may occur. Since most of the privately held land is along the relatively safe and accessible State Route (SR) 24 from Loa to Torrey and east of Capitol Reef National Park in Hanksville, development is occurring in this general area.

Historically and today, agriculture plays a huge part in the economy of Wayne County. Tourism has grown significantly since the establishment of Capitol Reef National Park in 1971. Transportation development had its beginnings in the original wagon trails, which brought the pioneers to this area. Later roads and SR 24 followed this east-west corridor. This corridor is where future development is likely to happen because of the private lands along this major transportation artery. Except for lands adjacent to the Fremont and Dirty Devil Rivers and their tributaries, this corridor is relatively safe from natural hazards.

1. Earthquake

Table 3: FEMA Hazard Profile for Earthquake in Wayne County

Frequency	Possible
Severity	Catastrophic
Location	Ground shaking will be felt throughout the western half of the county if a large earthquake were to occur. Surface fault rupture could be expected in areas of known historic fault movements. Liquefaction is expected in areas of high to moderate liquefaction potential, which covers a vast portion of Rabbit Valley, where most of the population resides.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Description of Location and Extent

Wayne County has a very limited seismic risk mostly contained to the western half of the county. Table 4 outlines fault line movement in Wayne County during the Quaternary Period or the last 1.6 million years (see Maps 1.1 and 1.2 starting on p.18 of this Annex).

Table 4: Fault Line Movement

NAME	MOVEMENT	SLIPRATE	STRUCTURE
Aquarius and Awapa Plateaus faults	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Thousand Lake fault	Mid to Late Quaternary (<750,000 years)	< 0.2 mm/yr	Simple
Thousand Lake fault	Quaternary (<1,600,000 years)	< 0.2 mm/yr	Simple
Needles fault zone	Latest Quaternary (<15,000 years)	< 0.2 mm/yr	Suspected

HAZUS MH Vulnerability Assessment

HAZUS-MH was used to determine vulnerability to earthquakes in the Six County planning area. Tables 5-9 are a summary of results from the HAZUS MH model. Damage and loss estimates are based on a 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete Wayne County HAZUS MH run is available in *Appendix O.*

Number of people

Whether an earthquake occurs at night, during the day, or during a commute plays a significant role in estimating the number of casualties as outlined in Table 5.

Table 5: Casualties

Casualties	Nighttime –Minor	8
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	6
	Daytime –Major	0
	Daytime- Fatalities	0
	Commute –Minor	7
	Commute –Major	0
	Commute-Fatalities	0

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 6 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 6: Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures	Total Cost in millions of dollars **
Residential	93	12.0
Commercial	3	1.67
Industrial	0	0.15
Totals	347 *	14.57**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Infrastructure Types and Amounts
Table 7 shows which critical facilities will receive damage and how much damage will result.

Table 7: Critical facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	0	0	0	0

Debris Removal –Table 8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space.

Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 8: Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	10
Loads (25 tons per load)	400

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9: Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	3
People Displaced	29
Value Exposed (mill. $)	2

2. Floods

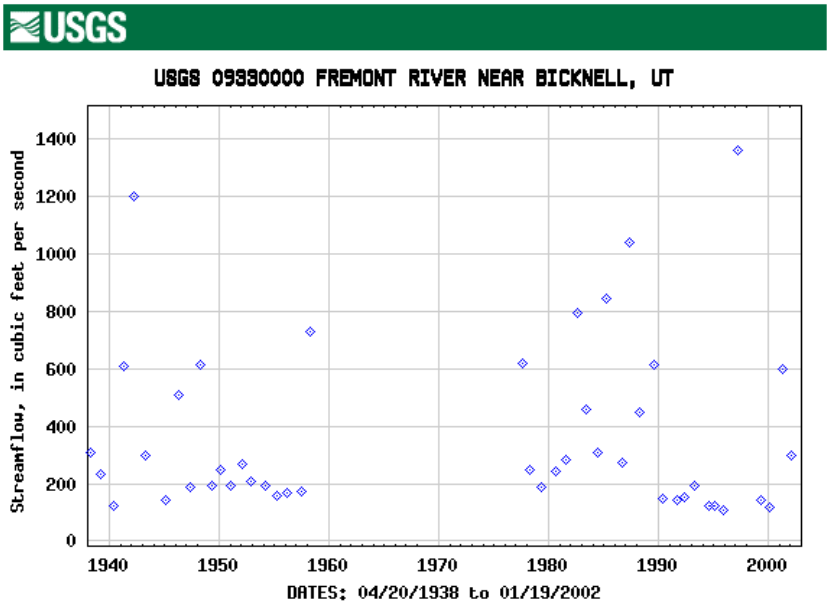
Table 10: FEMA Hazard Profile

Frequency	Likely
Severity	Limited
Location	Flooding would occur in and along flood plains.
Seasonal Pattern	Wayne County's main flooding threat is from snowmelt runoff during spring months.
Duration	The type of event determines the duration of flooding; flooding due to summer thunderstorms can last a couple of hours where as flooding due to spring runoff can last weeks.
Speed of Onset	Six to twelve hours.

Description of Location and Extent

Based on the flooding which occurred during the spring of 1983 and 1984 both as a result of rapid snow melt events, experience would suggest these events would appear to be a greater hazard than cloudburst storms. Yet serious hazards could result from either storm. Flooding is primarily from the Fremont and its tributaries Deep Creek, Pleasant Creek, Sandy Creek, and Sweetwater Creek. The Fremont River has caused damage to state route 24 in the past. Since 1936 the stream gauge near Bicknell has recorded discharges as high as 1360. See Chart 1.

Chart 1: Fremont River Discharges near Bicknell



Several dry washes around Hanksville have in the past flooded, resulting in property damage in Hanksville.

Description of type
Precipitation in Wayne County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains. Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather.

Note on Vulnerability Assessment
At this time, data was insufficient to conduct a risk analysis for flood events in Wayne County. Flood Insurance Studies were study were applicable to aid in determining risk. However, the current mapping projects being led by the county and state will result in better data that will assist in understanding risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA aims to provide individuals, businesses, and communities with information and tools to work proactively to mitigate hazards and prevent losses resulting from disasters. One of these tools is the new HAZUS MH flood model. Unfortunately at the current time this model does not work well enough to complete loss numbers for each jurisdiction in the county.

The U.S. Army Corps of Engineers wrote a Flood Hazard Identification Study (see *Appendix N)* which is included in the flood mitigation goals found in *Annex 8* and *Appendix U* of this plan. This study looks predominately at jurisdictions which are unmapped or mapped as D zones by the National Flood Insurance Program.

3. Landslides

Table 11: FEMA Hazard Profile for Landslides in Wayne County

Frequency	Likely
Severity	Negligible
Location	Mass wasting in Wayne County is located predominately along the Canyons surrounding Rabbit Valley (see Map 3.1 on p.20 of this Annex).
Seasonal Pattern	Landslides most often occur within Wayne County during spring months with higher than normal amounts of precipitation.
Duration	Several months
Speed of Onset	No warning

Description of Location and Extent

The areas at greatest risk to landslides are mostly along the canyons surrounding Rabbit Valley, especially the northeast portions of Lyman and east of Bicknell. Tables 12 and 13 show the number of acres and households at risk from landslides. The extent and cost of damage to roads and electric infrastructure are shown in Tables 14 and 15, respectively.

Table 12: Landslide Acres

County Name	Acres of Active landslides	Historically Active Landslides 1847 to Present
Wayne	217	158,416

Table 13: Structure Loss and Value as a Percentage of Total Acreage

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost*
Lyman	227	17/1,275,000

*Includes value of land.

Table 14: Roads

Name	**Miles**	**Estimated Cost**
Local Neighborhood/local/city street	106	255,831,000
State Route 12	5	12,067,500
State Route 24	33.8 Feet	15,446
State Route 72	1.4	3,378,900

Table 14 data represents total length of roads, which overlay historically active landslides.

Railroads

This vulnerability analysis using best available data found no railroad track at risk in Wayne County.

Table 15: Electric Infrastructure

Name	Description	Estimated Cost
Power Generation Station	Loa	10,000,000
Power Generation Station	Unknown owner	10,000,000

4. Wildfire Risk

Table 16: FEMA Hazard Profile

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Typically occur at the valley's boundary with the foothills.
Seasonal Pattern	Most wildfires affecting Wayne County occur during mid to late summer months (fire season).
Duration	The amount of time needed to contain a wildfire depends on a variety of uncontrollable variables such as: wind speed, relative humidity, type, and moisture content of fuel, weather, and topography. Thus containment time varies for each fire.
Speed of Onset	6 to 12 hours is the minimum amount of time given to homeowners in order to evacuate.

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Wayne County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Analysis of GIS data of Wayne County yielded a minimal county wildfire risk. Present wildfire risk is moderate to very low, with no areas classified as high or extreme. This is not to say there is not risk. The majority of county is covered by desert brush will moderate burn cycles.

See Map 4.1 on p. 21 of this Annex for a visual display of location and severity of wildfire risk in Wayne County. Tables 17-20 show the number of acres and households at different levels of wildfire risk in Wayne County.

Table 17: Wildfire Risk Acres

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Wayne	None	None	125,150	1,450,008

Table 18: Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Wayne	None/0	None/0	105/6,300,000

Table 19: Incorporated Wayne County*

City Name	Acres of High	Acres of Moderate
Bicknell	None	None
Hanksville	None	None
Loa	None	None
Lyman	None	38
Torrey	None	22

*No Extreme wildfire risk within Wayne County

Table 20: Structures in Wildfire Area

City Name	Households in Extreme/Cost*	Households in High/Cost*	Households in Moderate/Cost*
Bicknell	None/0	None/0	None/0
Hanksville	None/0	None/0	None/0
Loa	None/0	None/0	None/0
Lyman	None/0	None/0	3/180,000
Torrey	None/0	None/0	10/600,000

*Excludes content value, which would result in, and increase of 50% to the values listed.

Tables 21-23 show extent and cost of wildfire risk to roads, railroads, and electric infrastructure in Wayne County.

Table 21: Roads

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	340.4	821,555,400
State Route 12	12.4	29,927,400
State Route 24	13.7	33,064,950
State Route 72	1.2	2,896,200

Table 21 data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Table 22: Railroads

Railroad	Miles	Estimated Cost
Railroad	n/a	n/a

No rail loss

Table 23: Electric Substations

Name	Description	Estimated Cost
Power Generation Station	South of Torrey	10,000,000

5. Problem Soils

Table 24: Hazard Profile for Problem Soils in Wayne County

Frequency	Likely
Severity	Negligible (10-25% of jurisdiction affected)
Location	Lightly populated central and eastern Wayne County.
Seasonal Pattern	None
Duration	Problems associated with soils last for long periods of time.
Speed of Onset	More than 24 hour warning time.

Description of Location and Extent
The greatest hazard from problem soils is Expansive Soils around Torrey (see Map 5.1 on p.22 of this Annex).

6. Dam Failure

Table 25: Hazard Profile for Dam Failure

Frequency	Possible
Severity	Limited
Location	Would occur downhill from existing dams.
Seasonal Pattern	None
Duration	Depends on dam and type of break; Could be a wall of water which passes through in a few hours, or a slower break which could last for weeks.
Speed of Onset	6 to 12 hours.

Description of Location and Extent

There are three high hazard dams, which would impact Wayne County, if failure were to occur. Two of these dams, Johnson Dam and Forsythe Dam, are physically located in Sevier County adjacent to the Wayne County line and upstream on the Fremont River from the third dam Mill Meadow, which is located in Wayne County. The possibility exists for failure of one dam resulting in failure of downstream dams. Wayne County is very large in area and very small in populations, however the majority of the population does live below and within about thirty miles of the above-mentioned dams and within a few miles of the Fremont River and its flood plain. See Map 6.1 on p.23 of this Annex. The only high hazard dam physically located in Wayne County (see Table 26):

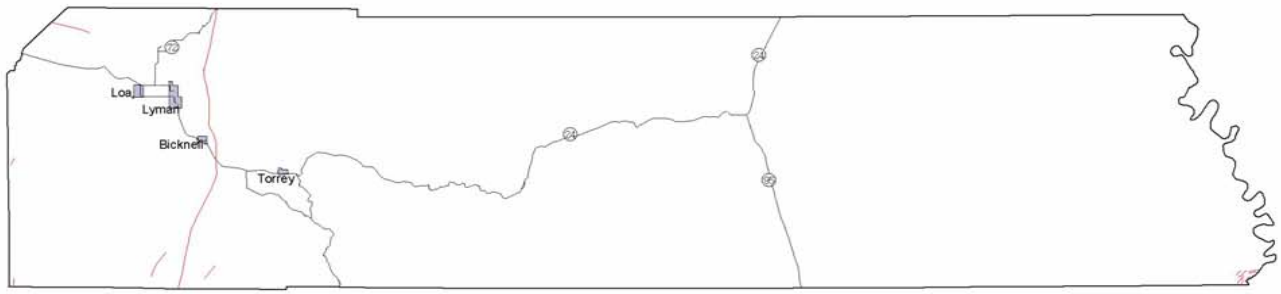
- Mill Meadow

Table 26: High Risk Dam

Name	Year Completed	Type	Storage Acre Feet	Breach Flow cfs
Mill Meadow	1954	Earth Fill	5232	116000

Note on the Wayne County Maps

The Town of Hanksville was incorporated in 1997, but somehow missed by the U.S. Census of 2000. Since the following maps are based on official census data, Hanksville Town was inadvertently excluded. Hanksville Town is located at the intersection of Utah Highways 24 and 95 in eastern Wayne County. During the vulnerability analysis Hanksville is considered as part of the county total.



Quaternary Faults 1.1

Wayne County Quaternary Faults

Major Roads
Cities
County Boundary

Explanation

Quaternary Faults

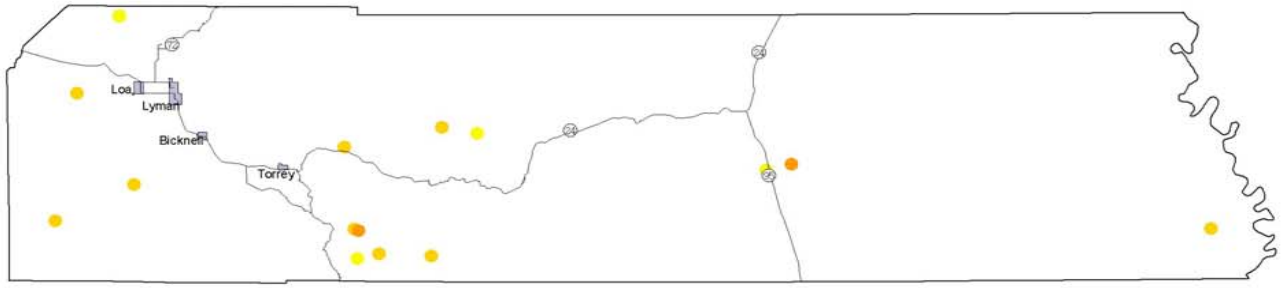
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

Epicenters 1.2

Wayne County Epicenters



Major Roads
Cities
County Boundary

Explanation

Epicenters by Magnitude

- 5 - 7
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

N W E S

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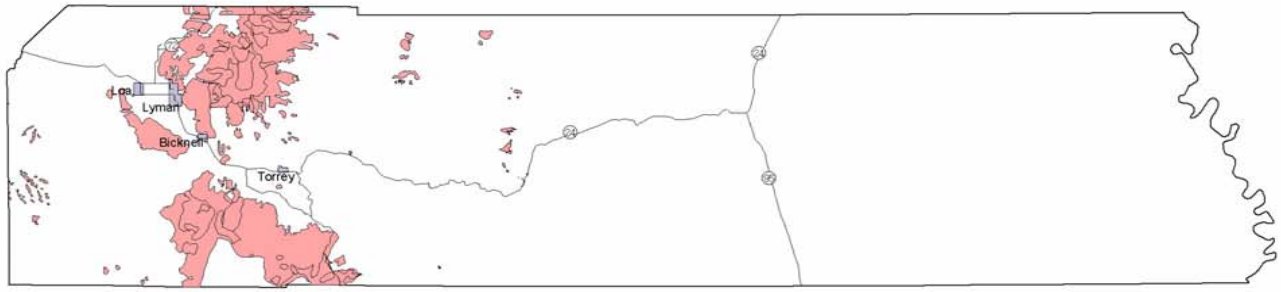
Landslides 3.1

Wayne County Landslides



Major Roads

Cities

County Boundary

Explanation

Landslides

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC

10 0 10 20 Miles

N
W E
S

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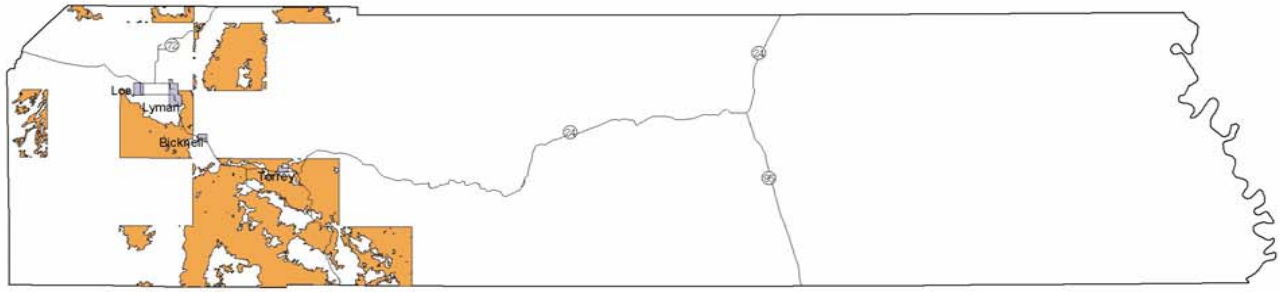
Wildfire Map 6

Wayne County Wildfire Risk



Major Roads
Cities
County Boundary

Fire Risk Explanation

Extreme
High
Moderate

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.

10 0 10 20 Miles

N
W E
S

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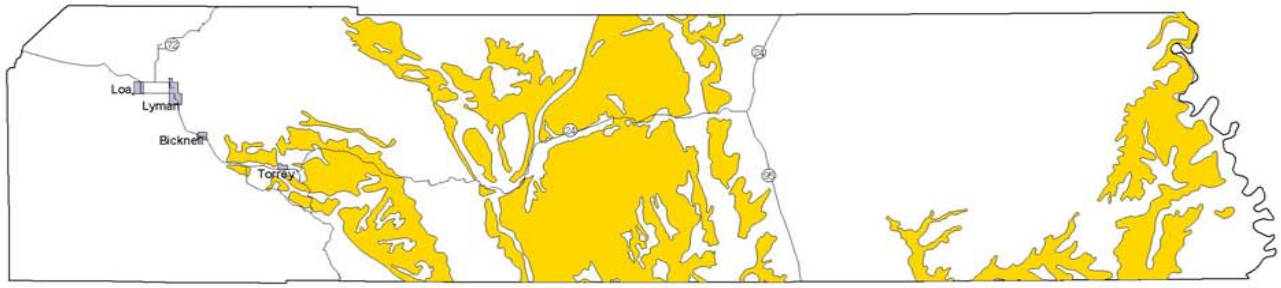
Problem Soil Map 5.1

Wayne County
Problem Soil Risk



Major Roads
Cities
County Boundary

Problem Soil Explanation

- Expansive Soils
- Limestone
- Silica Dunes
- Gypsum Dunes

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Problem soil data developed by Utah Geologic Survey and maintained by AGRC

10 0 10 20 Miles

N
W E
S

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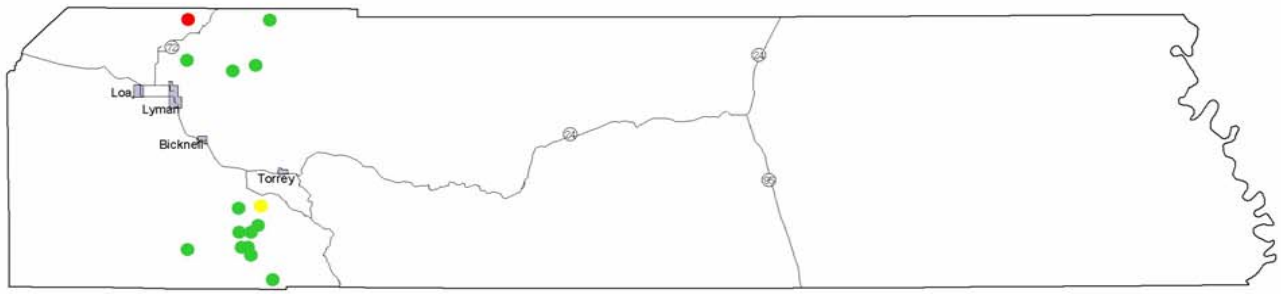


Dams and Impoundment Structures 6.1

Wayne County Dams and Impoundment Structures

Major Roads
Cities
County Boundary

Explanation

Dams and Impoundment Structures by Hazard Classification

- HIGH
- MOD
- LOW

Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Dam data created and maintained Utah Division of Water Rights Dam Safety Section

10 0 10 20 Miles

The information in this map was derived from digital databases housed within the Division of Emergency Services and Homeland Security. Care was taken in the creation of this map to insure accuracy, yet this map is provided "as is". DESHS cannot accept responsibility for any errors, omissions, and/or, positional accuracy, and therefore there are no warranties which accompany this product. Users are cautioned to field verify information contained within this product before making any decisions.

MITIGATION CAPABILITIES OF CERTAIN COUNTY AGENCIES

A. Wayne County Emergency Management

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

    a. Coordinate emergency planning and response activities with numerous county agencies. Planning encompasses preparedness, response, recovery, and mitigation.

    b. Responsible for everyday operations of the county's Emergency Operations Center.

    c. Update and exercise emergency operations and mitigation plans.

    d. Coordinate state sponsored training for county agencies including; law enforcement, public health, social services, fire departments, emergency medical services, etc.

    e. Coordinate the county's Local Emergency Planning Committee. (meets quarterly)

    f. Coordinate the county's Tier Two reporting. (hazardous materials)

    g. Public awareness and educational programs via newspapers, radio, and schools to decrease vulnerability to hazards.

    h. Work with schools and local businesses to help create site-specific hazard response plans and present in-service education to local business employees.

    i. Responsible for timely and effective public information releases during emergency situations.

    j. During a disaster declaration, emergency management has all county resources at their disposal including manpower, communications, and equipment.

    k. Have verbal mutual aid agreements with Millard, Piute, Sanpete, Sevier, and Wayne County Emergency Management Agencies for necessary resources during a disaster situation.

l. With effective planning, training, and exercising, emergency management can help to mitigate potential hazards within the county.

m. Assist in damage assessment and coordinate with state and federal agencies for recovery assistance.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

   a. In coordination with the Six County Association of Governments, assist with applications for federal and state funding such as the Hazard Mitigation Grant Program.

   b. Involved with inspecting hazardous material storage sites and fulfilling Tier Two reporting requirements.

   c. Participate in dam inspections with the Army Corp of Engineers.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Wayne County Emergency Management coordinates with appropriate local agencies to ensure preparedness, response, recovery, and mitigation. These agencies include:

   Wayne County Commissioners, Wayne County Road Department, Wayne County Sheriff Department, various other law enforcement, fire, communication, and emergency medical agencies.

   b. Non-local Agencies: Wayne County Emergency Management coordinates with numerous state and federal agencies. These agencies include the Utah Division of Emergency Services and Homeland Security, Utah Highway Patrol, State Health Department, Department of Transportation, and Federal Emergency Management Agency.

4. General recommendations/Emergency Management concerns:

   a. Provide listings of eligible mitigation projects so counties can be prepared when funds become available.

   b. Warning systems and sirens are outdated and inadequate. At this time, funding is not available for improvements.

c. County needs to add natural hazard mitigation to the General Plan and to the zoning and subdivision ordinances. Existing zoning requirements for flood plain management need to be enforced.

d. The existing addressing system is outdated and confusing for emergency responders and needs to be unified, revised and clarified, including the installation of appropriate signage. Outside as well as local funding should be sought for implementation of this project.

B. <u>Wayne County Highway Department *</u>

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

   a. Design bridges, culverts, and overflow sections. The County Highway Department follows a very detailed list of design standards for all projects within the county.

   b. Continually working with the Utah Department of Transportation (UDOT) on various projects since the UDOT dispenses federal funding. While the UDOT provides technical advice concerning guidelines and standards, they do not provide equipment, materials, or personnel.

2. Responsibility and authority in the regulating, inspecting or funding of projects:

   a. Responsible for and have authority to regulate and inspect all projects completed within the county.

   b. All projects funded by the state or federal government are designed by a consulting engineer and meet the usual acceptable federal standards. Inspection of federal aid projects is the responsibility of the consulting engineering company and is overseen by the county to ensure standards are met. Many county projects are designed with in-house expertise and engineers are consulted if problems arise.

   c. All funding in one-way or another comes through the county, whether it is a certain percentage of the federal aid project or 100% of the county projects.

3. Leadership and coordination with other government agencies:

a. Local Agencies: The County Highway Department has little interaction with other county agencies concerning roads and bridges. They do, however, coordinate with various county agencies concerning right of way and right of way purchasing. The legal aspect of right of way purchasing is overseen by the States Attorney's Office. The land values are usually developed by the Tax Equalization Office and approved by the County Commission.

b. Non-local Agencies: The County Highway Department coordinates with various State and Federal agencies for technical assistance, permitting, environmental concerns, archeological sites, and cultural issues. These agencies include the Utah Department of Transportation, US Fish and Wildlife, Corp of Engineers, and the Utah Historical Society.

4. General recommendations/Emergency Management concerns:

a. Wayne County Highway Department should assist local government with floodplain management and water development permitting.

b. Assist with a re-addressing project as needed.

C. Central Utah Public Health

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions)

a. Deal with bona fide health hazards using cause and effect in those areas for both mitigation and risk reduction. If it is a hazard affecting any number of persons and within the scope of public health, Central Utah Public Health (CUPH) will mitigate or exercise risk reduction through several methods ranging from enforcement of statutes to immunization programs.

b. Environmental Health has the knowledge and also access to the State Health Department for mitigation of incidents with hazardous or toxic wastes.

c. Programs include; waste water treatment, water pollution, public health nursing, immunization programs, solid waste regulation, food establishment inspections, air quality, and vector control.

2. Responsibility and authority in the regulating, inspecting or funding of projects.

a. CUPH Health is a unit of state government that operates through agreements or Memorandums of Understanding with the Utah Department of Health to enforce state public health statutes within the Six County district. Tax levies provide funding. There are no funding programs for non-operational programs.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Within the scope of public health, CUPH coordinates with the following local agencies; Wayne County Emergency Management, Wayne County Emergency Medical Service, local law enforcement agencies (city and county), local school boards, and planning and zoning agencies.

   b. Non-local Agencies: Within the scope of public health, CUPH coordinates with the following agencies; Utah Department of Health and state and federal law enforcement agencies.

4. General recommendations/Emergency Management concerns:

   a. Public Health is normally under funded and understaffed at all levels of government. Should CUPH be called upon for expertise at a time of emergency or disaster, it normally does not have instrumentation for site level determinations of any kind without support from other agencies.

   b. Public health agencies should be included in equipment storage; e.g., FEMA equipment "stored" and used at public health agencies, rather than being stored at a warehouse. For example, radio equipment that belongs to FEMA is based at county emergency management offices; the same could be done with air sampling equipment or other instruments/kits etc., which could be used by public health agencies both for daily work and at a time of emergency or disaster.

D. Wayne County Sheriff's Department

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

   a. Responsible for law enforcement and criminal investigation in unincorporated areas of the county and in smaller towns that do not have police departments.

b. Provide standard law enforcement manpower and equipment.

c. In disaster situations, provide; warning, rescue assistance, evacuation assistance, security, traffic control, and information assistance.

d. Provide public awareness and educational programs. (911 education, safe kids program, etc.)

e. Have mutual aid agreements with all surrounding counties and the Utah State Highway Patrol.

2. Responsibility and authority in the regulating, inspecting, or funding of projects:

a. None

3. Leadership and coordination with other government agencies:

a. Local Agencies: Within the scope of law enforcement, the Wayne County Sheriff's Department coordinates with various local agencies. These agencies include Wayne County Emergency Management and various local police departments.

b. Non-local Agencies: Wayne County Sheriff's Department coordinates with appropriate state and federal agencies including; Utah Highway Patrol, Utah Attorney Generals Office, Bureau of Criminal Identification, Utah Department of Transportation, National Park Service, National Forest Service, Bureau of Land Management and Federal Bureau of Investigation.

4. General recommendations/Emergency Management concerns:

a. Coordinate with and participate in local intra-agency planning and exercise endeavors.

E. Wayne Fire District

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

a. Respond to fires in order to protect lives, limit injuries, and minimize damage to property and the environment.

b. Respond to accidents in order to provide rescue assistance.

c. Assist Emergency Medical Services in providing emergency assistance to sick and injured. (first responders)

d. Provide standard firefighting manpower and equipment.

e. Respond to spills and releases of hazardous materials and assist in mitigating the detrimental human and environmental effects of these occurrences.

f. Respond to emergencies resulting from natural occurrences such as storms, floods, etc., and assist in mitigating the detrimental results of these occurrences.

g. Provide training for department members that will enable them to effectively and efficiently carry out their respective duties and responsibilities.

h. Develop and provide educational programs that promote the prevention of fires and encourage fire-safe and fire-smart activities.

i. Assist in enforcement of city fire ordinances.

j. Fire investigation.

k. Provide assistance to other jurisdictions, as department resources and commitments allow. Wayne Fire District has mutual aid agreements with Juab, Millard, Piute, Sanpete and Sevier Counties.

l. Inspections and preplanning within the fire district to reduce hazards and aid in fire prevention.

m. Assist with the county's tier two reporting. (Hazardous materials storage sites)

n. In disaster situations, provide assistance in warning, rescue, evacuation, and situation updates.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. None

3. Leadership and coordination with other government agencies:

   a. Local Agencies: In efforts to decrease vulnerability to hazards, the Wayne Fire District coordinates with various local agencies. These

agencies include Wayne County Emergency Management, Wayne County Sheriff's Department, Loa Fire Department, Hanksville Fire Department, Lyman Fire Department, Torrey Fire Department, local Public Works, and local Emergency Medical Services.

b. Non-local Agencies: Utah State Fire Marshal and the Federal Emergency Management Agency, Dixie National Forest, Fishlake National Forest, National Park Service and Bureau of Land Management.

4. General recommendations/Emergency Management concerns:

Our district has seen an increase in number and variety of calls. As first responders, we have to train and equip our fire departments for various situations that may arise, such as: vehicle extrication, various types of hazardous materials, and many other types of responses. Each added type of response increases the need for equipment and the time our volunteers need to spend in training. With the recent decrease in population in our district, volunteer retention and recruitment is also a concern.

a. Seek funding outside of the district for additional equipment that will improve the effectiveness of our responses as well as increase the margin of safety for our volunteers.

b. Explore training options to cover the expanding variety of responses in our district.

c. Look into recruitment and retention programs that will work in our district.

F. Utah State University Extension Service *

1. Mitigation and Risk Reduction: (including agency's role, capabilities, and programs that support mitigation actions.)

a. The Utah State University Extension Service provides practical, research-based information and educational programs to address critical issues facing individuals, families, agricultural producers, business operators, and communities.

b. County Extension Agents serve as subject-matter experts, educational planners, adult and youth teachers and community facilitators in several areas including agriculture and natural

resources, horticulture, family and consumer sciences, 4-H and youth community development.

c. Provide planning, designing, implementing, and evaluating of educational programs for livestock and forage clientele.

d. Areas of responsibility include beef and dairy cattle, swine, other livestock, water quality, waste management, and forages.

e. Provide programming for county citizens in the areas of family financial management, environmental concerns, housing, health and wellness, aging, foods and nutrition, parenting, and human development.

f. Serve as an information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc.

g. Assist with damage assessment related to agriculture.

2. Responsibility and authority in regulating, inspecting, or funding of projects:

   a. Authority is at federal level.

3. Leadership and coordination with other government agencies:

   a. Local Agencies: Wayne County Emergency Management and Central Utah Public Health.

   b. Non-local Agencies: Utah State University, Utah State Health Department, United States Department of Agriculture, and Farm Service Agency.

4. General recommendations/Emergency Management concerns:

   a. None.

OTHER AGENCY RESOURCES

A. Mitigation and risk reduction:

1. Wayne County Social Services: Temporary assistance to needy families, food stamps, medically needy programs, adult services, homeless assistance, family planning, etc.

2. Army Corps of Engineers: Water and dam management within the county. Provide technical expertise, sandbags, and heavy equipment.

3. Utah Highway Patrol: Situation and damage assessment; provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance; traffic control.

4. State Fire Marshal: Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.

5. Forestry, Fire & State Lands: Debris removal from recreational facilities; technical assistance; situation and damage assessment.

6. Utah Division of Wildlife Resources: Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.

7. State Radio Communications: Exercise readiness of warning systems and communication support.

8. Department of Agriculture: Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.

9. Department of Workforce Services: Situation assessment and administration of disaster unemployment assistance programs.

10. Human Services: Insure liaison with private relief agencies for disaster victims.

11. State Historical Society: Project screening and situation assessment.

Annex 8 -- Prioritization of Mitigation Projects

Specific mitigation projects to minimize impact of potential natural hazards were developed by all 54 participating jurisdictions and two bands of the Paiute Indian Tribe of Utah (see Table 1). These projects were assigned a priority of high, medium, or low by the Six County PDM Core Planning Team using input from each jurisdiction and emergency manager in the Six County Region. Priorities were given taking into account the following factors:

- Number of people protected by the project
- Technical feasibility
- Political support
- Environmental impacts
- Available funding sources

A guiding factor in prioritizing mitigation was the thought that mitigation should provide the greatest amount of good to the greatest amount of people when cost was taken into account. Prioritizing mitigation was difficult in this plan since the Six County Region is vulnerable to many different hazards, each with its own characteristics. Thus, recurrence intervals, past events, damage estimates compiled during the assessing vulnerability section of this plan were also taken into account.

Table 1: Prioritization of Mitigation Projects

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Multihazard	Public Education to mitigate casualties.	High	Schools, Emergency Mgmt. (EM) in Six County Region	Counties, State, Federal	Entire Six County Region	$200,000/yr.	Ongoing	Increased ability to educate public of hazard risks and preparedness.
Multihazard	Educating Community Emergency Response Teams (CERTs).	High	EM in Six County Region, CERT Trainers	Counties, State, Federal	Entire Six County Region	$18,000/yr.	Ongoing	Increased ability to educate first responders of hazard risks and preparedness.
Multihazard	Update Zoning Ordinances to prevent development in identifiable hazardous areas.	High	EM and County Planning Staff in Six County Region	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Prevents property damage and casualties due to hazards at moderate cost.
Multihazard	Join National Weather Service Strom Ready program.	Medium	EM in Six County Region	Counties NOAA	Entire Six County Region	Minimal	3 years	Participating jurisdictions will be ready for severe weather

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Earthquake	Seismically retrofit culinary water pipeline to withstand earthquake.	Medium	Levan Water Company	Unknown	Levan Town and Juab County	Unknown	Depends on Funding	Levan will still have adequate water after earthquake strikes.
Earthquake	Identify and Retrofit high risk public buildings and churches to prevent earthquake damage.	Low	EM in Six County Region, Building Inspectors	Cities, Towns, Counties, State, Federal	Entire Six County Region	$400,000,000	Depends on Funding	Will minimize property damage and casualties due to earthquake.
Flood	Adopt a No Special Flood Hazard Area (NSFHA) ordinance for certain municipalities outside of any floodplain.	Medium	Municipalities and Counties affected	Cities, Towns, Counties, State	Centerfield Town, Lynndyl Town	Unknown	Depends on Funding	Enables those municipalities at low risk to flood to concentrate on mitigating other hazards.
Flood	Build dike structure up to divert flood.	Medium	Juab County EM, Levan Town	County, State, Federal	Levan Town and Juab County	$5,000	Depends on Funding	Will prevent property damage and casualties due to flood.
Flood	Build debris basins on both Pigeon and Chicken Creeks. Protect the road and the culinary water line up Chicken Creek Canyon.	Medium	Juab County EM, Levan Town	County, State, Federal	Levan Town and Juab County	$3,000,000	Depends on Funding	Will alleviate flood damage to roads and water mains.
Flood	Build levees along the eastside drainage and a dyke on the west side of town to prevent flooding from Currant Creek and Mona Reservoir.	Medium	Juab County EM, Mona Town	County, State, Federal	Mona Town and Juab County	$400,000	Depends on Funding	Will help prevent property damage and casualties due to flood.
Flood	Install curb, gutter and storm drain system.	Medium	Juab County EM, Eureka City	City, County, State, Federal	Eureka City	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Evaluate and flood proof at risk buildings, particularly critical facilities.	Medium	Municipalities and Counties affected	City, Town, County, State, Federal	Fayette Town, Fountain Green City, Rocky Ridge Town, Wales Town	$70,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Chalk Creek flood control Project.	High	Fillmore City, Millard County EM	City, County, State, Federal	Fillmore City, Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Minor Flood Channeling along county roads.	Medium	Millard County Road Dept.	County, State, Federal	Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Clean Scipio Canal.	Medium	Scipio Town, Millard County EM	Town, County, State, Federal	Scipio Town, Millard County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Build flood ponds for Marysvale Town.	Medium	Marysvale Town, Piute County EM	Town, County, State, Federal	Marysvale Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control channel to divert flood from Revenue Gulch to Bullion Creek.	Medium	Marysvale Town, Piute County EM	Town, County, State, Federal	Marysvale Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control dykes between Circleville Town and the Sevier River.	Medium	Circleville Town, Piute County EM	Town, County, State, Federal	Circleville Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Dredge Sevier River near Circleville Town.	Medium	Circleville Town, Piute County EM	Town, County, State, Federal	Circleville Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood control pond in Kingston Canyon	Medium	Kingston Town, Piute County EM	Town, County, State, Federal	Kingston Town, Piute County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Construct flood control levees along Uinta/Gammett and Fountain Green Creeks.	Medium	Fountain Green City, Sanpete County EM	City, County, State, Federal	Fountain Green City, Sanpete County	$1,000,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Extend existing levee at mouth of Wales Canyon south.	Medium	Wales Town, Sanpete County EM, FS	City, County, State, Federal	Wales Town, Sanpete County	$150,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install SNOTEL site in the watershed of Canal Creek at 7,500' elevation.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Place a Stream Gauge on Canal Creek at the upper diversion.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Increased ability to warn inhabitants in these cities; Decreased risk of property damage and casualties due to flooding.
Flood	Perform watershed calibration study and a FLO 2D study of Canal Creek.	Medium	State Division of Emergency Services (DES), Natural Resource Conservation Service (NRCS), Sanpete County	Cities, County, State, Federal	Ephraim, Mt. Pleasant, and Spring Cities, Sanpete County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Storm Water Management Plan/Infrastructures	Medium	Ephraim City, Sanpete County EM	City, County, State, Federal	Ephraim City, Sanpete County	$35,000	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Construct flood channels in Ephraim City.	Medium	Ephraim City, Sanpete County EM	City, County, State, Federal	Ephraim City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct channels for flood mitigation in Fairview City.	Medium	Fairview City, Sanpete County EM	City, County, State, Federal	Fairview City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Purchase generator for 2nd water pump	Medium	Fairview City, Sanpete County EM	City, County, State, Federal	Fairview City, Sanpete County	$10,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Dig flood control ditch east of Fayette Town.	Medium	Fayette Town, Sanpete County EM	Town, County, State, Federal	Fayette Town, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Increase size of culvert pipe at Fayette Town.	Medium	Fayette Town, Sanpete County EM	Town, County, State, Federal	Fayette Town, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Level out creek bed to mitigate flooding in Gunnison.	Medium	Gunnison City, Sanpete County EM	City, County, State, Federal	Gunnison City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct flood diversion canal at mouth of Manti Creek Canyon.	Medium	Manti City, Sanpete County EM	City, County, State, Federal	Manti City, Sanpete County	Unknown	Depends on Funding	Decreased risk of casualties and property damage to hydroelectric power plant and 50 homes ($5,250,000) due to flooding;
Flood	Dig flood control channels near Mt. Pleasant City.	Medium	Mt. Pleasant City, Sanpete County EM	City, County, State, Federal	Mt. Pleasant City, Sanpete County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Strengthen canal outside Aurora City.	Medium	Aurora City, Sevier County EM	City, County, State, Federal	Aurora City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Build Utah Department of Transportation (UDOT) bridge above state canal north of Aurora City.	Medium	Aurora City, Sevier County EM, UDOT	City, County, State, Federal	Aurora City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Rebuild flood retention ponds in Glenwood Town.	Medium	Glenwood Town, Sevier County EM	Town, County, State, Federal	Glenwood Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Update flood map for Glenwood Town	Medium	Glenwood Town, Sevier County EM, FEMA	Town, County, State, Federal	Glenwood Town, Sevier County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Perform a flood engineering study for Koosharem Town.	Medium	Koosharem Town, Sevier County EM	Town, County, State, Federal	Koosharem Town, Sevier County	Unknown	Depends on Funding	Increased ability to determine proper mitigation of flood risk; Decreased risk of property damage and casualties due to flooding.
Flood	Construct concrete barriers and built up beams in Joseph Town.	Medium	Joseph Town, Sevier County EM	Town, County, State, Federal	Joseph Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade existing culverts to mitigate flood in Salina City.	Medium	Salina City, Sevier County EM	City, County, State, Federal	Salina City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install storm drain system in Redmond Town.	Medium	Redmond Town, Sevier County EM	Town, County, State, Federal	Redmond Town, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Maintain flood retention walls for Richfield City.	Medium	Richfield City, Sevier County EM	City, County, State, Federal	Richfield City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade storm drain system in Richfield City.	Medium	Richfield City, Sevier County EM	City, County, State, Federal	Richfield City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct small debris basin in Bertelson Canyon to mitigate flooding in Monroe City.	Medium	Monroe City, Sevier County EM	City, County, State, Federal	Monroe City, Sevier County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Span culinary water lines over Sand Creek to avoid flood damage to lines.	Medium	Torrey Town, Wayne County EM	Town, County, State, Federal	Torrey Town, Wayne County	Unknown	Depends on Funding	Decreased risk of damage to culinary water lines due to flooding.
Flood	Construct culverts to prevent washing out north of Bicknell.	Medium	Bicknell Town, Wayne County EM	Town, County, State, Federal	Bicknell Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Install larger pipe on Bull Creek in Hanksville Town.	Medium	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Upgrade flood dyke that drains into Bull Creek.	High	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Improve drainage system to prevent flooding in Hanksville Town.	Medium	Hanksville Town, Wayne County EM	Town, County, State, Federal	Hanksville Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Flood	Construct new reservoir to prevent flooding in Lyman Town.	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	Unknown	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Improve High Line Ditch to increase its flood capacity	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	$300,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Flood	Construct a mile long deflector levee.	Medium	Lyman Town, Wayne County EM	Town, County, State, Federal	Lyman Town, Wayne County	$300,000	Depends on Funding	Decreased risk of property damage and casualties due to flooding.
Landslide	Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.	Medium	EM in Six County Region.	Counties, State, Federal	Entire Six County Region	Unknown	Depends on Funding	Decreased risk of casualties due to landslides, enhanced warning for inhabitants.
Wildfire	Participate in the Utah Living with Fire Program. Particularly, at risk communities as identified in the National Fire Plan should be involved.	Medium	County Fire Wardens, FFSL, EM in Six County Region	Counties, State	Entire Six County Region	Minimal	2006	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	County ordinances requiring defensible space, water source development, proper road width and escape routes in fire prone areas.	High	County Fire Wardens, LEPC, County Zoning Commissions	Counties, State	Hotspots throughout Six County Region	$30,000	2005	Decreased risk of property damage and casualties due to uncontrolled wildfires.
Wildfire	Establish defensible space around forest and city structures, water source development, escape routes, and controlled burns.	High	Forest Service (FS), BLM, County Fire Wardens, State Forestry, Fire and State Lands (FFSL), LEPC, Homeowners Associations	National Fire Plan (NFP), Healthy Forests Initiative (HFI)	Hotspots throughout Six County Region	$45,000,000	Depends on Funding	Decreased risk of property damage and casualties due to uncontrolled wildfires.

Hazard	Project	Priority	Responsible Agency	Possible Funding Sources	Jurisdiction Affected	Estimated Project Cost	Estimated Completion Date	Benefits
Dam Failure	Regularly monitor high hazard dams, strengthening them when necessary.	High	Local Water Companies, LEPC, Utah Department of Natural Resources (DNR)	Counties, Utah DNR, Federal	High Hazard Dams identified in each county annex.	Unknown	Depends on Funding	Increased ability to prevent dam failure and warn public of impending dam failure.
Drought	Develop additional water sources and storage as well as implement conservation plans.	High	Kanosh Band Water Company	State, Federal	Kanosh Band, Paiute Tribe of Utah	Unknown	Depends on Funding	Reduces risk of crop damage from drought.
Severe Weather	Plant trees west of towns at high risk of windstorms.	Medium	Towns, County EM	Towns, County, State, Federal	Hinckley, Lynndyl, and Oak City Towns in Millard County	Unknown	Depends on Funding	Reduces risk of damage and casualties due to windstorms.

Appendix - A

Hazard Definitions

Flooding

Flooding is a temporary overflow of water onto lands not normally inundated by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss, and interruption of business. Floods also increase the likelihood of hazard such as transportation accidents, contamination of water supplies, and health risk increase after a flooding event.

Several factors determine the severity of floods including rainfall intensity, duration and rapid snowmelt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having, impermeable surfaces such as large parking lots, paved roadways, or post burned areas with hydrophobic soils. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

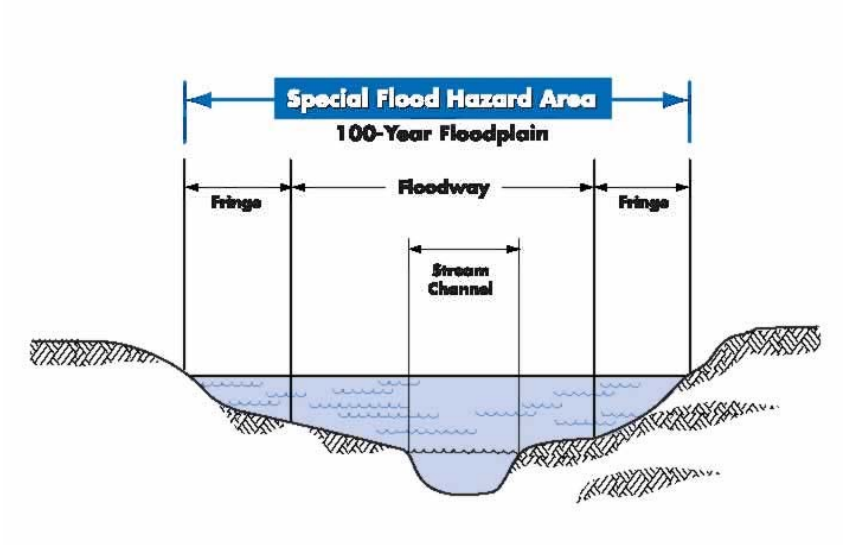
Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs during a particular season or in regions where annual flooding is due to spring melting of winter snow pack, areas at risk may be inundated nearly every year.

Conditions that may exacerbate floods:
Impermeable surfaces
Steeply sloped watersheds
Constrictions
Obstructions
Debris
Contamination
Soil saturation
Velocity

Explanation of Common Flood Terms **Figure A-1**

FIRM: Flood Insurance Rate Map

100-year flood (see Figure A-1): Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100 year-flood is also referred to as the base flood.



Base Flood: Is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

National Flood Insurance Program (NFIP): The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

Special Flood Hazard Area (SFHA): Is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

Floodway: Is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising that water surface elevation by more than one foot.

Earthquakes

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks when they can no longer withstand the stresses, which build up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. When rocks break they produce seismic waves that are transmitted through the rock outward producing ground shaking. Earthquakes are unique multi-hazard events, with the potential to cause huge amounts of damage and loss. Secondary effects of a sudden release of seismic energy (earthquake) include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, slope failure, and various types of flooding.

The Intermountain Seismic Belt

The Intermountain Seismic Belt (ISB), which Six County is part of, is a zone of pronounced earthquake activity up to 120 miles wide extending in a north south direction 800 miles from Montana to northern Arizona. The Utah portion of the ISB trends from the Tremonton Cache Valley area south through the center of the state, along the Wasatch Front, and the southwest through Richfield and Cedar City concluding in St. George. "The zone generally coincides with the boundary between the Basin and Range physiographic province to the west and the Middle Rocky Mountains and Colorado Plateau physiographic provinces to the east" (Eldredge 6).

Secondary Earthquake Threats

The major secondary effects of earthquakes include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, avalanches, rock fall, slope failure, and various types of flooding. Other sections discuss landslides, and flooding therefore they will not be discussed under secondary effects of earthquakes yet importance needs to be given to the fact that earthquakes can increase the likelihood of flooding and landslides.

Ground Shaking

Ground shaking causes the most impact during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated by earthquakes. Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves cause more damage to short stiff structures, were as low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). The PGA measures the rate in change of motion relative to the established rate of acceleration do to gravity.

Local geologic conditions such as depth of sediment and sediment make up, affect earthquake waves. Deep valley sediments increase the frequency of seismic waves relative to bedrock. In general, ground shaking increases with increased thickness of sediments" (Eldredge 8). Findings in recent geologic research done by Ivan Wong indicate and earthquake in Salt Lake County would produce higher PGA values than previously expected near faults and areas of near surface bedrock.

Surface Fault Rupture

During a large earthquake fault movement may propagate along a fault plain to the surface, resulting in surface rupture along the fault plain (see Picture A-1). The Wasatch fault is a normal (mountain building) fault with regards to movement, meaning the footwall of the fault moves upward and the hanging wall moves in a down direction. Thus faulting is on a vertical plain, which results in the formation of large fault scarps. Surface fault rupture along the Wasatch fault is expected for earthquakes with magnitudes of 6.5 or larger. The largest probable earthquake that could strike the Six County region is an earthquake with an estimated magnitude between 7.0 and 7.5; an earthquake of this magnitude, based on current research, would create "surface fault rupture with a displacement of between 16 to 20 feet in height with break segments 12 to 44 miles long" (Eldredge 10). In historic time surface fault rupture has only occurred once in Utah; the 1934 Hansel Valley earthquake with a magnitude 6.6 produced 1.6 feet of vertical offset.

Surface fault rupture presents several hazards, anything built on top of the fault or crossing the fault has a high potential of destroyed in the event of displacement. Foundations will be cracked, building torn apart, damage to roads, utility lines, pipelines, or any other utility line crossing the fault. It is almost impossible to design anything within reasonable cost parameters to with stand an estimated displacement of 16 to 20 feet.

Picture A-1: Displacement in excavation

Surface fault rupture doesn't occur on a single distinct plain; instead it occurs over a zone often several hundred feet wide known as the zone of deformation. This zone of deformation occurs mainly on the down thrown side of the main fault trace. Tectonic subsidence, caused by antithetic faults moving in the opposite direction of the main fault, slide down hill on the main fault scarp creating grabens (down dropped blocks) within the zone of deformation.

Liquefaction

Soil liquefaction occurs when water-saturated cohesion less sandy soils are subject to ground shaking. When liquefaction occurs soils behave more like a viscous liquid (quicksand) and lose their bearing capacity and shear strength. Two conditions must be met in order for soils to liquefy: (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy (lips). The loss of shear strength and bearing capacity due to liquefaction causes buildings to settle or tip and light buoyant structures such as buried storage tanks and empty swimming pools to float upward. Liquefaction can occur during earthquakes of magnitude 5.0 or greater.

Lateral Spread
Soils, once liquefied, can flow on slopes with angles of .5 to 5 percent this movement of liquefied soils is known as lateral spread. "The surficial soil layers break up and sections move independently, and are displaced laterally over a liquefied layer" (Eldredge 10). Liquefaction can cause damage in several ways, with lateral spreading being one of the most common. Displacement of three (3) or more feet may occur and be accompanied by ground cracking and vertical displacement. Lateral spreading causes roads, buildings, buried utilities, and any other buried or surface structure to be pulled apart.

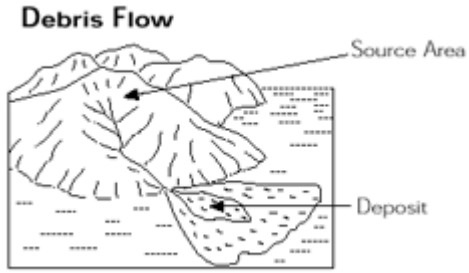
Various Flooding Issues Related to Earthquakes
Earthquakes could cause flooding due to the tilting of the valley floor, dam failure and seiches in lakes and reservoirs. Flooding can also result from the disruption of rivers and streams. Water tanks, pipelines, and aqueducts may be ruptured, or canals and streams altered by ground shaking, surface faulting, ground tilting, and land sliding.

Seiches
Standing bodies of water are susceptible to earthquake ground motion. Water in lakes and reservoirs may be set in motion and slosh from one end to the other, much like in a bathtub. This motion is called a seiche (pronounced “saysh”). A seiche may lead to dam failure or damage along shorelines.

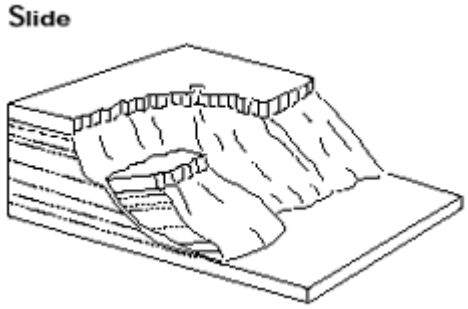
Landslides

Landslides are a “down slope movement of a mass of rock, earth, or debris”. Landslides, often referred to as mass wasting or slope failures, are one of the most common natural disasters. (Cruden 36). Slope failures can vary considerably in shape, rate of movement, extent, and effect on surrounding areas. Slope failures are classified by there type of movement, and type of material. The types of movement are classified as falls, slides, topples, and flows. “The types of material include rock, debris (coarse grained soil) and earth (fine grained soil)” (Eldredge 17). “Types of slope failures then are identified as rock falls, rock slides, debris flows, debris slides, and so on” (Eldredge 17). Slope failures occur because of either an increases in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). “Geology (rock type and structure), topography (slope gradient), water content, vegetative cover, and slope aspect are important factors of slope stability” (Eldredge 18).

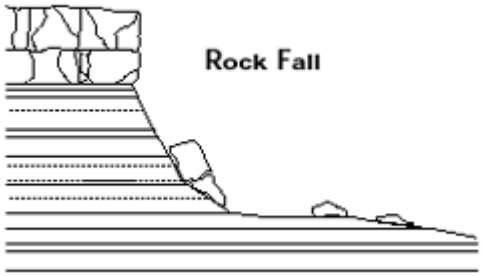
Figure A-2: Three Common Types of Landslides in Utah



Debris flows consist of sediment-water mixtures that flow down a streambed or hillside, commonly depositing sediment at canyon mouths in fan like deposits know as alluvial fans.



Slides are down slope movements of soil or rock on slopes.



Rock falls consist of rock(s) falling from a cliff or cut slope and are very common in the canyon country of southern Utah.

Conditions That Make Slopes More Susceptible to Landslides

- Discontinuities: faults, joints, bedding surfaces.
- Massive Materials over soft materials.
- Orientations of dip slope: bedding plans that dip out of slope.
- Loose structure and roundness.
- Adding weight to the head of a slide area: rain, snow, landslides, mine waste piles, buildings, leaks from pipes, sewers, and canals, construction materials fill materials.
- Ground shaking: earthquakes or vibrations.
- Increase in lateral spread caused by mechanical weathering.
- Removal of lateral support.
- Human activities: cut and fill practices, quarries, mine pits, road cuts, lowering of reservoirs.
- Removing underlying support: under cutting of banks in a river.
- Increase in pore water pressure: snow melt, rain, and irrigation.
- Loss of cohesion.

Wildfire

Identifying Hazards

A wildfire is an uncontrolled fire spreading through vegetative fuel often exposing or consuming structures. Wildfires often begin unnoticed and spread quickly and are usually sighted by dense smoke. Wildfires are placed into two classifications Wildland and Urban-Wildland Interface. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. URWIN areas are divided into three subclasses, each evident in counties within Six County:

- **Occluded**
  Occluded interface, are areas of wild lands within an urban area for example a park bordered by urban development such as homes.

- **Intermixed**
  Mixed or intermixed interface areas contain structures scattered throughout rural areas covered predominately by native flammable vegetation.

- **Classic**
  Classic interface areas are those areas where homes press against wildland vegetation along a broad front.

When discussing wildfires it is important to remember that fires are part of a natural process and are needed to maintain a healthy ecosystem. Three basic elements are needed for a fire to occur (1) a heat source (2) oxygen and (3) fuel. Two of the three sources are readily available in the counties making up the Six County region. Major ignition sources for wildfire are lightning and human causes such as arson, recreational activities, burning debris, and carelessness with fireworks. On average, 65 percent of all wild fires started in Utah can be attributed to human activities. Once a wildfire has started, vegetation, topography and weather are all conditions having an affect wildfire behavior.

Severe Weather

For the purpose of this mitigation plan the term severe weather is used to represent downbursts, lightning, heavy snowstorms, blizzards, avalanches, hail, and tornados.

Downbursts

A downburst is a severe localized wind, blasting from a thunderstorm. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories by size. Microburst, which cover an area less than

2.5 miles in diameter, and macro burst, which cover an area with a diameter larger 2.5 miles.

Lightning

During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightning is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes too great, there is a discharge of electricity that we know as lightning.

Heavy Snowstorms

A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to 20° F or lower. All winter storms make driving extremely dangerous.

Blizzards

A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Avalanches

Avalanches are a rapid down-slope movement of snow, ice, and debris. Snow avalanches are a significant mountain hazard in Utah, and nationally account for more deaths each year than earthquakes. Avalanches are the result of snow accumulation on a step slope and can be triggered by ground shaking, sound, or a person. Avalanches consist of a starting zone, a track, and a run-out zone. The starting zone is where the ice or snow breaks loose and starts to slide. The Track is the grade or channel down which an avalanche travels. The run-out zone is where an avalanche stops and deposits the snow.

The two main factors affecting avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Additional factors that contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

Topography plays a vital role avalanche dynamics. Slope angles between 30 to 45 degrees are optimum for avalanches with 38 degrees being the bulls-eye. Slopes with an angle above 45 degrees continually slough eliminating large accumulation. The risk of avalanches decreases on slope angles below 30 degrees.

Types of Avalanches Common in Utah:

Dry or slab avalanches: occur when a cohesive slab of snow fractures as a unit and slides on top of weaker snow, breaking apart as it slides. Slab avalanches occur when additional weight is added quickly to the snow pack, overloading a buried weaker layer. Dry snow avalanches usually travel between 60-80 miles per hour, reaching this speed within 5 seconds of the fracture, resulting in the deadliest form of snow avalanche.

Wet avalanches: occur when percolating water dissolves the bonds between the snow grains in a pre-existing snow pack, this decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour.

Hail Storms

Hailstones are large pieces of ice that fall from powerful thunderstorms. Hail forms when strong updrafts within, the convection cell of a cumulonimbus cloud carries water droplets upward causing them to freeze. Once the droplet freezes, it collides with other liquid droplets that freeze on contact. These rise and fall cycles continue until the hailstone becomes too heavy and falls from the cloud.

Tornados

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornados often occur at the edge of an updraft or within the air coming down from a thunderstorm. Tornadoes can have wind speeds of 250 miles per hour or more, causing a damage zone of 50 miles in length and 1 mile wide. Most tornados have winds less than 112 miles per hour and zones of damage less than 100 feet wide

Waterspout

Waterspouts are simply tornadoes that form over warm water. This typically occurs in Utah during a cold fall or late winter storms.

Scale

Tornadoes are classified by wind damage using the Fujita Scale (see Table A-1). The National Weather Service has used the Fujita Scale since 1973. This scale uses numbers from 0 through 5 with higher numbers assigned based on the amount and type of wind damage.

Table A-1: Fujita Scale

Category F0	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lowers limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobiles-size missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Drought

Drought is a normal recurrent feature of climate, although many, in Utah, erroneously consider it a rare and random event. It occurs in virtually all-climatic zones, while its characteristics vary significantly from one region to another. Droughts, simple put, are cumulative hazards, which result from long periods of below normal precipitation. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate.

The State or Utah, uses the Palmer Drought Severity Index or (PDSI) to quantify the existence of a drought. Using the PDSI, drought is expressed as a negative number. Much of the basis, used by the State, to determine drought years, or drought periods, comes from the PDSI. In addition, the State Climatologist, the National Geophysical

Data Center of NOAA, and the National Drought Mitigation Center use the PDSI. Further information on the Palmer Drought Severity Index can be found in Appendix F.

For the most part droughts no longer affect the availability of drinking water, thus no longer place peoples lives at risk, the same can not be said for a persons livelihood. Numerous water projects throughout the state have place enough water in storage to insure drinking water. Prolonged droughts have a significant affect on agricultural and agribusinesses, within the state dependent on irrigation water. Droughts also stress wildlife, and heighten the risk of wildfire.

Dam Failure

Dam failures result from the failure of a man made water impoundment structure, which often results in catastrophic down grade flooding. Dam failures are caused by one or a combination of the following: "breach from flooding or overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, vegetation and rodents, poor construction, lack of maintenance and repair, misuse, improper operation, terrorism, or a combination of any of these" (Eldredge 46). The Utah State Engineer has been charged with regulating non-federal dams in the State dams since 1919. "In the late 1970's Utah started its own Dam Safety Section within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act (PL-92-367)" (Eldredge 46).

The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, the size, height, volume, and incremental risk/damage assessments or dams are all variables used to assign dam hazard ratings in Dam Safety's classification system. Using the hazard ratings systems developed by the Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years. There are 134 dams within Six County of those 26 have received a high hazard rating by Dam Safety.

Problem Soils

Problem soils and rock constitute a widespread geologic hazard in Utah, covering approximately 18 to 20 percent of the state, and underlie many urbanized areas. The nine types of problem soil and rock in Utah are:

- Expansive Soil
- Collapsible Soil

- Limestone and Karst Terrain
- Gypsiferous Soil
- Soil Subject to Piping
- Dunes
- Peat
- Mine Subsidence
- Sodium Sulfate

Problems soils affecting the Six County region include expansive soil and rock, limestone and karst terrain, silica dunes, and gypsum dunes.

Expansive Soil and Rock
Clay minerals found in soils and rock expand and contract due to changes in moisture content. The most common clay mineral associated with expansive soils in Utah is montmorillonite, "which expands up to 2,000 times its original size, and can exert pressures up to 11,000 pounds per square foot" (Eldredge 30). The cracks created by the expansion and contraction process create a positive feed back mechanism that allows more water to enter during the next storm cycle. Within the Six County Region expansive soils are found along the eastern foothills and within Wayne County, which has vast areas of exposed macos shale. Problems associated with expansive materials are cracked foundations, heaving and cracking of road surfaces, failure of wastewater disposal systems, and broken water lines.

Collapsible Soil
Collapsible soil causes ground-surface subsidence when loose, dry, low density deposits decrease in volume when saturated for the first time since deposition. Frequently the water introduced into these soils is from human sources such as irrigation, water impoundment, lawn watering, alterations to natural drainages, and/or wastewater disposal.

Limestone and Karst Terrain
Closed depressions, caverns, and streams that abruptly disappear underground are characteristics of karst terrain. Limestone, dolomite, and gypsum are all common in the Six County region and susceptible to dissolution by ground water and surface water thus forming karst terrain. Karst features affect surface and subsurface drainage causing a collapse of the ground surface and often the contamination of ground water. The cavernous nature of the terrain allows surface or subsurface sources of pollution from landfills, waste water disposal systems, and buried gasoline tanks to enter the groundwater system.

Gypsiferous Soil
Gypsum is a primary component in some rocks, and the soils derived from them. Gypsiferous deposits, when wetted, are subject to settlement, causing sinkholes similar to those found in karst terrains. Weathered gypsum forms sulfuric acid and sulphate, which

reacts with certain types of cement often weakening foundations. Gypsum is also a week material with a low bonding strength.

Piping
Piping is a type of subsurface erosion caused by ground water moving along a permeable layer in unconsolidated materials and exiting at a free face, which intersects the unconsolidated layer. The movement of underground water removes fine-grained particles (silts and clay) creating subsurface voids, which act like channels directing the movement of water. These channels increase in size, as more and more water is collected, until the walls and roof can no longer support the weight and collapse. Over time this process forms a gully, which further concentrates erosion.

Dunes
Dunes form when sand derived from weathered rock or an unconsolidated deposit is blown by the wind into mounds or ridges. Migrating dunes can bury roads, and structures, clog waste and storm water systems, and cause contamination of local ground water.

In Utah, three types of material commonly form dunes: silica, gypsum, and oolites.

Silica Dunes comprised mainly of silica, are typically found along the western side mountain ranges in western Utah.

Gypsum Dunes are principally derived from the evaporation of playas and are found in Great Salt Lake Desert and along the lee side of many playas in the basins west of Delta.

Oolitic Dunes are composed of calcium carbonate, which is generally precipitated around brine shrimp fecal pellets. Oolitic dunes form in shallow water areas of the Great Salt Lake and are reworked by wind during low water lake cycles.

Many inactive or vegetated dunes in Utah are being reactivated by development and motorized recreation. Once dunes are denuded of there vegetation they begin to migrate once again.

Mine Subsidence
Utah has a long history of mining and there are numerous mines within Utah. Mining removes rock and leaves voids that, if not supported, can collapse and cause subsidence of the ground surface and sinkholes. Subsidence can occur in both active and abandoned mines.

Peat
Peat consists of partially decomposed plant remains. Peat usually accumulated in areas of shallow ground water and near standing water where oxygen depletion limits organic decay. Hazards associated with peat can include subsidence when water is removed, oxidations, and compression and settlement under. Peat deposits are considered a localized hazard occurring primarily along the shores of the Great Salt Lake, Utah Lake,

and low lying areas formerly occupied by Lake Bonneville. Mountainous areas commonly have localized small areas of peat, forming in head scarps created by landslides and behind glacial moraines. (Eldredge 33)

Sodium Sulfate

Sodium Sulfate is derived from the evaporation of playas and for the weathering of bedrock. "Soils with high concentrations of water-soluble sulfates exhibit an expansive phenomenon resembling that of expansive clays and frost heave." (Eldredge 33)

Appendix - B
Vulnerability Analysis

Table 1: Juab County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Callao Fire Dept	GIS	X								60	
Central Valley Medical Nephi	GIS	X	X			X				300	
Eureka Fire Dept		X								100	
Granite Ranch Fire Dept Trout Creek		X								50	
Juab County Sheriff's Nephi	GIS	X								200	
Levan Fire Dept	HAZUS MH	X								100	
Mona Fire Dept	GIS	X								100	
Nephi Fire Dept	HAZUS MH	X								150	
Nephi Fire Dept	GIS	X								150	
Rocky Ridge Fire Dept		X								65	
Care Facilities											
Canyon View Country Homes	HAZUS MH	X	X			X	X			200	
Schools											
District Office Nephi		X				X				100	
Mona School		X	X							300	
Nephi School	GIS	X	X							300	
Juab Middle School Nephi	GIS	X								600	
Juab High School Nephi	GIS	X								1,000	
Eureka School	GIS	X	X							300	
Tintic High Eureka	GIS	X								900	
Hazardous Material Storage Sites											
Ash Grove Cement	GIS			X			X			100	
Nephi Rubber Products	GIS			X			X			200	
Sunshine Mining Co	HAZUS HM			X			X			200	
Doyles Diesel	HAZUS HM			X			X			150	
Utah Power and Light	HAZUS HM			X			X			200	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Envirochem Sevices				X			X			100	
Chevron Nephi Bulk Plant				X			X			200	
AT&T Levan				X			X			60	
Utah Foam Products				X			X			60	
Power Substations											
Eureka Substation					X					10,000	
Mona Substation					X					20,000	
Nebo Substation					X					10,000	
Martin Marietta Substation					X					10,000	
Ockey Substation					X					10,000	
Vickers Substation					X					10,000	
Thermoid Substation					X					10,000	
Nephi Substation					X					10,000	
Soma Substation					X					10,000	
Juab Substation					X					10,000	
Mills Substation					X					10,000	
Costal States Energy					X					10,000	
Levan Substation					X					10,000	
Chief Cons Mining Substation					X					10,000	
Companies Employing Greater than 50 People											
Utah State University Range						X				100	
Quality Craft Woodworks						X				60	
Central Valley Medical Center						X				300	
Denny's Restaurant						X				150	
Heritage Hills Health Care						X				150	
JC Mickelson's Restaurant						X				150	
Juab School District						X				N/A	
Nephi Rubber Products						X				200	
Mid-State Consultants						X				100	
Mt. Nebo Thriftway						X				150	
Rural Health Management						X				80	
Sunset Rail						X				100	

Table 2: Millard County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Hospital Delta Community Medical Delta		X	X			X	X			1,000	
Delta Fire Department Delta	GIS	X								200	
Eskdale Fire Department Eskdale		X								100	
Fillmore Fire Department Fillmore		X								200	
Fillmore Medical Center Fillmore		X	X			X				1,000	
Garrison Fire Department Garrison		X								100	
Hinckley Fire Department Hinckley	GIS	X								100	
Holden Fire Department Holden	HAZUS MH	X								100	
Kanosh Fire Department Kanosh	GIS	X								100	
Leamington Fire Dept. Leamington	HAZUS MH	X								100	
Lynndyl Fire Dept Lynndyl	HAZUS MH	X								80	
Meadow Fire Dept Meadow	GIS	X								100	
Oak City Fire Dept Oak City	GIS	X								80	
Scipio Fire Dept. Scipio		X								100	
Care Facilities											
West Millard Care Center Delta		X	X				X			200	
Pleasant Acres for Elderly Delta		X	X				X			150	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Schools											
District Office Millard District Delta		X								100	
Delta North School		X	X							300	
Delta South School		X	X							300	
Fillmore School		X	X							300	
Delta Middle School Delta		X								600	
Fillmore Middle School		X								600	
Delta High		X								1,000	
Millard High Fillmore		X								1,000	
Hazardous Materials Storage Sites											
Flowell Electric				X						100	
County USDA Extension				X						100	
Chevron Fillmore Bulk Plant				X						100	
Brush Wellman Inc				X						100	
Losee Moving and Storage				X						100	
AT&T Clearlake				X						100	
Intermountain Generation Stat.				X						1,000	
AT&T Delta				X						100	
Ershing Inc				X						100	
Western Technologies Inc				X						100	
Rollings Envr				X						100	
AT&T Delta				X						100	
AT&T Scipio				X						100	
AT&T Confusion Mtn.				X						100	
Power Substations											
Pahvant Substation	HAZUS MH				X					10,000	
Mother Earth Substation					X					10,000	
Clear Lake Substation	HAZUS MH				X					10,000	
Cricket Substation	HAZUS MH				X					10,000	
Sunstone Substation	GIS				X					10,000	
Delta Mill Substation	GIS				X					10,000	
Delta Substation	GIS				X					10,000	
Continental Lime Substation	GIS				X					10,000	
McCormick Substation	GIS				X					10,000	
North Fields Substation	GIS				X					10,000	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Fool Creek Substation	GIS				X					10,000	
Lynndyl Substation	GIS				X					10,000	
Brush Beryllium Substation	GIS				X					10,000	
Southerland Substation	HAZUS HM				X					10,000	
Scipio Substation	HAZUS HM				X					10,000	
Intermountain Power Substation	HAZUS HM				X					20,000	
DMAD IPP Pump Substation					X					20,000	
Oak City Substation					X					10,000	
Holden IRR substation					X					10,000	
Fillmore SW. RK. Substation					X					10,000	
Fillmore T.V. Substation					X					10,000	
Fillmore City Substation					X					10,000	
Flowell Subtation					X					10,000	
IPP Substation					X					20,000	
IPP Mancamp Substation					X					20,000	
Flowell REA Substation					X					10,000	
Brush Wellman Substation					X					10,000	
Companies Employing Greater Than 50 People											
Quality Thriftway Delta						X				100	
West Millard Care Center Delta						X				200	
Fillmore Community Care Fillmore						X				200	
Pictsweet Mushroom Farm Fillmore						X				250	
Ash Grove Cement Fillmore						X				150	
Dunn's Wildhorse Resort Scipio						X				100	

Table 3: Piute County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Circleville Fire Dept.		X								100	
Junction Fire Dept.	GIS	X								100	
Marysvale Fire Dept.		X								100	
Piute County Sheriff's Junction		X								200	
Schools											
District Office Piute		X								150	
Circleville School Circleville		X	X							300	
Oscarson School Marysvale	GIS	X	X							300	
Piute High Junction	HAZUS MH	X								500	
Hazardous Material Storage Sites											
Smoots Irrigation	GIS									100	
Power Substations											
Circleville Substation					X					10,000	
Junction Substation					X					10,000	
Mineral Products Substation					X					10,000	
Marysvale Substation					X					10,000	
Dear Trail Substation					X					10,000	
Parker Mt. Substation					X					10,000	

Table 4: Sanpete County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Centerfield Police Dept Centerfield		X								200	
Ephraim Fire Dept Ephraim	GIS	X								200	
Fairview Fire Dept Fairview		X								100	
Fairview Police Dept Fairview		X								150	
Gunnison Fire Dept		X								200	
Gunnison Police Dept		X								200	
Gunnison Valley Hospital	GIS	X	X			X	X			5,000	
Manti Fire Dept	HAZUS MH	X								200	
Moroni Fire Dept	GIS	X								100	
Moroni Police Dept	HAZUS MH	X								100	
Mt. Pleasant Fire Dept	HAZUS MH	X								100	
Mt. Pleasant Police Dept	GIS	X								100	
Sanpete County Sheriff's Manti	GIS	X								300	
Sanpete Valley Hospital Mt. Pleasant		X	X			X	X			5,000	
Snow College Police Dept. Ephraim		X								100	
Spring City Fire Dept		X								100	
Spring City Police Dept		X								100	
Wales Fire Dept		X								100	
Care Facilities											
Mayfield Community Care Center		X	X				X			150	
Schools											
District Office North Mt. Pleasant		X				X				200	
District Office South Manti		X				X				200	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Fairview School		X	X							200	
Mt. Pleasant School		X	X							200	
Moroni School		X	X							200	
Spring City School		X	X							200	
North Sanpete Middle School Moroni		X								300	
North Sanpete High School Mt. Pleasant		X								500	
Wasatch Academy Mt. Pleasant		X	X							600	
Ephraim School		X	X							200	
Gunnison Valley School		X	X							200	
Manti School		X	X							200	
Ephraim Middle		X								300	
Gunnison Valley High		X								500	
Manti High		X								500	
Snow College Ephraim		X				X				20,000	
Hazardous Material Storage Sites											
Crystal Specialties				X						100	
Mt Pleasant City Corp				X						100	
Draycutt Corp.				X						100	
Moroni Feed				X						500	
AT&T Ephraim				X						200	
Alternater Electric				X						100	
Chevron Manti Bulk Plant				X						100	
Cox Transport				X						200	
Ensign Company				X						100	
Power Substations and Plants											
Moroni Feed Substation					X					10,000	
Moroni Processing Substation					X					10,000	
Mt. Pleasant Substation					X					10,000	
Moroni Substation					X					10,000	
Pine Creek Substation					X					10,000	
Jerusalem Substation					X					10,000	
Fountain Green Substation					X					10,000	
Fountain Green Plant Substation					X					10,000	
Fayette Substation					X					10,000	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Gunnison Substation					X					10,000	
Sanpitch Substation					X					10,000	
Rasmussen Substation					X					10,000	
URCF Substation					X					10,000	
Manti Substation					X					20,000	
Ephraim Substation					X					10,000	
Fairview Substation					X					10,000	
Fairview City Generation Plant					X					10,000	
Companies Employing Greater than 50 People											
Cox Rock Products Centerfield						X				200	
Auto Meter Products Ephraim						X				200	
Ephraim Mini Storage Ephraim						X				150	
Kent's Foods Ephraim						X				150	
Applied Composite Tech Fayette						X				100	
Corrections Dept Gunnison						X				20,000	
Gunnison Thriftway Gunnison						X				150	
Satterwhite Log Homes Gunnison						X				200	
Wasatch Technologies Gunnison						X				200	
Rivers West Apparel Manti						X				100	
Johnson Construction Mount Pleasant						X				150	
Terrel's Thriftway Mount Pleasant						X				200	
Wasatch Academy Mount Pleasant						X				600	
Wind Walker Guest Ranch Spring City						X				200	

Table 5: Sevier County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Aurora Fire Dept.		X								150	
Elsinore Fire Dept	GIS	X								150	
Koosharem Fire Dept		X								100	
Monroe Fire Dept		X								200	
Richfield Fire Dept		X								250	
Richfield Police Dept		X								200	
Salina Fire Dept	GIS	X								150	
Salina Police Dept	HAZUS MH	X								200	
Sevier County Sheriff's Office	GIS	X								500	
Sevier Valley Hospital	HAZUS MH	X	X			X				20,000	
Sigurd Fire Dept.	HAZUS MH	X								100	
Care Facilities											
Adelaide's House Care Facility Richfield	GIS	X	X							200	
Curtis Residential Care Facility Glenwood	GIS	X	X							200	
Beehive Homes Care Facility Richfield		X	X							200	
Schools											
District Office Richfield		X								300	
Ashman School Richfield		X	X							300	
Koosharem School		X	X							200	
Pahvant School Richfield		X	X							300	
Salina School		X	X							300	
North Sevier Middle Salina		X								500	
South Sevier Middle Monroe		X								500	
Red Hills Middle Richfield		X								500	
North Sevier High Salina		X								1,000	
Richfield High		X								1,000	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
South Sevier High Monroe		X								1,000	
Central Utah Youth Home Richfield		X	X							300	
Strom Ridge Richfield		X	X							200	
Pre-School Richfield		X	X							200	
Hazardous Materials Storage Sites											
U.S. Gypsum										300	
Georgia-Pacific Corp										300	
Hales Sand & Gravel				X						200	
Paragon Industries Inc				X						200	
Wilson Trucking Inc				X						200	
Sevier Valley Tech				X						200	
Wheeler Machinery Co				X						200	
UDOT Materials Lab				X						300	
Jones and DeMille				X						200	
Knight Mine				X						200	
Southern Utah Fuel Company	HAZUS MH			X						200	
Nowers Chevron Station				X						200	
Chevron USA	HAZUS MH			X						200	
DP Curtis Trucking	HAZUS MH			X						200	
BLM Richfield	GIS			X						300	
Power Substations											
Sufco Substation	GIS				X					10,000	
Link Canyon Substation	GIS				X					10,000	
Sigurd Substation	GIS				X					20,000	
Sevier Substation	GIS				X					10,000	
Aurora Substation	GIS				X					10,000	
Salina Substation	GIS				X					10,000	
Garkane Substation	HAZUS HM				X					10,000	
George Pacific Substation	HAZUS HM				X					10,000	
U.S. Gypsum Substation	HAZUS HM				X					10,000	
Moroni Feed Substation					X					10,000	
Richfield Substation					X					20,000	
Central Substation					X					10,000	
Elsinore Substation					X					10,000	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Monroe Substation					X					10,000	
Kimberly SW. RK. Substation					X					10,000	
Freedom Substation					X					10,000	
Winkleman Substation					X					10,000	
Companies Employing Greater than 50 People											
Redmond Minerals Redmond						X				500	
Barney Trucking Salina						X				300	
Georgia Pacific Salina						X				300	
Hales Sand & Gravel Salina						X				200	
Moroni Processing Salina						X				300	
Producers Salina Auction Salina						X				200	
Robinson Transport Salina						X				300	
United States Gypsum Sigurd						X				300	
Adelaide's House Richfield						X				200	
Albertson's Food Richfield						X				300	
Central UT Public Health Richfield						X				200	
DP Curtis Trucking Richfield						X				200	
Diamond C Trailers Richfield						X				200	
JTN Construction Richfield						X				200	
Kmart Richfield						X				500	
Larsen's Ace Hardware Richfield						X				300	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Lin's Marketplace Richfield						X				300	
Richfield Rehab Richfield						X				200	
Sevier County Sheriff's Office Richfield						X				500	
Snow College Maintenance Richfield						X				300	
Sorenson's Ranch School Richfield/Koosharem						X				200	
US Forestry Dept. Richfield						X				300	

Table 6: Wayne County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Critical Facilities											
Bicknell Fire Dept		X								100	
Hanksville Fire Dept	GIS	X								100	
Loa Fire Dept		X								100	
Lyman Fire Dept		X								100	
Teasdale Fire Dept		X								100	
Wayne County Sheriff's Office		X								150	
Care Facilities											
Beehive Home Care Facility	GIS	X	X							150	
Schools											
District Office	GIS	X								200	
Hanksville School	HAZUS MH	X	X							200	
Loa School	HAZUS MH	X	X							200	
Wayne Middle Bicknell	GIS	X								400	

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material Title 3	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value in $1,000's (Estimated)	Contents Value *
Wayne High Bicknell		X								600	
Hazardous Materials Storage Sites											
Ron Lewis Construction				X						100	
Power Substations											
Loa Substation					X					10,000	
Companies Employing Greater than 50 People											
Hidden Falls Market & Sinclair Torrey	GIS					X				200	
Aspen Achievement Academy Loa	GIS					X				200	
Wayne County School District Bicknell	HAZUS HM					X				200	

Appendix - C

Natural Hazard Mitigation Strategies

For the purpose of this mitigation plan, mitigation strategies will be divided into one of five categories according to how they accomplish mitigation. The six categories include:

- Emergency Services
- Natural Resource Protection
- Prevention
- Property Protection
- Public Information and Involvement
- Structural Protection

Emergency Service: emergency services protect people during and after a disaster examples include: mutual aid agreements, protection of critical facilities, health and safety maintenances, inventory of assets, and EMS/Police/Fire response and skill.

Natural Resource Protection strategies are strategies, which preserve or restore natural areas or the natural function an area provides this can include: wetlands protection, pollution reduction, erosion and sediment control, fuels reduction, and watershed maintenance.

Prevention: prevention measures are intended to keep the problem from occurring in the first place, and/or keep it from getting worse. Prevention strategies include: primarily planning, zoning, and ordinance issues such as, open space preservation, floodplain and wetland development regulations, storm water management, minimum set back requirements, and evacuation plans.

Property Protection measures are used to modify buildings within high-risk areas in an attempt to reduce damage. Property protection strategies might include: utility relocation, burying or flood proofing, non-structural earthquake mitigation, backup protections, insurance and other financial loss minimization actions, and technical evaluations and mapping. For the most part property protection measures do not affect a buildings appearance of use making them less expensive and particularly suitable for historical sites and landmarks.

Public Information and Involvement activities are intended to advise property owners, potential property owners, and visitors about the particular hazards associated with a property and ways to protect people and property from these hazards. Examples of public information include: NFIP education, providing maps with high hazard locations identified, informational mailings, workshops, real estate disclosures for natural hazards, and education.

Structural Protection/Projects are man made structures, which prevent damage from impacting property. Examples of structural protection include detention/retention basins, larger culverts, elevated seismic design, floodwalls, debris basins, landslide stabilization and levees.

I. Flood/Riverine Mitigation

Generic Mitigation
The following are generic mitigation strategies appropriate for addressing the hazard of flooding. Many of these strategies are expanded upon in the text that follows.

- Avoidance and zoning ordinances.
- Better flood routing through communities.
- Annual warning of risk information on how to protect property and lives.
- Flood insurance awareness, emphasis, and marketing.
- Projects such as levees/dams.
- Funding by a storm water tax in cooperation with Federal and State programs.
- Additional SNOTEL sites and enhanced instrumentation.
- Protection of roads and bridges.
- Greater reservoir capacities.
- Curtail development in flood-prone areas.
- General infrastructure protection.
- Develop river corridor parkways.
- Protection of wastewater treatment facilities from excessive inflows.
- Protection of drinking water supply systems.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.
- Protecting natural floodplain resources.

Emergency Services

Flood Warning
Warning systems designed to alert residence of rising floodwaters. Warning systems can disseminate the information through a number of means such as sirens, radio, television, mobile public address system, reverse 911, or door-to-door contact. Multiple or redundant warning systems are most effective, giving people more than one opportunity to be warned.
Flood Response
Flood response refers to the actions that are taken to prevent or reduce damage once a flood starts, and example of flood response is the turning of State Street into a river during the 1983 flood event. Flood response actions might include:

- Activation of the emergency operations center
- Sandbagging designated areas

- Closing streets and bridges
- Shutting off power to threatened areas
- Releasing children from school
- Ordering an evacuation
- Opening evacuation shelters

Many of these actions should be part of an emergency response plan EOP developed in coordination with the agencies that share responsibilities. The EOP once developed should be exercised and continually evaluated so when the plan is needed key players know what to do.

Critical Facilities Protection

Protecting critical facilities is vital, yet this protection draws workers and resources away from protecting other parts of a town or county. For this reason listed below are vital facilities and facilities with the potential of causing a secondary disaster if destroyed. It is important to keep these locations in mind with considering potential mitigation projects.

Facilities or locations vital to flood response efforts

- Emergency operations centers
- Police and fire stations
- Hospitals
- Highway garages
- Selected roads and bridges
- Evacuation routes

Facilities and locations, which if flooded would create a secondary disaster

- Facilities housing hazardous materials
- Wastewater treatment plants
- Schools
- Nursing homes

The above list of structures is applicable to all disasters.

Health and Safety Maintenance

Response to floods or other natural disasters should include measures to prevent damage to health and safety such as:

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Vaccination residents for tetanus
- Clearing streets
- Cleaning up debris

Many of these recommendations should be integrated into a public information program to educate residence on the benefits of health and safety precautions.

Natural Resource Protection

Wetlands Protection

Wetlands are capable of storing large amounts of floodwater, slowing and reducing downstream flows, and filtering the water. Any development that is proposed in a wetland is regulated by either federal and/or state agencies.

Mitigation techniques are often employed, which might consist of creating a wetland on another site to replace what would be lost through the development. This is not an ideal practice, however, since it takes many years for a new wetland to achieve the same level of quality as an existing one.

Erosion and Sedimentation Control

Controlling erosion and sediment runoff during construction and on farmland is important, since eroding soil will typically end up in downstream waterways. Sediment tends to settle where the water flow is slower, it will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters.

Sediment and erosion control have two principal components: minimize erosion with vegetation and capture sediment before it leaves the site. Slowing runoff increases infiltration into the soil, thereby controlling the loss of topsoil from erosion and the resulting sedimentation. Runoff and erosion control can be done through vegetation, terraces, contour strip farming, no-till farm practices, and impoundments.

Prevention Measures

Planning and Zoning

Land use plans are put in place to guide future development, recommending where and where not development should take place. Sensitive and vulnerable lands can be designated for uses that would not be incompatible with occasional flood events. The zoning ordinances can regulate development in these sensitive areas by limiting or preventing some or all development.

Open Space Preservation

Preserving open space is the best way to prevent flooding and flood damage. Open space preservation should not be limited to the flood plain. Other areas within the watershed may contribute to controlling the runoff that exacerbates flooding.

Floodplain Development Regulations

Floodplain development regulations typically do not prohibit development in the special flood hazard areas, but they do impose construction standards on what is built there. The intent is to protect roads and structures from flood damage and to prevent the development from aggravating the flood potential.

Floodplain development regulations are generally incorporated into subdivision regulations, building codes, and/or floodplain ordinances.

Subdivision regulations: these regulations govern how land will be divided into separate lots or sites. In some Utah cities these are known as Site Based Ordinances.

Building Codes: Standards can be incorporated into building codes that address flood proofing from all new and improved or repaired buildings.

Floodplain Ordinances: Communities that participate in the National Flood Insurance Program NFIP are required to adopt the minimum floodplain management regulations, as developed by FEMA. The regulations set minimum standards for subdivision regulations and building codes. Communities may adopt more stringent standards than those set forth by FEMA.

Storm Water Management
Development outside of a floodplain can contribute significantly to flooding by covering impervious surfaces, which increase storm water runoff. Storm water management is usually addressed in subdivision regulations. Developers are typically required to build retention or detention basins to minimize any increase in runoff caused by new or expanded impervious surfaces, or new drainage systems. Most larger cities and counties within Utah enforce an ordinance prohibiting storm water from leaving a site at a rate higher than it did before the development.

Drainage System Maintenance
Ongoing maintenance of channel and detention basins is necessary if these facilities are to function effectively and efficiently over time. A maintenance program should include regulations that prevent dumping in or altering watercourses or storage basins; regarding and filling should also be regulated.

Property Protection

Relocation
Moving structures out of the floodplain is the surest and safest way to protect against damage. Relocation is expensive, so this approach will probably not be used except in extreme circumstances.

Acquisition
Acquisition by governmental entity of land in a floodplain serves two main purposes: it ensures that the problem structure is addressed; and it has the potential to convert problem areas into community assets

Building Elevation
Elevation a building above the base flood elevation is the best on-site protection strategy. The building could be raised to allow water to run underneath it, or fill could by brought in to elevate the site on which the building sits.

Insurance

Above and beyond standard homeowners insurance, there is other coverage a homeowner can purchase to protect against flood hazard. Although this doesn't mitigate the problem it does allow the homeowner to shift the financial loss/risk onto another party. Two of the most common insurances offered against flood loss are:

National Flood Insurance: when a community participates in the NFIP, any local insurance agent is able to sell separate flood insurance policies under rules and rates set by FEMA. Rates do not change after claims are paid because they are set on a national basis.

Basement Backup Insurance: National Flood Insurance offers an additional deductible for seepage and sewer backup, provided there is a general condition of flooding in the area that was the proximate cause of the basement getting wet.

Public Information and Involvement

Outreach Programs

Outreach projects are proactive; giving the public information even if they have not asked for it. Outreach projects should be designed to encourage people to seek out more information and take steps to protect themselves and their properties. Examples include:

- Mass mailing or newsletters to all residents
- Notices directed to high risk area residents
- Displays in public buildings
- Newspaper articles and special sections
- Radio and TV news releases and interviews
- A detailed property owners handbook tailored for local conditions
- Presentations at meetings and neighborhood groups

Real Estate Disclosure

Disclosure of information regarding flood or hazard prone properties is important if potential buyers are to be in a position to mitigate damage. Federally regulated lending institutions are required to advise applicant that a property is in the floodplain. However, this requirement needs to be met only five days prior to closing, and by that time, the applicant is typically committed to the purchase. This only includes flood prone areas, at the exclusion of other hazards.

Map Information

Flood plain maps developed by FEMA outline the boundaries or the flood hazard areas. These maps can be used by anyone interested in a particular property to determine if it is in the floodplain. These maps are available from FEMA, the Utah Division of Emergency Services, and at many city and county planning offices. In addition the Utah Geologic Survey creates and maintains maps illustrating geologic hazards. These maps are available for sell at the Division of Natural Resources books store.

Structural Projects

The intent behind structural projects for flood mitigation is to prevent floodwaters from reaching properties. The shortcomings of almost all structural mitigation projects are that:

- They can be very expensive
- They disturb the land, disrupt natural water flows, and destroy natural habitats.
- They are built to an anticipated flood event, and my be exceeded by a greater-than-expected flood.
- They can create a false sense of security

Reservoirs
Reservoirs control flooding by holding water behind dams, or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate the river downstream can handle.

Reservoirs are expensive to build, occupy large tracts of land, require maintenance, and if they fail often result in greater down stream flooding than would occur during a natural flooding event.

Levees/Floodwalls
One of the best-known structural flood control measure levees and floodwalls are steel or concrete structures placed between the watercourse and the land.

Diversions
A diversion is simply a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversions structures can consist of surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel but during flooding events floodwaters spill over into the diversion channel.

Channel Modifications
Channel modifications include making a channel wider, deeper, smoother, or straighter. Common channel modifications include:

Dredging: Dredging is often cost-prohibitive because the dredged material must be disposed of somewhere else, and dredged streams usually fill back in with sediment.

Drainage Modifications: These include man-made ditches and storm sewers that help drain areas where the surface drainage system is inadequate or where underground drainage ways may be safer or more attractive.

Storm Water Management
Mitigation techniques for managing storm water include installing storm water systems, enlarging pipes, and street improvements in existing storm water systems.

Earthquakes

Generic Mitigation
Below is a list of generic earthquake mitigation strategies pertaining to secondary threats often associated with earthquakes.

Generic Ground Shaking Mitigation
- Understand peak horizontal acceleration and recurrence interval.
- Design appropriately.
- Zoning ordinances and building codes.

Generic Liquefaction Mitigation
- Move soil out.
- Densify soils in place.
- Remove ground water.
- Structural design.

Generic Surface Fault Rupture Mitigation
- Avoidance
- Zoning ordinances
- Earthquake resistant building design codes.
- Retrofitting of critical facilities and supporting equipment.
- Retrofitting under-designed buildings.
- Annual warning of risk/info on how to protect property and lives.
- Projects to seismically upgrade critical public facilities/utilities and shelters.
- Gather hazard and risk data/information.
- Protection of roads and bridges.
- General infrastructure protection.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.

Emergency Service:

Emergency Operations Planning
Maintain an earthquake response plan to account for secondary problems, such as fire and hazardous material spills.

Critical Facilities Protection
Protecting critical facilities is vital as the facilities play an important role in coordinating response and recovery following an earthquake. For this reason listed below are vital facilities and facilities with the potential of causing a secondary disaster if destroyed.

Facilities or locations vital to earthquake response efforts
- Emergency operations centers
- Police and fire stations

- Hospitals
- Highway garages
- Selected roads and bridges
- Evacuation routes

Facilities and locations, which if destroyed would create a secondary disaster

- Facilities housing hazardous materials
- Wastewater treatment plants
- Schools
- Nursing homes

Natural Resource Protection
Design of pipelines.

Prevention:
While earthquakes are not preventable proper planning, zoning, and building codes can prevent much of the damage common with earthquakes. Planning, zoning, and building codes should address minimums setbacks, critical faculty locations, steep slopes, areas with liquefiable soils, and insure high factor of safety ratings for critical facilities.

Property Protection

Nonstructural Mitigation
Nonstructural mitigation consist of mitigative measures that don't affect the overall look or purpose of the building yet prevent damage to no structural aspects and reduce the loss of life. In addition buildings with non-structural mitigation are frequently usable after an event. Examples of nonstructural mitigation include: tie downs, flexible utility connections, Mylar film on windows to prevent the glass from shattering, and added bracing.

Retrofitting
Retrofitting consists of upgrading the seismic safety of a building through structural and nonstructural mitigation techniques.

Insurance:
Above and beyond standard homeowners insurance, there is other coverage a homeowner can purchase to protect against earthquake hazard, something not covered under most homeowners insurance plans. Although this doesn't mitigate the problem it does allow the homeowner to shift the financial loss/risk onto another party.

Public Information and Involvement
Public information and involvement for earthquakes is similar to the mitigation strategies outlined in the flood and riverine section.

Real Estate Disclosure
Disclosure of information regarding earthquakes and hazard prone properties is important if potential buyers are to be in a position to mitigate damage. Unlike floodplains there are no federal laws, which require disclosure of earthquakes.

Structural Protection/Projects

Dam Failure

Generic Mitigation

- Proper mapping of flood plains, including mapping of dam breach flood potential.
- Knowledge must be made public so that emergency managers are aware and the public is aware when they buy and sell property.
- Updated Emergency Action Plans (EAP) and integration with GIS Systems.
- Maintaining proper flood plain and wetland geometry and vegetation will help route floods.
- Flood plain usage should be compatible with flood plain needs.
- More debris dams would help with floods and debris and mud and maintaining a flood control pool in existing dams would be beneficial.
- Protection of roads and bridges.
- General infrastructure protection.
- More authority to order releases and better forecasting would help in snowmelt floods and runoff.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.

Emergency Service:
Dam conditioning monitoring
Warning and evacuation plans based on dam failure

Natural Resource Protection

Prevention:
Dam failure inundation maps
Planning/zoning/open space preservation to keep downs stream areas clear
Building codes with flood elevations based on dam failure
Dam safety inspections
Draining the reservoir when conditions appear unsafe

Property Protection
Acquisition of building in the path of a dam breach flood
Flood insurance

Public Information and Involvement

Structural Protection/Projects
Dam improvements, spillway enlargements
Remove unsafe dams.

Wildfire

Generic Wildfire Mitigation

- Avoidance.
- Define, create, and maintain a defensible space.
- Plant drought and fire resistant vegetation.
- Ordinances.
- Modification of fuel loading in high hazard interface areas.
- Wildland fire training and experience for fire department personnel.
- Public education effort for people living in the interface.
- Additional suppression equipment needs of fire departments and the Utah Division of Forestry, Fire, and State Lands.
- Fuel modification in moderate hazard interface areas.
- Protection of roads and bridges.
- Annual warning of risk/info on how to protect life and property.
- Gather hazard and risk data/information.
- General infrastructure protection.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.
- Protection of drinking water supply systems.

Emergency Service:
Fire fighting

Natural Resource Protection

Prohibit development in high-risk areas.

Prevention:
Zoning ordinances to reflect fire risk zones

Planning and zoning to restrict development in areas near fire protection and water resources

Requiring new subdivisions to space buildings, provide firebreaks, on-site water storage, wide roads and multiple accesses.

Building code standards for roof materials, spark arrestors.

Maintenance programs to clear dead and dry bush trees

Regulations on open fires.

Property Protection
Retrofitting of roofs and adding spark arrestors
Landscaping to keep bushes and trees away from structures
Insurance rates based on distance from fire protection
Public Information and Involvement

Structural Protection/Projects

Landslides

Generic Mitigation

- Avoidance
    - Recognize landslide area
    - Zoning ordinances
- Remove landslide materials
- Drain subsurface materials
- Install surface drains
- Remove materials for the head of the landslide.
- Re-grade.
- Build buttress or retaining wall at the toe of the slope.
- Install soil nails and rock anchors.
- Maintain natural vegetation.
- Improved geologic mapping to identify potential landslide problems.
- Zoning ordinances prohibiting construction in or adjacent to areas with high landslide potential.
- Soil moisture sensors at SNOTEL sites.
- Gather hazard and risk data/information.
- Protection of roads and bridges.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.
- Protection of drinking water supply systems.
-

Generic Rock Fall Mitigation

- Avoidance.
- Stabilize rocks.
- Prerelease.
- Build berms or benches.
- Build structures to stop rocks.

Emergency Service:
Natural Resource Protection

Prevention:
Property Protection

Public Information and Involvement

Structural Protection/Projects

Severe Weather

Emergency Service:
Early warning systems
Natural Resource Protection

Prevention:
Building code standards for light frame construction, especially for wind-resistant roofs.
Property Protection

Public Information and Involvement

Structural Protection/Projects

Problem Soils

Generic Problem Soil Mitigation

- Avoidance.
- Presoak and Compact.
- Remove problem soil.

Landscape so that runoff moves away from foundations.

Emergency Service:
Natural Resource Protection

Prevention:
Property Protection

Public Information and Involvement

Structural Protection/Projects

Drought

Emergency Service:
Natural Resource Protection:

Prevention:

Property Protection:

Public Information and Involvement:

Structural Protection/Projects:

Appendix – D
Environmental Policies

Natural disasters are naturally occurring phenomena. They play an integral part in maintaining balance in our world. Meteorological, geological, or hydrological processes have shaped Utah for millions of years and will continue to shape the valley for millions more years. These unique phenomena only cause disasters when they affect humans and their structure. Modern engineering has made it possible to prevent damage from natural hazards; however the economic and environmental costs can be rather high. Tampering with the natural systems also can create an imbalance in the natural environment. The effects of many of these imbalances are still unknown. It is better to live with a small amount of risk, respect the natural process where appropriate, than to construct mitigation at every chance. Nature provides it's own mitigation measures that need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation measures all applicable city codes; county codes, state and federal laws pertaining to the environment must be followed. The majority of the proposed mitigation programs in this plan will be funded through federal programs, thus tied to federal funding.

"44 CFR 10.8 (d)(2)(iii) excludes this rule from the preparation of an environmental assessment or environmental impact statement, where the rule relates to actions that qualify for categorical exclusions under 44 CFR 10.8(d)(2)(iii), such as the development of plans under this section" (44 Code).

The following acts will be taken into consideration and will be incorporated when needed while organizing and implementing the PDM plan; Clean Air Act, Clean Water Act, Endangered Species Act, Floodplain Management, National Historic Preservation Act.

Clean Air Act (CAA) 1970: The Clean Air Act is the comprehensive Federal Law that covers the entire country under the Environmental Policy Act (EPA) regulating air emissions from area, stationary, and mobile sources. This law sets limits or National Ambient Air Quality Standards (NAAQS) on how much of a pollutant can be in the air anywhere in the United States, this controls the emissions of air pollutants. These limits ensure that all Americans have the same basic health and environmental protections. Maximum pollutant standards were set and states may have stronger pollution controls on an individual basis, but not weaker pollution controls than those set for the whole country. Each state explains how it will do its job under the Clean Air Act by developing a mandated "state implementation plan" (SIP) that has to be approved by EPA. The 1977 amendment was to set new dates for areas of the country that failed to meet the initial deadlines for achieving NAAQS. The 1990 amendments addressed problems such as acid rain, ground level ozone, stratospheric ozone depletion, and air toxics. This act required that facilities with large amounts of certain hazardous chemicals to have special emergency planning requirement. Based on a facilities potential threat or risk from chemical spills, fires, explosions, etc., a Risk Management Plan (RMP) is prepared that includes hazard identification, assessments, design and maintenance of a safe facility, necessary steps to prevent releases and ways to minimize the consequences from an accidental release (Clean Air).

Clean Water Act (CWA): The Federal Water Pollution Control Act Amendments of 1972 came about because of the growing awareness for controlling water pollution. As amended in 1977, this law became known as the Clean Water Act whose mission is to establish the basic structure for regulating discharges of pollutants into the waters of the United States, and to reduce and maintain the chemical, biological, and physical veracity. The act gave the Environmental Policy Act (EPA) the authority to set wastewater standards for industry. The act also required that each state adopt water quality standards, act to protect wetlands, and limit industrial and municipal discharges into navigable waters unless permitted. It funded the construction of wastewater treatment plants for nearly every city in the United States, and under construction grant programs from the EPA and recognized the need for planning for future problems that posed a threat from non-point source pollution (Clean Water).

Clean Water Act, Section 404-Wetland Preservation: This act regulates activities in wetland areas and authorizes EPA to restrict or prohibit the use of an area as a disposal site for dredged or fill material if the discharge will have unacceptable adverse affects on municipal water supplies, shellfish beds and fishery areas, wildlife and/or recreational areas. A permit must be issued that is based on regulatory guidelines developed in coincidence with the U.S. Army Corps of Engineers and the EPA (CWA Sec. 404).

Endangered Species Act of 1973: This act provides a plan for the protection of threatened and endangered plants and animals and the habitats in which they are found. Congress finds and declares that various species of fish, wildlife, and plants in the United States have been caused to become extinct, or are so depleted in numbers they are in danger of becoming extinct, as a result of economic development and expansion without adequate concern for conservation. Aesthetic, ecological, educational, historical, recreational, and scientific importance come from these species and are a value to our nation and its people. The U.S. will conserve, to a practicable extent, the species that face extinction and will encourage the States through federal assistance to develop and maintain conservation programs. The reason for the Act is to provide a means in which ecosystems with endangered and threatened species will be conserved. It is also declared that all state and local agencies resolve water resource issues in connections with conservation of endangered species (Endangered).

Floodplain Management Policy: The main points of the policy are to reduce the loss of life and property and the disruption of societal and economic pursuits caused by flooding or facility operations as well as to restore, sustain, and enhance the natural resources, ecosystems, and other functions of the floodplains. Activities will search for a balance between the, sometimes competing, uses of floodplains in a way that makes the most benefit to society. To pursue and encourage appropriate use of floodplains and to avoid long and short term negative impacts associated with the inhabitants and modification of floodplains and to avoid direct and indirect support of floodplain development, whenever there is a practicable alternative. "Functions (Natural) of floodplains include natural moderation of floods, fish, wildlife, and plant resources and habitat; groundwater recharge; and water quality maintenance. Uses of floodplains include storm water management; erosion control; open space; natural beauty, opportunity for specific study, outdoor education, recreation, and cultural preservation; and compatible economic utilization of floodplain resources by human society" (Floodplain, Reclamation).

National Historic Preservation Act of 1966: This act was found and declared by Congress because "the spirit and direction of the Nation are founded upon and reflected in its historic heritage…the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people." Some of the other main points of the act include the awareness of historic properties that are being lost or substantially altered. The preservation will continue a legacy of cultural, educational, aesthetic, inspirational, economic, and energy benefits for future generations. The knowledge of historic resources and "the encouragement of their preservations will improve the planning and execution of Federal and federally assisted projects and will assist economic growth and development. The act would like to use measures that will foster conditions in which historic resources can exist in productive harmony with present and future generations (National).

Section 106 of NHPD “requires all Federal agencies to take into account the effects of their actions on historic properties, and provide ACHP with a reasonable opportunity to comment on those actions and the manner in which Federal agencies are taking historic properties into account in their decisions” beginning at the early stages of planning to mitigate any adverse effects on historic properties (Section 106).

Appendix - E
Richter Magnitude Scale

The Richter Magnitude Scale

Seismic waves are the vibrations from earthquakes that travel through the earth; they are recorded on instruments called seismographs. Seismographs record a zig-zag trace that shows the varying amplitude of ground oscillations beneath the instrument. Sensitive seismographs, which greatly magnify these ground motions, can detect strong earthquakes from sources anywhere in the world. The time, locations, and magnitude of an earthquake can be determined from the data recorded by seismograph stations.

The Richter magnitude scale was developed in 1953 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquake. On the Richter scale, magnitude is expressed in the whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy that the amount associated with the preceding whole number value.

At first, the Richter Scale could be applied only to the records from instruments of identical manufacture. Now, instruments are carefully calibrated with respect to each other. Thus, magnitude can be computed from the record or any calibrated seismograph.

Earthquakes with magnitude of about 2.0 or less are usually called micro earthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes such as the 1964 Good Friday earthquake in Alaska have magnitudes of 8.0 or higher.
Description of Richter Scale from USGS Earthquake Hazards Program

Modified Mercalli Intensity and PGA Equivalents

MMI	Acceleration (%g) PGA	Perceived Shaking	Potential Damage
I	<0.17	Not Felt	None
II	0.17-1.4	Weak	None
III	0.17-1.4	Weak	None
IV	1.4-3.9	Light	None
V	3.9-9.2	Moderate	Very Light
VI	9.2-18	Strong	Light
VII	18-34	Very Strong	Moderate
VIII	34-65	Severe	Moderate to Heavy
IX	65-124	Violent	Heavy
X	>124	Extreme	Very Heavy
XI	>124	Extreme	Very Heavy
XII	>124	Extreme	Very Heavy

Table expressing relationship of peak horizontal ground acceleration (PGA) to Modified Mercalli Intensity (MMI) adapted after (Wald et al., 1999).

Appendix F

North Sanpete County Regional Fire Plan

for the Wildland / Urban Interface

Protecting Life, Property, and
Community Values
through
Community-Based Planning

Prepared by: North Sanpete Fire Council
Date Prepared: September 16, 2003

North Sanpete County Regional Fire Plan

INSTRUCTIONS

Declaration and Concurrence Page

This list needs to be customized to the individual plan. Provide the names and affiliations of all fire partners. This page will then be signed after all fire partners have reviewed the plan and concur with its contents. An Area Manager or Fire Management Officer from the Utah Division of Forestry, Fire and State Lands must be included.

Blake Ince, Blackhawk Mountain Estates Property Owners Association	Date
Donna Pendrey, Homeowners Association President	Date
Chuck Cummins, Indian Ridge Property Owners Association	Date
Jay Barlow, Indian Ridge Property Developer	Date
Jeff Cox, Fairview Volunteer Fire Department	Date
Fred Johnson, Sanpete County Fire Warden	Date
Claudia Jarrett, Sanpete County Commission	Date
Emery Polelonema, Six County Association of Governments	Date
Kevin G. Holman, Deputy County Sheriff, County Emergency Manager	Date
Kelly Allen, State of Utah, DNR, Div of Forestry, Fire & State Lands – Area Manager	Date
Lito Contreras, USDA Forest Service – Manti LaSal National Forest	Date
Robert Beal, Scout Master, Boy Scouts of America	Date

PART I
COMMUNITY DESCRIPTION

***Directions**: This section is to be completed by the Community Wildfire Committee. A community description identifies community resources that can be used to complete the goals of the plan as well as a physical description of the community that can help impact wildfire preparation and response decisions.*

INSTRUCTIONS

1. Planning Committee Members List

List the names, affiliations and phone numbers of the planning committee members, i.e. residents, council members, sheriff, etc.

Name	Affiliation	Phone Number	E-mail
John & Donna Pendrey	Hideaway Valley Homeowners Association	(435) 427-3264	
Theo & EdaBee Anderson	Resident	(435) 427-3588	theo@cut.net
Carl & Beverly Winters	Hideaway Valley Homeowners Association	(435) 427-3399	winters@cut.net
Spencer Shields	Resident	(435) 427-9316	
Bryan Ady	Resident	(435) 427-3383	ady@cut.net
Tom & Graciela Meyers	Resident	(435) 427-9802	102211.240@compuserve.com
Charles Brown	Resident	(435) 427-3289	
Jay Barlow	Resident	(435) 427-9303	
Ricky Butrum	Resident	(435) 427-9581	
Annette Grant	Resident	(435) 427-9518	
Randall & Bambi Elliott	Resident	(435) 427-3739	bce_1959@yahoo.com
McKay & Janae Larsen	Resident	(435) 427-3590	
Mitchell Loomis	Resident	(435) 427-9817	
Phil Alexander	Resident	(435) 427-9266	
Milton Rich	Resident	(435) 427-3634	
Clyde Holm	Resident	(435) 427-3574	
Dave Tanner	Resident	(435) 427-3627, (801) 465-4568	
Fred Johnson	Sanpete County Fire Warden	(435) 835-2117, (435) 851-1546	fredjohnson@utah.gov
Kevin Holman	Sanpete County Sheriff's Office	(435) 835-2191	holmank@sanpeteso.org
Keith Crumpton	Resident	(435) 427-9837, (801) 231-1933	
Charles Jeffs	Resident	(435) 283-4379, (435) 851-0095	
Chuck Cummins	Indian Ridge Property Owners Association	(801) 787-8444	
Dave Tanner	Resident	(435) 427-3627, (801) 465-4568	
Foulke, Glen & Linda	Resident	801-794-0399	

INSTRUCTIONS

2. Community Legal Structure

List the government entities associated with the community – city, town, unincorporated, special service district, homeowner association(s), other. Part of the purpose in this exercise is to help identify organizations through which grant funding – federal, state, or other - can be channeled.

Organization	Contact Person	Phone Number	E-mail
Sanpete County Commission	Commissioner Bruce Blackham, Chair	(435) 835-2141, cell (435) 851-1549	blackham@sanpetecounty-ut.gov
	Commissioner Greg Dettinger	cell (435) 851-1547	greg@sanpetecounty-ut.gov
	Commissioner Claudia Jarrett (Fire District and Forest Service Liaison)	(435) 283-7058, cell (435) 851-1540	jarrett@sanpetecounty-ut.gov, claudia.jarrett@snow.edu
Hideaway Valley Property Owners Association	Donna Pendrey, President	(435) 427-3264	
Fairview Volunteer Fire Department	Jeff Cox	(435) 835-2191 (dispatch), or Jeff Cox (435) 427-3535	TBD
State of Utah, Division of Forestry, Fire, and State Lands	Scott Zeidler	(801) 538-7487	scottzeidler@utah.gov
Sanpete County Sheriff's Office	Kevin Holman	(435) 835-2191	holmank@sanpeteso.org
Six County Association of Governments	Emery Polelonema	(435) 896-9222, x25	epolelon@sixaog.state.ut.us
	Edwin Benson	(435) 896-9222, x18	ebenson@sixaog.state.ut.us
Rotary Club	TBD	TBD	TBD
Chamber of Commrce	TBD	TBD	TBD
Sanpete Search & Rescue	TBD	TBD	TBD
Red Cross	TBD	TBD	TBD

INSTRUCTIONS

3. Population

Provide information regarding the population of the area, including:

Approximate full-time	Approximate number of lots	Approx. number of commercial entities
Approximate part-time	Approximate number of homes	Approx. visitor population during fire season

Total number of lots: 1959 lots Source: Sanpete County Recorder
Total number of homes: 331 (estimate)

Full-time residences:	115
Full-time residents:	380 persons (year-around residents, adults and children) (Note: Full-time residences are occupied by an average of 3.3 persons.)
Part-time residents:	673 persons (estimated 204 part-time residences times 3.3 persons per residence)
Seasonal residents:	1000+ (seasonal residents, adults and children)
Visitor population:	Through-traffic of around 1,000 to 2,000 people per day during fire season
Commercial entities:	5

Description	Hideaway Valley	Blackhawk Estates	Indian Ridge	Panorama Woods	Fairview Ranchos	Indianola
Total number of lots	448	449	740	242	48	32
Total number of homes/cabins	130 est	16	50 est	75 est	30 est	30 est
Full-time residences	64	7	2	TBD	20	22
Full-time residents	198	26	4	25 est	64	63
Part-time residences	65 est	9	50 est	70 est	5 est	5 est
Visitor population	See est.	See est.	See est.	See est.	See est.	See est.
Commercial entities	2	0	0	0	2	1

INSTRUCTIONS

4. Estimated Values at Risk

Provide an approximation of the estimated current values of residential and commercial property in the subdivision. The County Assessor should be able to assist with this information.

The estimated values at risk of residential and commercial property in the year 2003 are approximately $48,400,000.

These estimates are based on calculations that assume (1) each home is valued at $200,000, (2) each cabin is valued at $100,000, and (3) each business is valued at $1,000,000. (Note: The County Assessor declined to answer the request for information. Estimation of values at risk is planned as part of this Community Fire Plan.)

Subdivision Name	Estimated values at risk of residential and commercial property in the year 2003.
Hideaway Valley	$21,300,000
Blackhawk Estates	$ 2,300,000
Indian Ridge	$ 5,400,000
Panorama Woods	$ 7,000,000
Fairview Ranchos	$ 6,500,000
Indianola	$ 5,900,000

INSTRUCTIONS

5. Natural Resources at Risk

Describe the natural resources at risk in the subdivision and surrounding area.

The North Sanpete communities border on National Forest lands. The recreation areas of Skyline Drive are immediately east of the communities. The National Forest lands include timber, watershed, wildlife, and recreational resources. The communities themselves include agricultural resources.

INSTRUCTIONS

6. Commercial Entities

List contact information for commercial entities in the area (not just in the subdivision).

Organization	Contact Person	Phone Number / E-mail	Address
(6) Questar Gas (pipeline)	TBD	800-541-2824 to report breaks, leaks, or odors.	2100 S Industrial Park Rd., Richfield, UT 84701
Central Utah Telephone	Eddie Cox	435-427-3331 / ecox@cut.net 435-427-3809 fax	45 W Center Fairview, UT 84629
Utah Power	Mark Cox	mark.cox@pacificorp.com	
Walker's Gas and Groceries		435-427-9304	336 N State Fairview, UT 84629
Fred and Audrey's Gas and Groceries	TBD	TBD	TBD
Far West Bank	TBD	435-427-3361	320 N Milburn Rd. Fairview, UT 84629
Big Pine Sports	TBD	435-427-3338	340 N Milburn Rd Fairview, UT 84629
Cox Automotive	Ron Cox	435-427-9241	255 E Canyon Rd Fairview, UT 84629
MJK Construction	TBD	435-427-9299	47 W Center Fairview, UT 84629
Christiansen Brothers Rock Products	Brent Christiansen	435-462-9166	PO Box 191 Fairview, UT 84629
(5) Noorlander Building & Roofing, Inc.	James Noorlander	435-427-3711	HC 13 Box 4314 Fairview, UT 84629
(1) Bryan Ady Excavating	Bryan Ady	435-427-3383	HC 13 Box 300-12 Fairview, UT 84629
Fairview Drilling & Pump Service	Roger Paulsen	435-427-3421	131 N. 200 E. PO Box 289 Fairview, UT 84629
(1) CC Horses & Tack	TBD	TBD	HC 13 Box 300-25 Fairview, UT 84629
(5) Troy Young's Awnings	Troy Young	435-427-3412	34780 N. 7900 E.

			HC 13 Box 4409 Fairview, UT 84629
Johansen Sand & Gravel	TBD	435-462-9426, 435-462-2487	TBD

Located in the (1) Hideaway Valley, (2) Blackhawk Estates, (3) Indian Ridge, (4) Panorama Woods, (5)Fairview Ranchos, or (6) Indianola..

INSTRUCTIONS

7. Formal Associations

List contact information for civic groups, churches, volunteer organizations, etc.

Organization	Contact Person	Phone Number	E-mail
LDS Church	Carl Winters	(435) 427-3399	winters@cut.net
Boy Scout Troop 1660	Robert Beal	(435) 427-3719	
Cub Scout Troop 1660	Robert Beal	(435) 427-3719	

INSTRUCTIONS

8. Media Support

List contact information for local media, such as newspapers, newsletters, websites, etc.

Organization	Contact Person	Phone number	E-mail
KMTI Radio – Manti, Utah		435-835-7301	
Pyramid Newspaper (weekly)		435-462-2134	pyramid@avpro.com
Messenger Newspaper (weekly)		435-835-4241	dcall@manti.com
Horseshoe Trader (weekly)		435-835-6272	
Provo Daily Herald (daily)			

INSTRUCTIONS

9. Schools

List contact information for all public and private schools in the community.

Organization	Contact Person	Phone; E-mail	Address
Fairview Grade School		(435) 427-9204	11200 E. 24500 N. Fairview, UT 84629
North Sanpete High School		(435) 462-2452	390 E. 700 S. Mt. Pleasant, UT 84647
Wasatch Academy		(435) 462-2411	120 S. 100 W. Mt. Pleasant, UT 84647
Snow College		(435) 283-7000	150 E. College Avenue Ephraim, UT 84627

INSTRUCTIONS

10. Transportation

List contact information for any railroad, highway, or other public transportation routes or means in the community.

Organization	Contact Person	Phone Number	E-mail
Sanpete County Road Department	Steve Keller	(435) 835-6441	None
Utah Dept. of Transportation (Shed 4334)	TBD	(435) 462-2272	TBD

INSTRUCTIONS

11. Private Emergency Services and Equipment

List privately-owned equipment and services available for wildfire response, with contact information. If such services or equipment are already contracted under the County Mobilization Plan, they should not be listed here.

Type of Equipment	Contact Person	Phone; E-mail	Address
Back Hoe, Bulldozer, Track Hoe	Bryan Ady	(435) 427-3383; ady@cut.net	HC-13 Box 300-12, Fairview, UT 84629
Back Hoe, Bobcat	Terrell Pack	(435) 427-3340	Fairview, UT 84629
Bulldozer, Back Hoe, Road Grader	Jay Barlow	(435) 427-9303	HC-13 Box 4231, Fairview, UT 84629

INSTRUCTIONS

12. Restricting covenants, ordinances, etc.

Describe any pertinent restricting covenants, ordinances, etc., concerning wildfire in the community. For example, requirements regarding gated communities, building construction materials, vegetation removal.

The following restrictions need to be considered in any fuel management or fire protection projects:

Homeowner Association Bylaws, where they exist, are generally regarded as not negatively impacting wildfire mitigation efforts in the community, e.g., none of the communities are gated. Evaluation of Homeowner Association Bylaws is planned as part of this Community Fire Plan.

INSTRUCTIONS

13. Insurance Rating

Provide the current insurance rating for the community. (The community's primary fire protection provider should be able to assist with this information.)

Fire Insurance Rating: The north Sanpete County area generally carries a fire insurance rating of Class 9.

INSTRUCTIONS

14. PHYSICAL DESCRIPTION

While completing the following assessments of the community, consider the height, width, weight, and turnaround needs of emergency equipment. Exact clearance requirements may vary by community.

Road clearance height	≥ 13'6"	Dead end street turnaround	≥ 100' diameter
Road clearance width	≥ 20'	Bridge/culvert weight limit	= 20 tons per axle

Driveway clearance height	≥ 13'6"	Driveway turnarounds*	≥ 30' (inside turning radii), 45' (outside turning radii)
Driveway clearance width	≥ 12'	Driveway turnouts**	≥ 10' wide and 30' long

* for driveways in excess of 150' in length

** for driveways in excess of 200' in length and less than 20' in width

If desired, section 14 (pages 10 - 12) can be copied, completed, and included in the community fire plan.

INSTRUCTIONS

A. Access

Provide detailed information regarding access to the community, including all-weather and seasonal access.

(1) Hideaway Valley,

i. Directions to community:
From Fairview, go north on State Highway 89 for 9 miles. Turn east on Hideaway Valley Road (poorly marked) for 0.9 miles. Turn north and enter the Hideaway Valley subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 9 miles. Turn east on Hideaway Valley Road (poorly marked) for 0.9 miles. Turn north and enter the Hideaway Valley subdivision.

ii. All-weather access: Yes, to signs indicating the limit of snow removal. (4-wheel drive may be required to some properties.)

iii. Seasonal access: Yes, to signs indicating the limit of snow removal. (4-wheel drive may be required to some properties. Some properties inaccessible in winter.)

(2) Blackhawk Estates,

i. Directions to community:

From Fairview, go north on State Highway 89 for 9 miles. Turn east on Hideaway Valley Road (poorly marked) for 0.9 miles. Continue east and enter the Hideaway Valley subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 9 miles. Turn east on Hideaway Valley Road (poorly marked) for 0.9 miles. Continue east and enter the Hideaway Valley subdivision.

ii. All-weather access: Yes. (4-wheel drive may be required to some properties.)
iii. Seasonal access: Yes, volunteer snow removal. (4-wheel drive may be required to some properties. Some properties inaccessible in winter.)

(3) Indian Ridge,

i. Directions to community:
From Fairview, go north on State Highway 89 for 9 miles. Turn west on Big Hollow Road (poorly marked) and enter the Indian Ridge subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 9 miles. Turn west on Big Hollow Road (poorly marked) and enter the Indian Ridge subdivision.
ii. All-weather access: Yes. (4-wheel drive may be required to some properties.)
iii. Seasonal access: Yes. (4-wheel drive may be required to some properties. Some properties inaccessible in winter.)

(4) Panorama Woods,

i. Directions to community:
From Fairview, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and proceed 3 miles to enter the Panorama Woods subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and proceed 3 miles to enter the Panorama Woods subdivision.
ii. All-weather access: No. (4-wheel drive may be required to some properties. Some properties inaccessible in inclement weather and in snow.)
iii. Seasonal access: Yes. (4-wheel drive may be required to some properties. Some properties inaccessible in inclement weather.)

(5) Arrowhead Estates,

i. Directions to community:
From Fairview, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and proceed 5 miles to enter the Arrowhead subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and proceed 5 miles to enter the Arrowhead subdivision.
ii. All-weather access: No. (4-wheel drive may be required to some properties. Some properties inaccessible in inclement weather and in snow.)
iii. Seasonal access: Yes. (4-wheel drive may be required to some properties. Some properties inaccessible in inclement weather.)

(6) Fairview Ranchos I, II, and III,

i. Directions to community:
From Fairview, go north on State Highway 89 for 10 miles. Turn west on Road (poorly marked) and enter the Fairview Ranchos subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 10 miles. Turn west on Road (poorly marked) and enter the Fairview Ranchos subdivision.
ii. All-weather access: Yes. (4-wheel drive may be required to some properties.)
iii. Seasonal access: Yes. (4-wheel drive may be required to some properties.)

(7) Indianola,

i. Directions to community:

From Fairview, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and enter the Indianola subdivision.
From Fairview Volunteer Fire Department, go north on State Highway 89 for 10 miles. Turn east on Indianola Road (poorly marked) and enter the Indianola subdivision.

ii. All-weather access: Yes.
iii. Seasonal access: Yes.

(8) Milburn,

i. Directions to community:
From Fairview, go north on Milburn Road for 6 miles.
From Fairview Volunteer Fire Department, go north on Milburn Road for 6 miles.
ii. All-weather access: Yes.
iii. Seasonal access: Yes.

INSTRUCTIONS

B. Roads

Provide information regarding the condition and types of roads in the community. Percentages are ideal, but general estimations are sufficient.

i. Few road signs are present.

ii. 20% are pavement; 65% are gravel; 15 % are dirt

iii. Most will support 2 lanes of traffic. Numerous 1 lane roads in the area.

iv. Some are loop roads.

iv. Some are dead-end roads. Of these, most have inadequate turnaround space available at the end of the road for emergency equipment (based on turning radius listed in front of this section).

INSTRUCTIONS

C. Driveways

Provide a general assessment of the driveways in the community, in regard to emergency equipment (based on height and width information listed in front of this section) and emergency response.

i. Most driveways width and height clearance, road grades and vegetation appearance are adequate for emergency equipment.

ii. Few individual homeowners have posted their name and address. (Note: Most homes have “county” or “rural” addresses which do not adequately provide “directions” to properties.)

INSTRUCTIONS

D. Structures

Assess the community in regard to building structures and wildfire hazard – construction materials, visibility, etc. Percentages are ideal, but general estimations are sufficient.

i. Most are of wood-frame construction.
ii. Most have wood decks or porches.
iii. Most have wood shake or shingle roofs.
iv. Few are visible from the main subdivision road.

INSTRUCTIONS

E. Bridges, Gates, Culverts, other

Assess the community's infrastructure for potential obstacles to emergency response. Consider weight, height, and width information of emergency vehicles as listed in front of this section.

i. All bridges support emergency equipment.
ii. All gates provide easy access to emergency equipment.
iii. Some culverts are easily crossed by emergency equipment.

INSTRUCTIONS

F. Utilities

Assess and provide information on the utilities serving the community, in regard to wildfire hazard and emergency response capabilities.

i. Telephone service is below ground.

   Provided by: Central Utah Telephone Telephone #: (435) 427-3331

ii. Electrical service is both above and below ground.

Provided by: Utah Power Telephone #: (877) 548-3768, (888) 221-7070

iii. Are there homes / structures utilizing propane? Yes

If yes: 95 % of those propane tanks are above ground

If some are above ground: None are marked with a flag or by other highly visible means

List locations of those propane tanks above ground. Development of a list of above-ground propane tanks is planned as part of this Community Fire Plan.

iv. Are there homes / structures utilizing natural gas? Yes

v. Primary water sources:

Approximately 5 % of homes use central water system.

Approximately 90 % of homes use individual wells.

Approximately 5 % of homes have additional private water source.

Water provided by: Indian Ridge Water Conservancy District Telephone #: (435) 427-9303

PART II:
COMMUNITY PRESCRIPTION

***Directions**: This section is to be completed by the Community Wildfire Committee. A community prescription includes the goals of the plan, identifies specific actions needed to complete the goals of the wildfire plan and identifies responsible parties, resources and priorities.*

INSTRUCTIONS

1. Goals of Plan

Provide a brief statement of the goals of the Community Wildfire Plan. **Each plan must address the following: Fuel Reduction, Facilities and Equipment, Education, Emergency Response Plan (including comprehensive plans for shelter-in-place and evacuation), Regulative Issues, and Evaluation and Maintenance.**

1 . GOALS/PURPOSE OF PLAN

A. Increase public awareness of the risks posed by wildfire to life safety and property of area residents through implementation of a wildfire hazard education program.
B. Increase life safety and enhance forest health through the implementation of a survivable space program. Objective is to achieve 75% of the homes within the project area within a 5 year period.
C. Develop and implement hazardous fuels mitigation program to establish fuel breaks where needed and to reduce hazardous fuel concentrations within and surrounding our area.
D. Establish a fire safe road program.
E. Increase water supplies for fire suppression needs.
F. Establish perimeter fuel breaks to increase public safety.
G. Evaluate, upgrade, and maintain community wildfire response facilities, equipment, and training.
H. Develop and implement a comprehensive emergency response plan.
I. Address regulatory issues impacting community wildfire prevention and response needs.

INSTRUCTIONS

2. Identification of Actions

Describe projects that need to be done to complete the goals of the plan, and to perform annual and periodic maintenance of the plan.

GOAL: A. Increase public awareness of the risks posed by wildfire to life safety and property of area residents through implementation of a wildfire hazard education program.

ACTION 1: Implement a wildfire safety education program within the project area.

ACTION 2: Plan and implement an annual wildfire awareness day within the project area.

ACTION 3: Identify sources of fire safety information.

ACTION 4: Obtain pamphlets, maps, and other information; and arrange for distribution.

ACTION 5: Develop mailing list of landowners in the area, including telephone contact information, wherever permission can be secured from the landowner to disclose the information.

ACTION 6: Distribute periodic newsletter with pertinent fire safety information.

ACTION 7: Establish notice boards where pertinent information can be posted for general public view.

ACTION 8: Work with partners to determine needs and establish a model site(s), model planting(s), or other model resource(s) to demonstrate and/or show community members what can be done.

GOAL: B. Increase life safety and enhance forest health through the implementation of a survivable space program. Objective is to achieve 75% of the homes within the project area within a 5 year period.

ACTION 1: Coordinate and implement a wildfire lot assessment program within the project area.

ACTION 2: Implement a survivable space program within the project area.

GOAL: C. Develop and implement hazardous fuels mitigation program to establish fuel breaks and/or other mitigation treatments where needed to reduce hazardous fuel concentrations within and surrounding our area.

ACTION 1: Implement a wildfire safety education program within the project area.

ACTION 2: Coordinate an annual brush/fuel removal activity within the project area.

ACTION 3: Identify and develop brush/slash fuels disposal area with convenient access to landowners and make them fire safe. Clearly designated areas for culled vegetation. Provide aid to the Fuel Reduction Committee in making disposal areas safe.

ACTION 4: Obtain use of a chipper for the general area.

ACTION 5: Encourage marking of propane and gas storage areas.

GOAL: D. Establish a fire safe road program.

ACTION 1: Coordinate an annual wildfire safety awareness day within the project area.

ACTION 2: Identify roads that do not meet existing fire codes (UFC) for such items as dead end roads, inadequate turn-arounds, over hanging vegetation, etc.

ACTION 3: Coordinate with Property Owners Associations, developers and county officials to conduct fuel clearance activities.

ACTION 4: Identify inadequate turnabouts and explore ways and means to enlarge them to appropriate size.

ACTION 5: Establish adequate turn abouts for emergency equipment.

ACTION 6: Implement a street and road marking program to aid emergency services personnel.

ACTION 7: Develop an accurate map of project area identifying structures and resources useful to fire suppression and emergency response responders.

ACTION 8: Provide updated maps of the area to emergency response groups annually.

ACTION 9: Encourage county officials to complete E911 for the area.

ACTION 10: Develop general evacuation strategies and distribute to landowners.

ACTION 11: Work with local church groups and Red Cross as to needs in case of catastrophic fire.

ACTION 12: Work with fuel reduction committee to have safe areas located throughout area where people could migrate in event of catastrophic fire.

ACTION 13: Work with partners to get GPS maps and/or other mapping resources available for community use and/or for developing updated maps.

GOAL: E. Increase water supplies for fire suppression needs.

ACTION 1: Evaluate possible sources of water, including developing pond(s) or developing well(s).

ACTION 2: Work with state water resources to develop water rights to support water supplies for fire suppression.

GOAL: F. Establish perimeter fuel breaks to increase public safety**.**

ACTION 1: Implement a fuel break program within the project area.

ACTION 2: Work with appropriate partners (private, state, federal) on the best location for fuel breaks and implement the establishment of fuel breaks.

ACTION 3: Once established, implement maintenance of fuel breaks.

GOAL: G. Evaluate, upgrade, and maintain community wildfire response facilities, equipment, and training.

ACTION 1: Work with appropriate partners to determine equipment, facility, and training needs.

ACTION 2: Work with appropriate partners to develop fire suppression strategies and train personnel.

ACTION 3: Work with appropriate partners to train personnel for Community Emergency Response Team (CERT).

ACTION 4: Work with appropriate partners to train personnel for appropriate levels of fire awareness and fire-fighting skills.

ACTION 5: Work with appropriate partners to train personnel for appropriate levels of first aid or emergency medical (EMT) skills.

ACTION 6: Identify existing equipment, personnel, and external resources.

GOAL: H. Develop and implement a comprehensive emergency response plan.

ACTION 1: Develop an emergency notification system.

ACTION 2: Develop an emergency action plan.

ACTION 3: Develop an emergency shelter-in-place plan.

ACTION 4: Develop secondary escape routes.

ACTION 5: Work with appropriate partners to secure cellular telephone service for the area to support emergency communication requirements.

ACTION 6: Work with appropriate partners to evaluate and secure suitable redundant and fail-safe communications technology (radio communications, UDOT Emergency Radio Transmitter, local sirens, in-home radio receivers, etc.) for the area to support emergency communication requirements.

GOAL: I. Address regulatory issues impacting community wildfire prevention and response needs.

ACTION 1: Identify rules that impact wildfire preparation and response and make recommendations for improvement.

ACTION 2: Evaluate feasibility of using non-profit status structure for homeowners association(s) or partnership with a non-profit organization(s).

INSTRUCTIONS

3. Identification of Responsible Parties, Resources and Priorities

Outline how the actions described in Item 2 will be accomplished, by listing responsible parties (person who is responsible for each action), resources (assets needed to complete actions), and priorities (designating of each action as high, medium or low priority).

Accomplishment of specific actions targeted against specific goals must be managed through the careful orchestration of the available community resources. To accomplish this, the community will convene committees to focus on major subdivisions of activities, committees may include, but are not limited to:

- North Sanpete Fire Council, the overall advisory body

NSFC Supporting Committees:

- Fuel Reduction Committee, the advisory body coordinating fuel reduction/mitigation activities
- Awareness, Education, and Training Committee, the advisory body coordinating the educational effort
- Demonstration Projects Committee, the advisory body coordinating demonstration activities
- Communication and Signage Committee, the advisory body coordinating communications and signs

- Annual Cleanup Committee, the advisory committee coordinating the annual/semi-annual cleanups
- Public Relations Committee, the advisory committee coordinating sharing our successes and searching for new resources
- Technical Committee, the advisory body coordinating assessment activities
- Accountability and Records Committee, the advisory body coordinating accounting of community labor, materials, and equipment usage.

The committees will work with the partners and resources identified, or that may be identified in the future. Partners and resources include, but are not limited to:

- Property Owners
- Property Owners Associations
- Builders and Developers
- State of Utah, DNR, Div of Forestry, Fire & State Lands
- Forest Service
- Sheriff's Department
- Fairview Volunteer Fire Department
- Fairview Police Department
- Sanpete County Commissioner
- Six County Association of Governments
- Questar Gas
- Utah Power
- Central Utah Telephone
- KMTI Radio
- Local Publications: Pyramid, Horseshoe Trader, Messenger
- Local Businesses
- Utah State University
- Snow College
- Local Churches
- FireWise
- Living With Fire
- American Red Cross
- Boy Scouts of America

The Goals and Actions in this plan are managed in accordance with the following table:

Aim	Action	Resources	Responsible Party	Priority

North Sanpete County Regional Fire Plan				
GOAL: A. Increase public awareness of the risks posed by wildfire to life safety and property of area residents through implementation of a wildfire hazard education program.	ACTION 1: Implement a wildfire safety education program within the project area.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • Forest Service • Sheriff's Department • Snow College • KMTI Radio • NSFC Supporting Committees	Responsible Committee: North Sanpete Fire Council, Responsible Person: Chair	High
	ACTION 2: Plan and implement an annual wildfire awareness day within the project area.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • KMTI Radio • NSFC Supporting Committees	Responsible Committee: Public Relations Committee, Responsible Person: Chair	Medium

	ACTION 3: Identify sources of fire safety information.	• Property Owners Associations • Property owners • FireWise • Living With Fire • Six County Association of Governments • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Utah State University • Department of the Interior - Bureau of Land Management • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee, Responsible Person: Chair	Medium
	ACTION 4: Obtain pamphlets, maps, and other information; and arrange for distribution.	• FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Utah State University • Department of the Interior - Bureau of Land Management • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	Medium
	ACTION 5: Develop mailing list of landowners in the area, including telephone contact information, wherever permission can be secured from the landowner to disclose the information.	• Property Owners Associations • Property Owners • Local Churches • Central Utah Telephone • Sanpete County Recorder • NSFC Supporting Committees	Responsible Committee: Public Relations Committee Responsible Person: Chair	Low

	ACTION 6: Distribute periodic newsletter with pertinent fire safety information.	• Property Owners Associations • Property Owners • Local Churches • Boy Scouts of America • KMTI Radio • Pyramid • Horseshoe Trader • Messenger • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee, Responsible Person: Chair	Low
	ACTION 7: Establish notice boards where pertinent information can be posted for general public view.	• Property Owners Associations • Property Owners • Sheriff's Department • Local Businesses • Boy Scouts of America • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	Medium
	ACTION 8: Work with partners to determine needs and establish model site(s), model planting(s), or other model resource(s) to demonstrate and/or show community members what can be done to improve potentially survivable space.	• Property Owners Associations • Property Owners • Local Churches • USDA Forest Service • Utah State University • Snow College • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • Boy Scouts of America • KMTI Radio • NSFC Supporting Committees	Responsible Committee: Demonstration Projects Committee Responsible Person: Chair	Medium
GOAL: B. Increase life safety and enhance forest health through the implementation of a survivable space program. Objective is to achieve 75% of	ACTION 1: Coordinate and implement a wildfire lot assessment program within the project area.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire	Responsible Committee: Technical Committee Responsible Person: Chair	High

the homes within the project area within a 5 year period.		Department • NSFC Supporting Committees		
	ACTION 2: Implement a survivable space program within the project area.	• Property Owners Associations • Property Owners • Local Churches • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • NSFC Supporting Committees	Responsible Committee: Fuel Reduction Committee Responsible Person: Chair	High
GOAL: C. Develop and implement hazardous fuels mitigation program to establish fuel breaks and/or other mitigation treatments where needed to reduce hazardous fuel concentrations within and surrounding our area.	ACTION 1: Implement a wildfire safety education program within the project area.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • Forest Service • Sheriff's Department • Snow College • KMTI Radio • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	High

	ACTION 2: Coordinate an annual brush/fuel removal activity within the project area.	• Property Owners Associations • Property Owners • Local Churches • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Boy Scouts of America • KMTI Radio • NSFC Supporting Committees	Responsible Committee: Fuel Reduction Committee Responsible Person: Chair	High
	ACTION 3: Identify and develop brush/slash fuels disposal area with convenient access to landowners and make them fire safe. Clear designated areas for culled vegetation. Provide aid to the Fuel Reduction Committee in making disposal areas safe.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • County Government • NSFC Supporting Committees	Responsible Committee: Annual Cleanup Committee Responsible Person: Chair	Medium
	ACTION 4: Obtain use of a mobile chipper or chipper services for the general area.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • County Government • NSFC Supporting Committees	Responsible Committee: Annual Cleanup Committee Responsible Person: Chair	Medium

	ACTION 5: Encourage marking of propane and gas storage areas.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • County Government • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High
GOAL: D. Establish a fire safe road program.	ACTION 1: Coordinate an annual wildfire safety awareness day within the project area.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Associations • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	Medium
	ACTION 2: Identify roads that do not meet existing fire codes (UFC) for such items as dead end roads, inadequate turn-arounds, over hanging vegetation, etc.	• Property Owners Associations • Property Owners • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	High

	ACTION 3: Coordinate with Property Owners Associations, developers and county officials to conduct fuel clearance activities.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Fuel Reduction Committee Responsible Person: Chair	High
	ACTION 4: Identify inadequate turnabouts and explore ways and means to enlarge them to appropriate size.	• Property Owners Associations • Property Owners • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	High

	ACTION 5: Establish adequate turn abouts for emergency equipment.	• Property Owners Associations • Property Owners • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	High
	ACTION 6: Implement a street and road marking program to aid emergency services personnel.	• Property Owners Associations • Property Owners • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High

	ACTION 7: Develop an accurate map of project area identifying structures and resources useful to fire suppression and emergency response responders.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High
	ACTION 8: Provide updated maps of the area to emergency response groups annually.	• Property Owners Associations • Property Owners • Neighboring Property Owners Association • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	Low

	ACTION 9: Encourage county officials to complete E911 for the area.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Association • FireWise • Living With Fire • USDA Forest Service • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • Fairview Volunteer Fire Department • County Road Department • County Government • NSFC Supporting Committees	Responsible Committee: Public Relations Committee Responsible Person: Chair	High
	ACTION 10: Develop general evacuation strategies and distribute to landowners.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Associations • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High

	ACTION 11: Work with local church groups and Red Cross as to needs in case of catastrophic fire.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Associations • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • American Red Cross • NSFC Supporting Committees	Responsible Committee: Public Relations Committee Responsible Person: Chair	Medium
	ACTION 12: Work with fuel reduction committee to have safe areas located throughout area where people could migrate in event of catastrophic fire.	• Property Owners Associations • Property Owners • Local Churches • Neighboring Property Owners Associations • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High
	ACTION 13: Work with partners to get GPS maps and/or other mapping resources available for community use and/or for developing updated maps.	• Property Owners Associations • State of Utah, DNR, Div of Forestry, Fire & State Lands • Sheriff's Department • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High

GOAL: E. Increase water supplies for fire suppression needs.	ACTION 1: Evaluate possible sources of water, including developing pond(s) or developing a well(s).	• Property Owners Associations • Property Owners • Neighboring Property Owners Associations • Utah Department of Natural Resources • FireWise • Living With Fire • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	Medium
	ACTION 2: Work with state water resource to develop water rights to support water supplies for fire suppression.	• Property Owners Associations • Property Owners • Local Churches • Utah Department of Natural Resources • FireWise • Living With Fire • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	Medium

GOAL: F. Establish perimeter fuel breaks to increase public safety..	ACTION 1: Implement a fuel break program within the project area.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: Fuel Reduction Committee Responsible Person: Chair	High
	ACTION 2: Work with appropriate partners (private, state, federal) on the best location for fuel breaks and implement the establishment of fuel breaks.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: Fuel Reduction Committee Responsible Person: Chair	High

	ACTION 3: Once established, implement maintenance of fuel breaks.	• Property Owners Associations • Property Owners • FireWise • Living With Fire • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Commission • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	Low
GOAL: G. Evaluate, upgrade, and maintain community wildfire response facilities, equipment, and training.	ACTION 1: Work with appropriate partners to determine equipment, facility, and training needs.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	High

	ACTION 2: Work with appropriate partners to develop fire suppression strategies and train personnel.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Public Relations Committee Responsible Person: Chair	Medium
	ACTION 3: Work with appropriate partners to train personnel for Community Emergency Response Team (CERT).	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • American Red Cross • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	Medium
	ACTION 4: Work with appropriate partners to train personnel for appropriate levels of fire awareness and fire-fighting skills.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	Medium

	ACTION 5: Work with appropriate partners to train personnel for appropriate levels of first aid or emergency medical (EMT) skills.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • American Red Cross • NSFC Supporting Committees	Responsible Committee: Awareness, Education, and Training Committee Responsible Person: Chair	Medium
	ACTION 6: Identify existing equipment, personnel, and external resources.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	High

GOAL: H. Develop and implement a comprehensive emergency response plan.	ACTION 1: Develop an emergency notification system.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	High
	ACTION 2: Develop an emergency action plan.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: North Sanpete Fire Council Responsible Person: Chair	High
	ACTION 3: Develop an emergency shelter-in-place plan.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: North Sanpete Fire Council Responsible Person: Chair	High

	ACTION 4: Develop secondary escape routes.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • NSFC Supporting Committees	Responsible Committee: Technical Committee Responsible Person: Chair	High
	ACTION 5: Work with appropriate partners to secure cellular telephone service for the area to support emergency communication requirements.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Central Utah Telephone • AT&T • Cellular One • Verizon Wireless • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	Medium

	ACTION 6: Work with appropriate partners to evaluate and secure suitable redundant and fail-safe communications technology (radio communications, UDOT Emergency Radio Transmitter, local sirens, in-home radio receivers, etc.) for the area to support emergency communication requirements.	• Property Owners Associations • Property Owners • Local Churches • FireWise • Living With Fire • Sheriff's Department • Fairview Volunteer Fire Department • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Utah Department of Transportation • Utah State Police • NSFC Supporting Committees	Responsible Committee: Communication and Signage Committee Responsible Person: Chair	Low
GOAL: I. Address regulatory issues impacting community wildfire prevention and response needs.	ACTION 1: Identify rules that impact wildfire safety and make recommendations for improvement.	• Property Owners Associations • Property Owners • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • Fairview Volunteer Fire Department • Sanpete County Watershed Authority • NSFC Supporting Committees	Responsible Committee: North Sanpete Fire Council Responsible Person: Chair	Low
	ACTION 2: Evaluate feasibility of using non-profit status structure for homeowners association(s) or partnership with a non-profit organization(s).	• Property Owners Associations • Property Owners • Builders and Developers • State of Utah, DNR, Div of Forestry, Fire & State Lands • USDA Forest Service • Sheriff's Department • NSFC Supporting Committees	Responsible Committee: Accounting Records Committee Responsible Person: Chair	Low

PART III:
RESOURCES

***Directions**: This section is to be completed through joint effort between the Community Wildfire Committee and fire officials. This section will contain a list of wildfire preparation and response resources that are selected by the community for retention in a community wildfire reference library.*

INSTRUCTIONS

List of Resources

List wildfire preparation and response resources to be retained in a community wildfire reference library, such as brochures, leaflets, books, magazines, videos, charts, etc.

Informational materials

General Fire Prevention

"Are You Living in the Red?" pamphlet (Utah Fire Assessment Project: Bureau of Land Management et.al.)
"Living With Fire" video (Utah Living With Fire)
"Living With Fire" pamphlet (Utah Living With Fire)
"Living With Fire, A Guide for the Homeowner" pamphlet (Great Basin Fire Prevention)
"Protect Your Home Wildfire, Tips for Homeowners" door hanger (Utah Living with Fire)
"Living with Fire" book mark (Utah Living with Fire)
"Living with Fire" refrigerator magnet (Utah Living with Fire)
"Preventing Home Ignitions" video (FireWise)
"Wildfire – Are You Prepared" brochure (American Red Cross)
"Emergency Preparedness Checklist" brochure (American Red Cross)
"Your Family Disaster Supplies Kit" brochure (American Red Cross)
"Your Family Disaster Plan" brochure (American Red Cross)
"Food and Water in an Emergency" brochure (American Red Cross)
"Community Wildfire Preparation Workshop" brochure (Community Solutions)

Landscaping/Building

"Firewise Plants for Utah Landscapes" Utah Forest Facts newsletter (Utah State University Extension)

Community Planning

"Community Wildfire Preparation Program, 2002 Report" brochure (Community Solutions)
"Community Wildfire Preparation Workshop Guide" manual (Community Solutions)
"Potential Wildfire Partners" brochure (Community Solutions)
"Mapping Networks – Questions to Ask" brochure (Community Solutions)

Websites and E-Mail Addresses

FireWise Home Page – http://www.firewise.org
Forest Service Fire Management Website – http://www.fs.fed.us/r3/sfe/fire/index.html
Insurance Services Office (town fire ratings) – http://www.isomitigation.com/
National Fire Protection Association – http://www.nfpa.org
National Interagency Fire Ctr, Wildland Fire Prevention/Education – http://www.nifc.gov/preved/rams.html
U.S. Department of Agriculture "How to Get Information" (contacts) – http://www.usda.gov/news/howto/nre.htm

Utah BLM Fire Management Website – http://www.ut.blm.gov/fire/Assessment/assessment.html
Utah Twenty-First Century Communities Program – http://utahreach.usu.edu/comm21/index.htm
Community Solutions - cmtysolutions@aol.com

PART IV:
TECHNICAL ASSESSMENTS

Community Description

Physical Description

Area

Legal description: T 12 S R 4 E Sections 1 - 24, 30, 31

USGS Map Quadrangle: Indianola, Spencer Canyon and Big Hollow

Topography and Vegetation

Slope:

Range _0_% to _35_%

Aspect:

Aspects in this area face all directions, with homes on many different aspects

Vegetation:

The vegetation in the area is dominated by a fuel model 4, consisting of a Pinyon Juniper mix and Oak Brush. There are large areas of fuel model 6, sage and grass and fuel model 1, short grass. There is a small amount of Aspen and Conifer in the upper elevations of Indian Ridge and Elk Ridge areas.

Water Supply

Ponds / Creeks / other natural water sources:

Pond/Creek	Location / GPS Coordinates	Permanent/ Intermittent	Helicopter Access?	Pump Volume or Required?	Type: Gal/min
Peterson Irrigation Pond 1	12 463093 X 4400657	Intermittent	Yes	Yes	100,000 gal
Peterson Irrigation Pond 2	12 463112 X 4400523	Intermittent	Yes	Yes	100,000 gal
Bigler/Terry Pond	12 460581 X 4406119	Permanent	Yes	Yes	1 mill + gal
Terry Farms Pond	12 458738 X 4403534	Permanent	Yes	Yes	150,000 gal
Hartney Lake	12 452645 X 4401404	Intermittent	Yes	Yes	1 mill + gal
Cowley Irrigation Pond 1	12 455667 X 4402899	Intermittent	Yes	Yes	750,000 gal
Cowley Irrigation Pond 2	12 454940 X 4405252	Intermittent	Yes	Yes	200,000 gal
Beck Resort Lake	12 454501 X 4405396	Permanent	Yes	Yes	1 mill + gal
Beck Irrigation Pond	12 455394 X 4405676	Intermittent	Yes	Yes	100,000 gal
Panorama Fill Station	12 463800 X 4406275	Permanent	No	No	600 gal
Shower Station	12 464070 X 4404397	Permanent	No	No	600 gal
Thistle Creek at Weir	12 460686 X 4406599	Permanent	No	Yes	600 gal/min
Irrigation Risers	Fields around Indianola	Permanent	No	No	800 gal/min

Hydrants:

Location	Type: Dry/Pressurize	Data: *TP&S	GPM (max.) Output	Comments
• None				

Water Tanks / Other available water storage (underground cisterns, swimming pools, etc.):

Location	Access	# of gallons*	Responsible Entity	Phone #
• None				

Emergency Services / Equipment Capabilities

Describe the types of emergency services and equipment available from local, county, state, and federal resources.

911 Services: Ambulance out of Fairview, 20 minute response time.
Fire Department out of Fairview, 20 minute response time
Fire Department out of Mt. Pleasant, 30 minute response time
Sheriff's deputy for law enforcement

Local: Fire Department out of Elk Ridge (untrained, unstaffed) 1 brush truck, 1 small water tender.

County: Sanpete County Search and Rescue (for searches or evacuation)
Dozers, Graders and other equipment for fire suppression
Sheriff's deputies for law enforcement, traffic control and evacuation

State: Fire Warden (with Engine type VI)
Highway Patrol
Fire Management personnel

Federal: Retardant Air Tankers (out of Hill Airforce Base and Cedar City)
Helicopter type III (out of Richfield)
Small retardant air tankers (out of Fillmore and or Nephi)
Additional air support as needed from around the Western U.S.
Hand Crews from around the Western U.S.
Fire management teams

Hazard Evaluation

Fire History

Fire Name	Start Date	Township/ Range	Section	Acres Burned
PANORAMA WOODS	August 9, 1980	T12S R4E	1	2
STEELES FIRE	July 19, 1982	T12S R3E	3	3
MILBURN REST	July 21, 1982	T13S R4E	3	0.25
MT. BALDY	September 2, 1982	T12S R3E	9	0
HIDE AWAY VALLEY	July 1, 1984	T12S R4E	2	0
DRY CREEK	July 21, 1984	T13S R5E	4	1
MILBURN	July 6, 1985	T13S R4E	12	0.1
MUD SPRING	September 8, 1986	T13S R4E	4	0.25
SKYVIEW DAIRY	June 25, 1987	T13S R4E	35	0.25
FAIRVIEW WEST	June 28, 1987	T13S R4E	2	1
INDIANOLA	August 5, 1987	T12S R4E	5	2
GAGING STATION	September 12, 1987	T13S TR5E	24	0
MT. BALDY	September 25, 1987	T12S R3E	26, 27, 34, 35	3000
DRY CRK/MILBURN	October 10, 1988	T13S R5E	18	700
ELVON GRANT	August 2, 1989	T12S R4E	8	1
UINTA GULCH	August 16, 1989	T13S R4E	6	4
MILBURN FARM	October 31, 1989	T13S R4E	26	0.1
SECTION 16	July 27, 1990	T12S R3E	16	0.25
SKYLINE E.INDIANOLA	July 29, 1990	T12S R5E	9	0.25
PANORAMA WOODS CABIN	September 2, 1990	T12S R4E	12	0.25
SOUTH FORK	September 28, 1990	T12S R5E	9	0.25
LONE PINE	July 10, 1992	T12S R5E	29	0.1
BLACKHAWK	August 8, 1992	T12S R4E	9	0
GEORGE MOORE	July 5, 1993	T12S R4E	10	0.25
ROBERT OLSEN	September 14, 1993	T12S R4E	36	0.25
INDIANOLA ROADSIDE	July 7, 1994	T12S R4E	21	0.38
OAK CREEK RIDGE	September 12, 1994	T13S R5E	9	0.25
CAMPER FIRE	July 22, 1995	T13S R5E	24	0
INDIAN RIDGE	September 16, 1995	T12S R4E	31	0.5
WHITE PINE	September 17, 1995	T13S R5E	27	0.25
SPENCER CANYON	June 24, 1996	T12S R3E	9	1
BROWN'S PEAK	June 26, 1999	T12S R 5E	6	0.1
WHEELER	July 4, 2001	T13S R4E	3	0.25
BANKS	July 8, 2001	T13S R4E	27	0.1
HIDE AWAY HILL	July 28, 2001	T12S R4E	10	0.1
BIG HORN	August 1, 2001	T12S R4E	7	3
PIPELINE	August 12, 2001	T12S R5E	3	0.1
LARRY BURKE	August 25, 2001	T13S R4E	11	2
STONE QUERY	August 29, 2001	T13S R4E	26	0.1
FAIRVIEW PEAK	August 30, 2001	T13S R5E	31	0.1
GILLESPIE	September 2, 2001	T13S R5E	18	0.1
DRY CREEK	October 7, 2001	T12S R5E	27	0.25
COX	June 1, 2002	T13S R4E	25	0.25
DEVILS KITCHEN	July 10, 2002	T12S R3E	6	0.2
MUDD	August 19, 2002	T31S R4E	31	0.25
OAKER HILLS	October 4, 2002	T12S R4E	31	0.1
MEYERS FIRE	June 1, 2003	T12S R4E	14	0.1
SNAIL HOLLOW	August 14, 2003	T12S R4E	24	0.1

Subdivision Rating

The subdivision is **high** for wildfire hazard, based on the following criteria:

Rating Points	Slope	Aspect	Topography	Response Time	Fuel type	Desity	Fire History 25 Years	Dwellings Per Acre
1	<10%	North	Valley Bottom	<15 min	Hardwoods	20%	<1/township	<.01
2	20%	East	Low on Slope	30 min	Gras/Sage	40%	1 - 2/township	.01 - .25
3	30%	Flate	Mid Slope	45 min	Pin./Juniper	60%	3 - 7/township	.25 - .5
4	45%	South	ridge Top	60 min	Mtn. Brush	80%	8 - 13/township	.5 - 1
5	>60%	West	Canyon/Draw	>60 min	Conifer	100%	14+/township	1 – 2
North Sanpete Region Score	2	4	3	2	3	3	4	3
Overall Score	24	High						

Rating Index

1 - 10	Low
11 - 20	Moderate
21 - 30	High
31 - 40	Extreme

Property / Structure Rating

All lots will be rated for wildfire hazard, as arranged by the Fire Council with fire officials and as permitted by the owners. The estimated time of completion for all ratings is ____October 2005_____.

Documentation of individual property ratings should be included in the Appendix.

Expected Fire Behavior

a. Fuel Model 4 Pinyon, Juniper & Oak

Slope	Rate of Spread	Flame Length
1. 0%	153 chains/hr	27 ft
2. 10%	154 chains/hr	27 ft
3. 20%	159 chains/hr	27 ft
4. 30%	166 chains/hr	28 ft

b. Fuel Model 6 Sage and grass

Slope	Rate of Spread	Flame Length
0%	43 chains/hr	7 ft
10%	43 chains/hr	7 ft
20%	44 chains/hr	7 ft
30%	47 chains/hr	7 ft

c. Fuel Model 1 grass

Slope	Rate of Spread	Flame Length
0%	136 chains/hr	5 ft

10%	136 chains/hr	5 ft
20%	136 chains/hr	5 ft
30%	136 chains/hr	5 ft

Detailed fire behavior documentation included in the Appendix.

Community Prescription

Fuel Modification Projects

Project (briefly identify)	Timeframe	Person in Charge
• Create defensible space around each home	October 2008	N. Sanpete Fire Council
• Thin and remove vegetation on perimeter roads for fuel breaks	October 2006	N. Sanpete Fire Council

Defensible space and fuel breaks will require annual treatment to maintain them. Treatments may be mechanical or chemical.

Infrastructure Improvements (Utilities, Water Developments, Equipment Acquisition / Repair, etc,)

Project (briefly identify)	Timeframe
• Create an alternate escape road out of Blackhawk	October 2004
• Create alternate escape routes out of Indian Ridge going south and north	October 2004
• Develop a pond on the valley floor that can serve as a helicopter dip sight	October 2006
• Develop as many dry hydrants in each community as possible	October 2005
• Establish a centralized, trained fire department	October 2005
• Improve main roads in each community to 24 ft of traversable surface	October 2007

Education

Goal (briefly identify)	Timeframe
• Train 90% of the home owners regarding defensible space	October 2005
• Train fire leadership to write defensible space prescriptions	May 2004
• Establish a resource library for wildfire information	May 2004

Wildfire Response / Pre-Attack Plan

Emergency Notification

In the event of a wildfire, report should be made immediately to Sanpete County Sheriff's dispatch (911) who will dispatch appropriate fire suppression resources. Next, notification should be made to the appropriate home owner's association leadership of the subdivision or subdivisions threatened by the fire. The LDS bishop should be notified so that the church structure can be used to notify everyone in the area of the threat to their property.

Hide Away Valley	Donna Pendry President	435 427-3264
Indian Ridge	Chuck Cummins President	801 787-8444
Panorama Woods		
Oaker Hills	Lynn Warner President	801 798-3818
Elk Ridge	David Martinez President	801 966 5941
LDS Bishop	Carl Winters	435 427-3399

Fire Protection Responsibilities

Fire protection responsibilities in the North Sanpete Area are assigned as follows. Individual home fires will be suppressed by the Fairview Fire Department, who will also provide command leadership during suppression activities. They may seek assistance as needed in their judgment from neighboring fire departments.

Wildland fires on privately owned land and state land will fall under the direction of the Sanpete County Fire Warden. He will provide command leadership and mobilize local, regional and national resources as needed for fire suppression activities. Federal firefighting resources will be mobilized as needed to assist local resources.

Fire suppression responsibilities for fire on Federal Forest land will be handled by the Manti LaSal National Forest. Local firefighting resources may assist the Forest Service as needed.

Multi-jurisdictional fires will be managed using unified command with representatives from each involved agency.

Response time to the Indianola Valley will generally not be less than 25 minutes because of fire department mobilization time and travel time involved.

Predetermined Command, Staging and Helibase Areas

Command Posts may be set up in the following areas:

- The pavilion inside Hide Away Valley.
- The Indian Ridge Lodge House.
- The Junction of hwy 89 and the Big Hollow road in the fields.
- The Junction of hwy 89 and the Hide Away Valley road in the fields.
- In fields along the road to Big Horn Ranch

Staging Areas may be set up in the following areas:

- In fields along the road to Big Horn Ranch.
- The Junction of hwy 89 and the Big Hollow road in the fields.
- The Junction of hwy 89 and the Hide Away Valley road in the fields.

Helibases may be set up in the following areas:

- In fields along the road to Big Horn Ranch.
- The Junction of hwy 89 and the Big Hollow road in the fields.
- The Junction of hwy 89 and the Hide Away Valley road in the fields.
- South of the Bigler/Terry irrigation pond.

Safety Zones and In-place Sheltering

In all events, where the lives of citizens are threatened, the first priority will be to evacuate the area. No in-place sheltering will be attempted as long as there is an escape route available out of the community. There are currently no available in-place sheltering or safety zones available in any of the communities. There is no place where the vegetation is sufficiently thin so as to impede fire progress. However, if trapped within communities the following places may be considered as a last resort, the grass area near the pavilion in Hide Away Valley, The grass area around Hartney Lake in Indian Ridge and the grass area in the south end of Panorama Woods. Also as last resort, citizens may consider remaining in homes where an effective defensible space has been created. None of these areas are to be considered as good safety zones.

Traffic Control

All traffic control within the subdivisions will be the responsibility of the Sanpete County Sheriff and his deputies. Traffic control along Hwy 89 will be handled by Sanpete County deputies and the Utah State Highway Patrol.

Suppression Operational Mode

In nearly all cases, wildland fires will be suppressed with an aggressive offensive operational mode.

Defensive operations will only be employed during periods when high resource values such as home are in imminent danger of being burned. Then firefighters will employ a defensive mode to protect the high value resources. Only the firefighters and equipment needed in defensive mode will be so employed. All other resources will be used in offensive operations. If the demand for defensive forces requires all available fire fighting resources, and the likelihood of success is high that homes will be preserved, then all firefighting resources will be so employed until additional resources can be procured. If conditions make a defensive mode unlikely to succeed in protecting homes, then firefighting resources will be employed in an offensive mode to contain and control the main fire until reinforcements can provide enough manpower to allow defensive activities.

Determining Resources Needed

The resources utilized on all wildland fires will be representative of the values at risk and the difficulty of suppression. Fires that pose no threat to homes and can be extinguished by local resources will be handled with local resources. Only those fires whose complexity and threat justify the use of expensive regional and national resources will be so staffed. If a fire poses a threat to a community, every possible effort will be made and appropriate available resource including local, regional and national will be used.

Local resources will generally include:

- Local volunteer fire department personnel and engines.
- Local Forest and BLM personnel and engines.
- A single engine air tanker.
- A type III helicopter.
- Mechanized equipment such as bull dozers and road graders.

Regional and national resources will include:

- Firefighting hand crews.
- Heavy air tankers.
- Additional type III helicopters.
- Type I and type II helicopters.
- Type I and type II fire management teams.

Pre-suppression Goals

The community can make the area more fire safe by pursuing the following goals:

- Educate the residents about the threat of wildfire and what they can do to reduce the threat.
- Create defensible space around homes.
- Insure that road systems are adequate to handle resident traffic and firefighting equipment at the same time.
- Establish a local, trained fire department.
- Develop water sources within the housing areas that can be used in fire suppression.
- Establish fire breaks around the perimeters of each community.

APPENDIX

INSTRUCTIONS

This section is to be filled as needed by both the Community Wildfire Committee and fire officials. Items can include, but are not limited to:

- Contact Lists
- Homeowner Checklists
- Assessment Project Worksheets
- Examples / Sample documents
- Maps
- Glossary

Appendix A – Contact Lists

Utah Division of Forestry, Fire and State Lands
Utah Resource & Development Councils
Emergency Management / Fire Agencies
Utah Associations of Governments
Other Planning / Training Resources
American Red Cross
Utah Department of Natural Resources
USDA Forest Service ~ Utah Offices
Bureau of Indian Affairs ~ Utah Offices
Tribes
Bureau of Land Management ~ Utah Offices
Fish and Wildlife Service ~ Utah Offices
National Park Service ~ Utah Offices
Emergency Call-Down List ~ TBD

Appendix B – Maps

Topography ~ TBD
Boundaries ~ TBD
Escape routes ~ TBD
Safety zones ~ TBD

Appendix C – Assessments / Worksheets

Survivable Space Assessment Worksheets ~ TBD
Wildfire Hazard Rating Form ~ TBD
Wildland Urban Interface Project Sheet (funding) ~ TBD

Appendix D – Checklists / Homeowner Information

Fire Disaster Potential Checklist for Homeowners ~ TBD
Fire Disaster Potential Checklist for Developers ~ TBD
Landscaping and Survivable Space Checklist ~ TBD
Construction Checklist ~ TBD
Fire Resistant Plants ~ TBD
Emergency Response checklist ~ TBD
Zoning recommendations checklist ~ TBD

Appendix E – Other

Wildfire Glossary ~ TBD

AGENCY CONTACT INFORMATION

Utah Department of Natural Resources

Division of Forestry, Fire and State Lands

Bear River Area Office
Craig Pettigrew, Area Manager
*Blain Hamp, Acting FMO**

1780 N. Research Parkway, Ste 104
N. Logan, UT 84341-1940
(435) 752-8701

Wasatch Front Area Office
Dick Buehler, Area Manager
Barbara Gardner, Area Forester

1594 W. North Temple, Ste 3520
Salt Lake City, UT 84116
(801) 538-5555

Southwestern Area Office
Ron Larsen, Area Manager
Larry LeForte, FMO

585 North Main
Cedar City, UT 84720-2643
(435) 586-4408

Northeastern Area Office
Dale Jablonski, Area Manager
Stephen Rutter, FMO

152 East 100 North
Vernal, UT 84078-2126
(435) 781-5463

Fred Johnson
Sanpete County Fire Warden
160 North Main
Manti, UT 84642
(435) 835-2117
(435) 851-1546 cellular
fredjohnson@utah.gov

Central Area Office
Kelly Allen, Area Manager
Mike Melton, FMO

115 East 900 North
Richfield, UT 84701-1847
(435) 896-5697

Southeastern Area Office
Gary Cornell, Area Manager
Heather O'Hanlon, Interface Project Coordinator

1165 S. Highway 191, Suite 6
Moab, UT 84532-3002
(435) 259-3766

** FMO = Fire Management Officer*

Utah Resource & Development Councils

Bear River RC&D
1860 N. 100 East
No. Logan, UT 84341
(435) 753-3871

Castlelands RC&D
P.O. Box 1287
Huntington, UT 84528
(435) 687-2985

Color Country RC&D
2460 W. Highway 56 #5
Cedar City, UT 84720
(435) 586-7449

Dinosaurland RC&D
240 W. Highway 40
Roosevelt, UT 84066
(435) 722-0884

Mountainlands RC&D
2210 S. Hwy 40, Suite B
Heber City, UT 84032-3527

Panoramaland RC&D
3490 N. 600 E.
Richfield, UT 84701
(435) 896-8965 ext. 42

Bonneville RC&D
5370 S. 1030 W.
Murray, UT 84123
(801) 262-6838

Emergency Management / Fire Agencies

Federal Emergency Mgmt Agency
Denver Federal Center
Building 710, Box 25267
Denver, CO 80225-0267
(303) 235-4800

Utah Comprehensive Emergency Management
Rm. 1110, State Office Bldg.
Salt Lake City, UT 84114
(801) 538-3400

Utah State Fire Marshal
5272 S. College Dr., Ste 302
Murray, UT 84123-2611
(801) 284-6350

Northern Utah Interagency Fire Center
DES North Building
17800 South Camp Williams Road
Riverton, UT 84065
(801) 908-1900

Richfield Interagency Fire Center
1809 Industrial Parkway Road
Richfield, UT 84701
(435) 896-8404
Noni Dalton or
Jill Ivie (435) 896-1573

Utah Associations of Governments

Bear River Assn. Of Governments
170 N. Main
Logan, UT 84321
(435) 752-7242

Mountainland Assn. Of Governments
586 East 800 North
Orem, UT 84097-4146
(801) 229-3800

Southeastern Assn. Of Governments
375 S. Carbon Ave., Box 1106
Price, UT 84501
(435) 637-5444

Five County Assn. Of Governments
906 N. 1400 W., Box 1550
St. George, UT 84770
(435) 673-3548

Six-County Assn. Of Governments
250 North Main
Richfield, UT 84701
(435) 896-9222

Uintah Basin Assn. Of Governments
855 E. 200 N. (112-3)
Roosevelt, UT 84066
(435) 722-4518

Other Planning / Training Resources

Community Solutions, Inc.
Kathy Hammons, Janet Johnson
386 East 600 North
Midway, UT 84049
(435) 657-0668
cmtysolutions@aol.com

Utah Rural Development Council
351 W. Center Street, Admin 304D
Cedar City, UT 84720
(435) 586-7852

Wasatch Front Regional Council
420 W. 1500 S., Ste 200
Bountiful, UT 84010
(801) 292-4469

American Red Cross

Cache County Chapter
1115 North 200 East, Ste 140
Logan, UT 84341
(435) 752-1125

Ogden Chapter
2955 Harrison Boulevard
Ogden, UT 84403
(801) 627-0000

Greater Salt Lake Area Chapter
465 South 400 East, Box 3836
Salt Lake City, UT 84110-3836
(801) 323-7000

Mountain Valley Chapter
865 North Freedom Blvd.
Provo, UT 84604-3315
(801) 373-8580

Southern Nevada Chapter
3672 N. Rancho Drive
Las Vegas, NV 89130
(702) 791-3311

Western Colorado Chapter
506 Gunnison Avenue
Grand Junction, CO 81501
(970) 242-4851

Utah Department of Natural Resources

Divisions other than Forestry, Fire and State Lands

Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, UT 84116
(801) 538-4700

Regional Office – Ogden
(801) 476-2740

Regional Office – Vernal
(435) 789-3103

Regional Office – Springville
(801) 489-5678

Regional Office – Price
(435) 636-0263

Regional Office – Cedar City
(435) 865-6103

Division of Oil, Gas & Mining
1594 W. No. Temple, Ste 1210
Salt Lake City, UT 84116
(801) 538-5340

Division of Water Rights
1594 W. No. Temple, Ste 220
Salt Lake City, UT 84116
(801) 538-7240

Regional Office – Logan
(435) 752-8755

Regional Office – Vernal
(435) 781-5327

Regional Office – Price
(435) 637-1303

Regional Office – Richfield
(435) 896-4429

Regional Office – Cedar City
(435) 586-4231

Division of Water Resources
1594 W. No. Temple, Ste 310
Salt Lake City, UT 84116
(801) 538-7230

Division of Parks & Recreation
1594 W. No. Temple, Ste 116
Salt Lake City, UT 84116
(801) 538-7220

Northeast Region
(435) 649-9109

Northwest Region
(801) 533-4229

Southeast Region
(435) 259-3755

Southwest Region
(435) 586-2789

For information on State Parks:
http://www.stateparks.utah.gov

Utah Geological Survey
1594 W. No. Temple, Ste 3110
Salt Lake City, UT 84116
(801) 538-3300

U.S. Department of Agriculture

Forest Service ~ Utah Offices

Intermountain Regional Office
Federal Building
324 25th Street
Ogden, UT 84401
(801) 625-5306

Dixie National Forest
1789 N. Wedgwood Lane
Cedar City, UT 84720
(435) 865-3700

Uinta National Forest
88 West 100 North
Provo, UT 84601
(801) 342-5780

Ashley National Forest
355 North Vernal Avenue
Vernal, UT 84078
(435) 789-1181

Fishlake National Forest
115 East 900 North
Richfield, UT 84701
(435) 896-9233

Wasatch-Cache National Forest
8236 Federal Building
125 South State Street
Salt Lake City, UT 84138
(801) 524-3900

Manti-LaSal National Forest
540 N. Main
Ephraim, UT 84627
(435) 283-4151
Tom Shore, District Ranger, Sanpete Ranger District

Manti-LaSal National Forest
599 West Price River Drive
Price, UT 84501
(435) 637-2817

U.S. Department of Interior

Bureau of Indian Affairs ~ Utah Offices

Phoenix Area Office
For Arizona, Nevada, Utah
P.O. Box 10
Phoenix, AZ 85001
(602) 379-6600

Southern Paiute Field Station
P.O. Box 720
St. George, UT 84711
(435) 674-9720

Uintah & Ouray Agency
P.O. Box 130
Fort Duchesne, UT 84026
(435) 722-2406

Tribes

Skull Valley Goshute Reservation
P.O. Box 150
Grantsville, UT 84029
(801) 363-7726

Goshute Business Council
P.O. Box 6104
Ibapah, UT 84034
(435) 234-1136

Paiute Indian Tribe
Of Utah Tribal Council
600 North 100 East Paiute Drive
Cedar City, UT 84720
(435) 586-1112

Uintah & Ouray Tribal
Business Committee
P.O. Box 190
Fort Duchesne, UT 84026
(435) 722-5141

U.S. Department of Interior

Bureau of Land Management ~ Utah Offices

Salt Lake Field Office
2370 South 2300 West
Salt Lake City, Utah 84119
(801) 977-4300

Vernal Field Office
170 South 500 East
Vernal, Utah 84078
(435) 781-4400

Fillmore Field Office
35 East 500 North
Fillmore, Utah 84631
(435) 743-3100

Richfield Field Office
150 East 900 North
Richfield, Utah 84701
(435) 896-1500

Price Field Office
125 South 600 West
Price, Utah 84501
(435) 636-3600

Moab Field Office
82 East Dogwood
Moab, Utah 84532
(435) 259-2100

Cedar City Field Office
176 East D.L. Sargent Drive
Cedar City, Utah 84720
(435) 586-2401

St. George Field Office
345 East Riverside Drive
St. George, Utah 84720
(435) 688-3200

Kanab Field Office
318 North First East
Kanab, Utah 84741
(435) 644-4600

Monticello Field Office
435 North Main, P.O. Box 7
Monticello, Utah 84535
(435) 587-1500

Grand Staircase-Escalante
National Monument
190 E. Center
Kanab, UT 84741
(435) 644-4300

U.S. Department of Interior

Fish and Wildlife Service ~ Utah Offices

Ecological Services Field Office
2369 West Orton Circle
West Valley City, UT 84119
(801) 975-3330

Senior Resident Agent – Ogden
P.O. Box 2369
Ogden, UT 84402
(801) 625-5570

Fish Springs Natl. Wildlife Refuge
Highway 36, Pony Express Trail
Ibapah, UT 84034
(435) 831-5353

Colo. River Wildlife Mgmt Refuge, **Ouray Natl. Wildlife Refuge**
19001 East Wildlife Refuge Road
Randlett, UT 84063-2042
(435) 545-2522

Colorado River Fishery Project
1380 South 2350 West
Vernal, UT 84078-2042
(435) 789-4078

Fish & Wildlife Service Management Assistance Office
1380 South 2350 West
Vernal, UT 84078-2042
(435) 789-0354

U.S. Department of Interior

National Park Service ~ Utah Offices

Arches National Park
P.O. Box 907
Moab, UT 84532-0907
(435)719-2100 (Headquarters)

Bryce Canyon National Park
P.O. Box 170001
Bryce Canyon, UT 84717-0001
(435) 834-5322 (Headquarters)

California Natl. Historic Trail
324 S. State Street, Suite 250
P.O. Box 45155
Salt Lake City, UT 84145-0155
(801) 539-4095 (Headquarters)

Canyonlands National Park
2282 S. West Resource Blvd.
Moab, UT 84532-3298
(435) 719-2100 (Headquarters)

Capitol Reef National Park
HC 70 Box 15
Torrey, UT 84775-9602
(435) 425-3791 (Visitor Info)

Cedar Breaks Natl. Monument
2390 W. Highway 56, Suite 11
Cedar City, UT 84720-4151
(435) 586-9451 (Visitor Info)

Glen Canyon Natl. Recreation Area
P.O. Box 1507
Page, AZ 86040-1507
(928) 608-6200 (Headquarters)

Golden Spike National Historic Site
P.O. Box 897
Brigham City, UT 84302-0897
(435) 471-2209 (Visitor Info)

Hovenweep National Monument
McElmo Route
Cortez, CO 81321
(435) 719-2100 (Headquarters)

Mormon Pioneer Natl. Historic Trail
Long Distance Trails Office
324 South State, Suite 250
Salt Lake City, UT 84145-0155
(801) 539-4095 (Headquarters)

Natural Bridges Natl. Monument
HC 60 Box 1
Lake Powell, UT 84533-0101
(435) 719-2100 (Headquarters)

Pony Express Natl. Historic Trail
Long Distance Trails Office
325 South State St., Ste 324
Salt Lake City, UT 84145-0155
(801) 539-4093 (Headquarters)

Rainbow Bridge Natl. Monument
PO Box 1507
Page, AZ 86040-1507
(520) 608-6200 (Headquarters)

Timpanogos Cave Natl. Monument
R.R. 3, Box 200
American Fork, UT 84003-9803
(801) 756-5239 (Headquarters)

Zion National Park
SR 9
Springdale, UT 84767-1099
(435) 772-3256

Appendix G

FEMA Hazard Profile

A hazard profile was created for each hazard in each county within Six County Association of Governments jurisdiction. These profiles including potential severity or magnitude, frequency, location, seasonal pattern, duration, and speed of onset, were developed based on a model suggested by FEMA Region VIII. The information within each field of the table was derived by the Counties participating in the mitigation planning process based on GIS risk analysis, history of occurrence, and expert advice.

FEMA Hazard Profile

Frequency	Possible
Severity	Catastrophic
Location	A large magnitude earthquake would produce ground shaking felt throughout the entire region. Surface fault rupture is expected in areas of known historic fault movements, for earthquake with a magnitude 6.5 or greater.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Frequency:

- Highly Likely
  Near 100% probability in next year.
- Likely
  Between 10% and 100 % probability in the next year, or at least one chance in 10 year period.
- Possible
  Between 1% and 10% probability in the next year, or at least one chance in next 100 years.
- Unlikely
  Less than 1% probability in the next 100 years.

Severity or Magnitude:

- Catastrophic
  - Multiple fatalities if event were to occur
  - Complete shutdown of facilities for 30 days or more
  - More than 50 percent of property is severely damaged

- Critical
    - Injuries and/or illnesses results in permanent disability
    - Complete shutdown or critical facilities for at least 2 weeks
    - More than 25 percent of property is severely damaged
- Limited
    - Injuries and/or illnesses result in permanent disability
    - Complete shut down of critical facilities for more than one week
    - More than 10 percent of property is severely damaged
- Negligible
    - Injuries and/or illnesses are treatable with first aid
    - Minor quality of life lost
    - Shutdown of critical facilities and services for 24 hours or less
    - Less than 10 percent of property is severely damaged

Location:
Areas most likely to be affected or the sectors most likely to be affected.

Seasonal Pattern:
The particular season the event is most likely to occur. Examples include tornado season and hurricane season.

Duration:
The amount of time between when and event starts to when the event ends. For example the ground shaking caused by an earthquake is only a minute where as hurricanes can event can be several days.

Speed of Onset:
Probable amount of warning time before an event occurs.

- Minimal or no warning time
- 6 to 12 hours warning time
- 12 to 24 hours warning time
- More than 24 hours warning

Warning time is vital as it allows people seek safe locations or shelters and prepare their property in hopes of reducing damages.

Appendix H

Community Pre-Disaster Mitigation Planning Meetings

In October and November of 2002, SCAOG staff had mitigation planning meetings with all six county commissions at their regularly scheduled public meetings. The staff also had planning meetings where the Disaster Mitigation Survey* (see below) was discussed with the 48 mayors in the region. On November 6, 2002 the staff had a planning meeting with the SCAOG Executive Board at their regularly scheduled public meeting.

Juab County		
Commission	October 21, 2002	October 6, 2003
Eureka	October 29, 2002	October 28, 2003
Levan	October 29, 2002	October 28, 2003
Mona	October 29, 2002	October 28, 2003
Nephi	October 29, 2002	October 28, 2003
Rocky Ridge	October 29, 2002	November 10, 2003
Millard County		
Commission	October 28, 2002	October 6, 2003
Delta	November 7, 2002	November 6, 2003
Fillmore	November 7, 2002	November 6, 2003
Hinckley	November 7, 2002	November 6, 2003
Holden	November 7, 2002	November 6, 2003
Kanosh	November 7, 2002	November 6, 2003
Leamington	November 7, 2002	November 6, 2003
Lynndyl	November 7, 2002	November 6, 2003
Meadow	November 7, 2002	November 6, 2003
Oak City	November 7, 2002	November 6, 2003
Scipio	October 31, 2002	October 30, 2003
Piute County		
Commission	October 15, 2002	October 14, 2003
Circleville	November 5, 2002	November 4, 2003
Junction	November 5, 2002	November 4, 2003
Kingston	November 5, 2002	November 4, 2003
Marysvale	November 5, 2002	November 4, 2003
Sanpete County		
Commission	October 22, 2002	October 7, 2003
Centerfield	November 1, 2002	October 10, 2003
Ephraim	October 17, 2002	October 10, 2003
Fairview	October 17, 2002	October 9, 2003
Fayette	November 1, 2002	October 10, 2003
Fountain Green	October 17, 2002	October 10, 2003
Gunnison	November 1, 2002	October 10, 2003
Manti	November 1, 2002	October 9, 2003
Mayfield	November 1, 2002	October 10, 2003
Moroni	October 17, 2002	October 9, 2003

Mt. Pleasant	October 17, 2002	October 9, 2003
Spring City	October 17, 2002	October 9, 2003
Sterling	November 1, 2002	October 10, 2003
Wales	October 23, 2002	October 10, 2003
Sevier County		
Commission	October 21, 2002	October 20, 2003
Aurora	October 31, 2002	October 30, 2003
Annabella	November 8, 2002	November 7, 2003
Elsinore	October 31, 2002	November 7, 2003
Glenwood	November 8, 2002	November 7, 2003
Joseph	November 8, 2002	November 7, 2003
Koosharem	November 4, 2002	November 13, 2003
Monroe	October 30, 2002	October 31, 2003
Redmond	October 23, 2002	October 30, 2003
Richfield	November 8, 2002	November 7, 2003
Salina	January 17, 2003	October 30, 2003
Sigurd	November 8, 2002	November 7, 2003
Wayne County		
Commission	November 4, 2002	September 29, 2003
Bicknell	November 4, 2002	November 3, 2003
Hanksville	November 4, 2002	November 3, 2003
Loa	November 4, 2002	November 3, 2003
Lyman	November 4, 2002	November 3, 2003
Torrey	November 4, 2002	November 3, 2003

North Sanpete and Bullion Canyon (Marysvale) Fire Planning Meeting in Ephraim, October 22-23, 2003.

*What follows is the complete text of the survey:

DISASTER MITIGATION

The Federal Emergency Management Agency (FEMA) has been authorized by Congress to fund Disaster Mitigation Plans. Communities that participate can apply for mitigation funding with FEMA paying 75% and other sources including local paying 25%. In addition, these same communities may receive FEMA assistance in the case of a natural disaster. Utah has decided to plan at the regional level contracting with the AOG's to develop the plans in conjunction with the Emergency Managers.

Please answer the following questions and be prepared to discuss it further in our scheduled visit:

1. Community_____

2. Name/Title of person filling out questionnaire_____

3. What are the natural hazards that threaten your community (i.e. Drought, Earthquake, Fire, Flood, etc.)?_____
_____
_____
_____
_____
_____
_____

4. Who is your Disaster Point of Contact?_____

5. Are you participating in the National Flood Insurance Program (NFIP)? Y N

6. What are your previous mitigation projects?
_____
_____
_____
_____
_____
_____
_____

7. What are your potential mitigation projects?
_____
_____
_____
_____
_____
_____
_____

8. What are your current Geographic Information Systems (GIS) capabilities?
_____
_____
_____
_____

9. Any Other Comments?
_____
_____
_____
_____

The completed surveys are available at the Six County Planning Offices, 250 N Main, Richfield, UT 84701.

Appendix I

Glossary of Terms

Abutment (dam) - the valley side against which a dam is constructed.

Acre-foot of water - approximately 326,000 gallons of water, or approximately a football field covered by one foot of water.

Active Faults - An active fault is defined as a fault displaying evidence of displacement along one or more of its traces during Holocene time (about the last 11,000 years).

Aftershocks - earthquakes during the seconds, hours, days to months following a larger earthquake (main shock) in the same general region.

Alluvial fan - a cone-shaped deposit of stream sediments, generally deposited at the base of a mountain where a stream encounters flatter terrain.

Amplitude (seismic waves) - the maximum height of a wave crest or depth of a trough. Amount the ground moves as a seismic wave passes, as measured from a seismogram.

ATV All Terrain Vehicle

Avalanche path - the area in which a snow avalanche runs; generally divided into starting zone, track, and run out zone.

Basin and Range physiographic province - consists of north-south-trending mountain ranges separated by valleys, bounded by the Rocky Mountains and the Colorado Plateau to the east and the Sierra-Cascade Mountains to the west (includes western Utah).

Bearing capacity - the load per unit area, which the ground can safely support without excessive yield.

Bedrock - solid in-place rock, sometimes exposed and sometimes concealed beneath the soil.

Collapsible soil (hydro compaction) - loose, dry, low-density soil that decreases in volume or collapses when saturated for the first time following deposition.

Critical Areas - Environmentally sensitive areas, which include wetlands fish and wildlife habitat conservation areas; geologically hazardous areas; areas with a critical recharging effect on aquifers used for potable water; and frequently flooded areas. Critical areas have measurable characteristics which, when combined, create a value for or potential risk to public health, safety and welfare.

Critical/Essential Facilities - Structures meeting one or more of the following criteria:

- Fire stations, police stations, storage facilities for vehicles/equipment needed after a hazard event, and emergency operation centers.
- Hospitals, nursing homes, and housing which is likely to contain occupants who may not be sufficiently mobile to avoid injury or death as a result of a hazardous event
- Public and private utility facilities, which are vital to maintaining or restoring normal services to, damaged areas after a hazardous event.
- Structures or facilities that produce, store, or use highly flammable, explosive, volatile, toxic and/or water reactive materials

Debris flow - involves the relatively rapid, viscous flow of surficial material that is predominantly coarse grained.

Debris slide - involves predominantly coarse-grained material moving mainly along a planar surface.

Delta - a deposit of sediment formed at the mouth of a river where it enters an ocean or lake.

Earth flow - involves fine-grained material that slumps away from the top or upper part of a slope, leaving a scarp, and flows down to form a bulging toe.

Earthquake - a sudden motion or trembling in the earth as fracture and movement of rocks along a fault release stored elastic energy.

Earthquake Fault Zone - earthquake fault zones are regulatory zones around active faults. The zones are used to prohibit the location of critical facilities and structures designed for human occupancy from being built astride an active fault. Earthquake Fault Zones are plotted on topographic maps at a scale of 1-inch equals 2,000 feet. The zones vary in width, but average about one-quarter mile wide.

Earthquake induced Seiches - Earthquake generated water waves causing inundation around shores or lakes and reservoirs.

Epicenter - the point on the earth's surface directly above the focus of an earthquake.

Erosion - the removal of earth or rock material by many types of processes, for example, water, wind, or ice action.

Expansive soil and rock - soil and rock, which contain clay minerals, that expands and contracts with changes in moisture content.

Fault - A -break in the earth along which movement occurs.

Fault segment - section of a fault that behaves independently from adjacent sections.

Fault zone - an area containing numerous faults.

FEMA - The Federal Emergency Management Agency was authorized under Section 404 of the Stanford Act. Provides funding for hazard mitigation projects that are cost-effective and comply with existing post-disaster mitigation programs and activities. These projects cannot be funded through other programs to be eligible.

Fill - material used to raise the surface of the land generally in a low area.

Fire-resistant vegetation - plants that do not readily ignite and burn when subjected to fire because of inherent physiological characteristics of the species such as moisture content, fuel loading, and fuel arrangement.

Flood plain - an area adjoining a body of water or natural stream that has been or may be covered by floodwater.

Flood way - An area of land immediately adjacent to a stream or river channel that, in times of flooding, becomes an enlarged stream or river channel and carries the floodwater with the highest velocity.

Floodplain - an area adjoining a body of water or natural stream that has been or may be covered by floodwater.

Floodplain (100 year) - Floodplains that have the potential to flood once every 100 years or that has a one percent chance of flooding equal to or in excess of that in any given year.

Fluvial - concerning or pertaining to rivers or streams.

Focus - the point of origin of an earthquake within the earth, and the origin of the earthquake's seismic waves.

Formation (geologic) - a map able rock unit consisting of distinctive features/rock types separate from units above and below.

Frequency (seismic waves) - the number of complete cycles of a seismic wave passing a point during one second.

Fuel (fire) - vegetation, building material, debris, and other substances that will support combustion.

Fuel break - a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located strip of land to reduce or hinder the rate of fire spread.

Fuel type - a category of vegetation used to indicate the predominate cover of an area.

Glacial moraine - debris (sand to boulders) transported and deposited by glacial ice along a glacier's sides or terminus.

Graben - a block of earth down dropped between two faults.

Gradient (slope) - a measure of the slope of the land surface.

Ground failure - a general term referring to any type of ground cracking or subsidence, including landslides and liquefaction-induced cracks.

Ground shaking - the shaking or vibration of the ground during an earthquake.

Ground water - that portion of subsurface water which is in the zone of saturation.

Gypsiferous deposits - soil or rock containing gypsum, which can be subject to dissolution.

Gypsum - a mineral composed of hydrated calcium sulfate. A common mineral of evaporates.

Hazard Mitigation Plan - The plan resulting from a systematic evaluation of the nature and extent of vulnerabilities posed by a hazard present in society that includes the strategies needed to minimize future vulnerability to hazards.

Hazard Mitigation - Any action taken to reduce or permanently eliminate the long-term risk to human life and property and the environment posed by a hazard.

HAZUS - Hazard United States. Earthquake Loss estimation software using GIS databases developed by FEMA.

Head (landslide) - the upper parts of the slide material along the contact between the disturbed material and the main scarp.

Holocene - geologic epoch covering the last 10,000 years (after the last Ice Age).

Igneous rocks - rocks formed by cooling and hardening of hot liquid material (magma), including rocks cooled within the earth (for example, granite) and those that cooled at the ground surface as lavas (such as basalt).

Impermeable - materials having a texture that does not permit water to move through. Intermountain seismic belt - zone of pronounced seismicity, up to 120 miles wide and 800 miles long, extending from Arizona through central Utah to northwestern Montana.

Lacustrine - concerning or pertaining to lakes.

Lake Bonneville - a large, ancient lake that existed 30,000 to 12,000 years ago and covered nearly 20,000 square miles in Utah, Idaho, and Nevada. The lake covered many of Utah's valleys, and was almost 1,000 feet deep in the area of the present Great Salt Lake.

Lake Bonneville sediments - sediments deposited by Lake Bonneville, found in the valleys, which range from gravels and sands to clays.

Landslide - a general term for a mass of earth or rock, which moves down slope by flowing, spreading, sliding, toppling, or falling (see slope failure).

Lateral spread - lateral down slope displacement of soil layers, generally several feet or more, above a liquefied layer.

Levee (flood) - a berm or dike used to contain or direct water, usually without an outlet or spillway.

Liquefaction - sudden large decrease in shear strength of cohesion less soil (generally sand or silt) caused by collapse of soil structure and temporary increase in pore-water pressure during earthquake ground shaking.

Magnitude (earthquake) - a quantity characteristic of the amplitude of the ground motion of an earthquake. The most commonly used measurement is the Richter magnitude scale; a logarithmic scale based on the motion that would be measured by a standard type of seismograph 60 miles from the earthquake's epicenter.

Metamorphic rocks - rocks formed by high temperatures and/or pressures (for example, quartzite formed from sandstone).

Middle Rocky Mountains physiographic province - consists of mountainous terrain of high relief, extending from northern Utah to Wyoming, Idaho, and Montana (includes the Wasatch Range and Uinta Mountains in Utah).

Modified Mercalli intensity (MMI) - the most commonly used intensity scale in the U.S.; it is a measure of the severity of earthquake shaking at a particular site as determined from its effect on the earth's surface, man, and man's structures.

Montmorillonite - a clay mineral characterized by expansion upon wetting and shrinking upon drying.

Natural vegetation - native plant life existing on a piece of land before any form of development.

Normal fault - fault caused by crustal extension in which relative movement on opposite sides is primarily vertical; for example, the Wasatch fault.

Oolite - spherical grains of carbonate sand with a brine shrimp fecal pellet nucleus.
Outlet (dam) - a conduit through which controlled releases can be made from the reservoir.

Peat - unconsolidated surficial deposit of partially decomposed plant remains.

Period (geologic) - a standard (world-wide) geologic time unit.

Permeability - the capacity of a porous rock or soil for transmitting a fluid.

Physiographic province - a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piping (problem soil and rock) - a weak incoherent layer in unconsolidated deposits that acts as a channel directing the movement of water. As the layer becomes saturated it conducts water to a free face (cliff or stream bank for example) that intersects the layer, and material exits out a "pipe" formed in the free face. Piping can occur in a dam as the result of progressive development of internal erosion by seepage.

Pore space - the open spaces in a rock or soil between solid grains. The spaces may be filled with gas (usually air) or liquid (usually water).

Porosity - the ratio of the volume of pore space in rock or soil to the volume of its mass, expressed as percentage.

Probable Maximum Flood (PMF) - a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in a region.

Probable Maximum Precipitation (PMP) - the maximum amount and duration of precipitation that can be expected to occur on a drainage basin.
Problem soil and rock - geologic materials that are susceptible to volumetric changes, collapse, subsidence, or other engineering geologic problems.

Project Impact - An initiative of the Federal Emergency Management Agency intended to modify the way in which the United States handles natural disasters. The Goal of Project Impact from a Federal Government perspective is to reduce the personal and economic costs of hazard events by bringing together the private and public sector to better enable the citizens of a community to protect themselves from natural hazards.

Quaternary - a geologic time period covering the last 1.6 million years.

Recurrence interval - the length of time between occurrences of a particular event (an earthquake, for example).

Rock fall- abrupt free fall or down slope movement, such as rolling or sliding, of loosened blocks or boulders from an area of bedrock. The rock-fall run out zone is the area below a rock-fall source, which is at risk from falling rocks.

Rock topple - forward rotation movement of a rock unit(s) about some pivot point.

Run out zone (avalanche) - where a snow avalanche slows down and comes to rest (deposition zone). For large avalanches, the run out zone can include a powder- or windblast zone that extends far beyond the area of snow deposition.

Sand boil (earthquake) - deposit of sandy sediment ejected as water and sand to the surface, formed when ground shaking has caused liquefaction at depth.

Scarp - a relatively steeper slope separating two more gentle slopes. Scarps can form as result of earthquake faulting.

Sediment - material that is in suspension, is being transported, or has been moved from its site of origin by water, ice, or wind, and has come to rest on the earth's surface either above or below the sea level.

Sedimentary rocks - rocks formed from loose sediment such as sand, mud, or gravel deposited by water, ice, or wind, and then hardened into rock (for example, sandstone); or formed by dissolved minerals precipitating out of solution to form rock (for example, tufa).

Seiche - a standing wave generated in a closed body of water such as a lake or reservoir. Ground shaking, tectonic tilting, sub aqueous fault rupture, or landsliding into water can all generate a seiche.

Seismic waves - vibrations in the earth produced during earthquakes.

Seismicity - seismic or earthquake activity.

Sensitive clay - clay soil that experiences a particularly large loss of strength when disturbed. Deposits of sensitive clay are subject to failure during earthquake ground shaking.

Shear strength - the internal resistance that tends to prevent adjacent parts of a solid from "shearing" or sliding past one another parallel to the plane of contact. It is measured by the maximum shear stress that can be sustained without failure.

Shear stress - a stress causing adjacent parts of a solid to slide past one another parallel to the plane of contact.

Slope failure - a general term referring to any type of natural ground movement on a sloping surface (see landslide).

Slump - a slope failure that slides along a concave rupture surface. Generally slumps do not move very far from the source area.

Snow avalanche - a rapid down slope movement of a mass of snow, ice, and debris.

Stafford Act Robert T. Stafford Disaster Relief and emergency Assistance Act, PL 100-707, signed into law November 23 1988: amended the Disaster Relief Act of 1974, PL 93-288

Starting zone (avalanche) - where the unstable snow or ice breaks loose and starts to slide.
Subsidence - a settling or sinking of the earth's crust.

Surface fault rupture (surface faulting) - propagation of an earthquake-generated fault rupture to the ground surface, displacing the surface and forming a scarp.

Tectonic subsidence - subsidence (down dropping) and tilting of a basin on the down dropped side of a fault during an earthquake.

Toe (landslide) - the margin of disturbed material most distant from the main scarp.

Track (avalanche) - the slope or channel down which a snow avalanche moves at a fairly uniform speed.

Unconsolidated basin fill - uncemented and nonindurated sediment, chiefly clay, silt, sand, and gravel, deposited in basins.

Urban area - a geographical area, usually of incorporated land, covered predominately by engineered structures including homes, schools, commercial buildings, service facilities, and recreational facilities.

Urban/Wildland Interface (Urwin) - a geographical area where two different environments, wildland and urban residential, meet and affect each other.

Velocity (ground motion) - the rate of displacement of an earth particle caused by passage of a seismic wave.

Wasatch fault - a normal fault that extends over 200 miles from Malad City, Idaho to Fayette, Utah, and trends along the western front of the Wasatch Range.

Watershed - the area of land above a reference point on a stream or river, which contributes runoff to that stream.

Weathering - a group of processes (such as the chemical action of air, rain water, plants, and bacteria and the mechanical action of temperature changes) whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.

Wildfire - uncontrolled fire burning in vegetation.

Wildland area - a geographical area of unincorporated land covered predominately by natural vegetation.

Wildland Urban Interface - Wildland vegetation and forested areas adjacent to or intermingled with residential developments.

Zone of deformation (earthquake) - the width of the area of surface faulting over which earth materials have been disturbed by fault rupture, tilting, or subsidence.

List of Acronyms and Recognized Abbreviations

AGRC	Automated Geographic Reference Center
AOG	Association of Governments
Assoc.	Association
ATV	All Terrain Vehicle
Bldg.	Building
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
Bur.	Bureau
CEM	Comprehensive Emergency Management
Corp.	Corporation
CRS	Community Rating System
Dept.	Department
DESHS	Division of Emergency Services and Homeland Security
Div	Division
DMA 2000	Disaster Mitigation Act of 2000
DOT	Department of Transportation
DNR	Division of Natural Resources
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FFSL	Forestry Fire and State Lands
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FS	Forest Service

GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HAZUS MH	Hazards United States
ICS	Incident Command System
LEPC	Local Emergency Planning Committee
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
SCS	Soil Conservation Service
SEUALG	Southeastern Utah Association of Local Governments
SLC	Salt Lake City
SPI	Standardized Precipitation Index
SWSI	Surface Water Supply Index
UGS	Utah Geological Survey
URWIN	Urban-Rural Wildland Interface Zone
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UT.	Utah
WFRC	Wasatch Front Regional Council

Appendix J

National Flood Insurance Policy

Most of the known floodplain areas in the United States have been mapped by Federal Emergency Management Agency, which administers the National Flood Insurance Policy (NFIP). The NFIP gathers flood risk data for specific water-courses, lakes, and coastal flood hazard areas, maps, and causes of flooding within a community. This information is compiled into a Flood Insurance Study that designates special flood hazards areas, flood risk zones and establishes base flood elevations (State and Local Mitigation Planning 2-12).

National Flood Insurance Status for Six County Association of Local Governments is as follows.

Table J-1: National Flood Insurance Status

FEMA Federal Insurance Administration 8/19/02

County Name	Community Name	Date of Entry	Date of Current Effective Map
Juab	Unincorporated Juab County	Not participating	
Juab	Eureka	3/1/86	3/1/86
Juab	Levan	2/2/84	NSFHA
Juab	Mona	Not participating	
Juab	Nephi	8/5/86	11/4/87
Juab	Rocky Ridge	Not participating	
Millard	Unincorporated Millard County	9/4/87	9/4/87
Millard	Delta	12/09/85	NSFHA
Millard	Fillmore	11/5/85	NSFHA
Millard	Hinckley	11/30/83	NSFHA
Millard	Holden	3/1/86	3/1/86
Millard	Kanosh	12/11/85	NSFHA
Millard	Leamington	9/4/87	9/4/87
Millard	Lynndyl	Not participating	
Millard	Meadow	7/2/76	7/2/77*
Millard	Oak City	2/2/84	NSFHA
Millard	Scipio	2/2/84	NSFHA
Piute	Unincorporated Piute County	3/18/86	3/18/86
Piute	Circleville	1/30/84	NSFHA
Piute	Junction	1/16/87	1/16/87
Piute	Kingston	2/4/77	2/4/78*
Piute	Marysvale	2/5/86	2/5/86
Sanpete	Unincorporated Sanpete County	6/1/86	6/1/86
Sanpete	Centerfield	Not participating	
Sanpete	Ephraim	4/3/87	4/3/87
Sanpete	Fairview	2/1/87	2/1/87
Sanpete	Fayette	Not participating	
Sanpete	Fountain Green	Not participating	
Sanpete	Gunnison	1/30/84	NSFHA
Sanpete	Manti	8/4/87	8/4/87

Table J-1: National Flood Insurance Status FEMA Federal Insurance Administration 8/19/02			
County Name	**Community Name**	**Date of Entry**	**Date of Current Effective Map**
Sanpete	Mayfield	5/28/76	5/28/77*
Sanpete	Moroni	8/5/80	8/5/80
Sanpete	Mt. Pleasant	9/24/84	9/24/84
Sanpete	Spring City	8/5/80	8/5/80
Sanpete	Sterling	Not participating	
Sanpete	Wales	Not participating	
Sevier	Unincorporated Sevier County	7/1/86	9/7/98
Sevier	Annabella	10/30/79	10/30/79
Sevier	Aurora	12/4/79	1/12/82
Sevier	Elsinore	8/14/79	4/6/98
Sevier	Glenwood	7/1/86	7/186
Sevier	Joseph	8/28/79	6/2/95
Sevier	Koosharem	2/2/84	NSFHA
Sevier	Monroe	7/24/79	7/24/79
Sevier	Redmond	11/30/83	NSFHA
Sevier	Richfield	9/29/86	9/29/86
Sevier	Salina	9/29/86	9/29/86
Sevier	Sigurd	1/1/86	1/1/86
Wayne	Unincorporated Wayne County	Not participating	
Wayne	Bicknell	1/30/84	NSFHA
Wayne	Hanksville	Not participating	
Wayne	Loa	12/20/74	12/20/74*
Wayne	Lyman	Not participating	
Wayne	Torrey	6/18/86	NSFHA

* Areas which have had special flood hazard areas identified but are not in the program

The 100-year flood designation applies to the area that has an average 1 percent chance of flooding in any given year. Note that a 100-year flood could occur once every ten years or even two years in a row (2-12).

Base Flood Elevation (BFE) is the elevation of the water surface resulting from a flood that has a 1% chance of being flooded in any given year (100-year floodplain). The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1988, or other datum referenced in the FIS report (2-12).

The Special Flood Hazard Area (SFHA) is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain) (2-12).
Floodway is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising the water surface elevation by more than one foot.

The level or depth of flooding is determined by the probability. The probability of a flood is based on a statistical chance of a particular size flood occurring in any given year. The percent annual chance of floods is estimated based on watershed and climatic characteristics or watershed models, water surface elevation, and hydraulic models that reflect topographic characteristics. Flood frequencies can be determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size may occur (2-12).

Appendix K

Promulgation Letter/Resolution

This appendix delineates the promulgation letter that was disseminated to the six counties and the 48 incorporated communities. The following is a sample of the Resolution:

RESOLUTION
FOR
PRE-DISASTER MITIGATION PLAN

WHEREAS - The Federal Emergency Management Agency (FEMA) has determined that mitigating natural disasters is more cost-effective than responding to them;

and

WHEREAS - Per a new federal law, Local governments now have to plan for ways to reduce the impacts of natural disasters in order to be eligible for certain types of federal disaster assistance;

and

WHEREAS - This Six County Pre-Disaster Mitigation Plan meets the goal of mitigating natural disasters in the Six County Association of Governments (SCAOG) region;

and

WHEREAS - The Community of _____ is a member of the SCAOG, and established rural consortium, participating as the Six County Pre-Disaster Mitigation Planning Team Leader and accepts the challenge to implement this plan to properly mitigate natural disasters;

NOW THEREFORE - Be it resolved that the community of _____accepts the Six County Association of Governments Pre-Disaster Mitigation Plan as it relates to them in lessening the impact of future natural disasters.

Name: _____ **Title:** Mayor

Signature:_____ **Date:**_____

Appendix L

Economy and Land Use Information

According to the Utah State Department of Workforce Services 1998 employment figures, the District has a workforce of 23, 827. The industrial sectors of government, trade, services, and agriculture are the top four employers in the Region. They employ 75 percent of the workforce or 17,870 employees. To view the employment of all industrial sectors of the Six County area, *see Table 2, Industrial Sectors and Employment.*

Table 2 - Industrial Sectors and Employment

County	Mining	Construction	Manufacturing	TCPU	Trade	FIRE	Services	Government	Ag
Juab	22	98	370	54	687	31	585	621	285
Millard	101	74	220	589	915	59	620	1019	967
Piute	0	1	2	39	30	6	7	141	154
Sanpete	8	395	1059	261	1316	153	951	2364	997
Sevier	331	383	579	604	1862	138	1387	1556	567
Wayne	0	69	32	18	236	11	320	286	247
Total	462	1020	2262	1565	5046	398	3870	5987	3217
Percent	1.9%	4.3%	9.5%	6.6%	21.2%	1.7%	16.2%	25.1%	13.5%

Source: Utah Department of Workforce Services, Workforce Information

A brief explanation of each industrial sector follows. This includes a summary of historical, present, and future impacts these industries have on employment within the District**.** See *Figure 4, Employment by Industry: Historical & Projected*

The government services sector is the largest employer in the Region. This sector includes public land agencies, federal, state, and local governments and education. This industry currently employs 5,987 or 25 percent of the region's workforce. This compares to 3,917 or 22 percent in 1980, which equates to an annual growth rate of two percent over the past 20 years. It is projected that by 2020 government employment will reach 8,521 or 24 percent slowing annually to 1.5 percent. The government services sector continues to serve as the single strongest employment provider within the region. See *Figure 4, Employment by Industry: Historical & Projected*

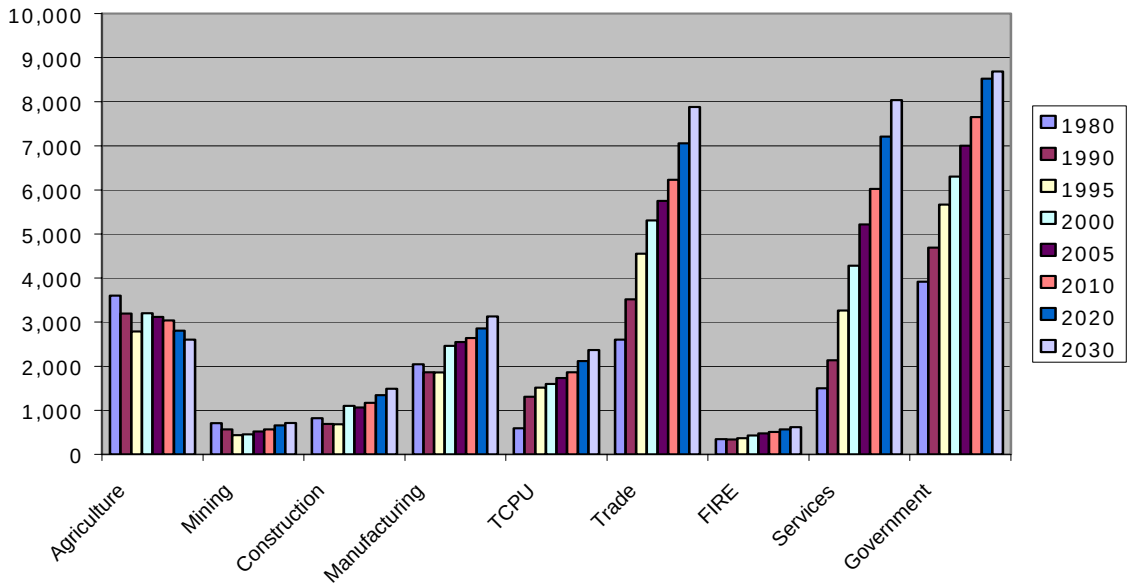
The trade sector currently employees 5,046 or 21 percent of the region's workforce. This sector includes nearly all economic activity involved in retail or wholesale buying and selling. Historically, the trade industry employed 2,605 or 14 percent in 1980 equating to an annual growth rate of three percent over the past 20 years. The next two decades will see the trade industry increase to 7,060 or 20 percent. Annual growth rate is projected at 1.5 percent. See *Figure 4, Employment by Industry: Historical & Projected*

The service sector includes a diverse group of industries including such establishments as hotels and motels, laundries, photo studios, shoe repairs, advertising, building maintenance, computer processing, auto repair, theaters, recreation, health services, engineering, accounting, etc. This industry is largely impacted by the Region's growth. Currently this sector employs 3,870 or 16 percent of the workforce. In 1980 the service industry employed 1,502 or eight percent. This equates to an annual growth rate of five percent. By 2020 it is anticipated that employment in the services industry will increase to 7,208 or 11 percent with annual growth of four percent. Additionally, the increase of tourism has greatly influenced growth in the *trade* and *service* employment sector. According to "Transient Room Tax" data, tourism has grown from $88,140 in 1980 to $399,387 in 1998 equating to a 78% percent increase or four and one third percent annual growth. The annual growth rate is four percent for tourism. The service sector is the fastest growing industry within the District**.** *See Figure 4, Employment by Industry: Historical & Projected*

The agricultural sector was traditionally the major employer of the area. It includes seed production, sheep/wool, turkeys, hogs, beef, dairy farming, poultry, crop harvesting, etc. Over the past 30 years, agricultural employment has steadily declined. In 1980 agriculture employed 3,599 or 20 percent of the workforce. In 1998 this number decreased to 3,204 or 12 percent. It is anticipated this trend will continue with employment declining to 2,808 or just eight percent of the workforce in 2020. This equates to an annual decrease of one and one half percent, the largest decline of any sector within the region. See *Figure 4, Employment by Industry: Historical & Projected*

The mining, construction, manufacturing, transportation/communications/utilities (TCU), finance/insurance/real estate (FIRE) sectors make up the remaining 24 percent of the workforce or 5,707 employees. In 1980 these sectors employed 3,925 or 21 percent. Employment in these industries is anticipated to reach 10,429 or 30 percent of the workforce in 2020. The TCU sector will increase by 52 percent while manufacturing and construction is anticipated to grow by 22 percent and 18 percent respectively. Over the next 20 years, mining and FIRE both show an average of one and one half percent annual increase to 1,230 employees in these two sectors. See *Figure 4, Employment by Industry: Historical & Projected*

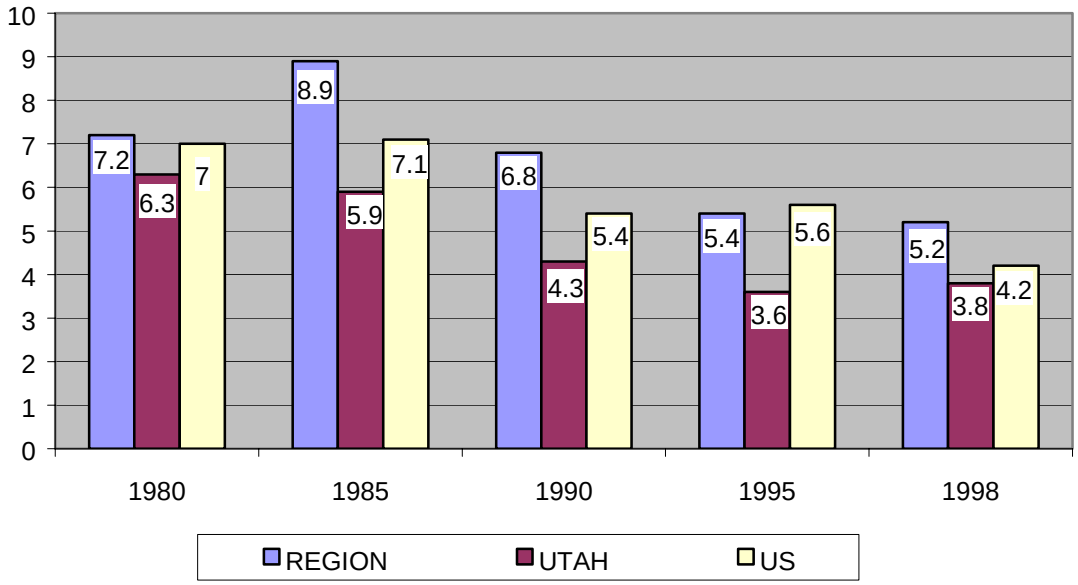
Figure 4: Employment by Industry: Historical & Projected



Source: Dept. of Workforce Services / Governor's Office of Planning and Budget--Demographic and Economic Analysis Section UPED Model System

Unemployment continues to be higher in the District when compared to State and national averages. Over the past two decades, the Region has experienced an average unemployment rate of 6.5 percent compared with the State's 4.7 percent and the national's 5.9 percent. To graphically view historical unemployment data comparisons, *see Figure 5, Unemployment Rates (%).* Unemployed and underemployed persons are affected to a greater degree than their employed counter parts all other variables held equal. Unemployed people similar to those on a fixed income often do not have the financial resources needed to accomplish personal post disaster recovery.

Figure 5: Unemployment Rates (%)



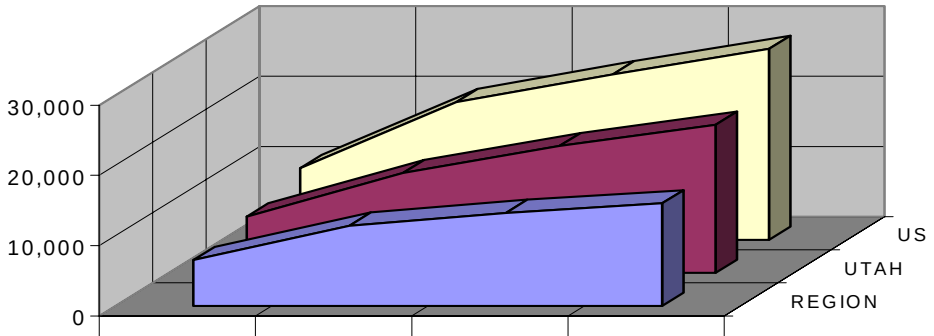
Source: Bureau of Labor Statistics / Utah Dept. of Workforce Services, Workforce Information and Bureau of Census Statistics

A contributing factor to the higher unemployment rate is the development of seasonal employment in the fast growing *trade* and *services* sectors. Additionally, the rural setting of the Six County region makes it difficult to attract an industrial base that is able to provide long-term family sustaining employment.

INCOME LEVELS

Per-capita income among the residents of Central Utah remains significantly lower than that of the state and nation. *Figure 6, Per Capita Personal Income*, graphically compares per capita income data between the Region, State, and nation since 1980.

Figure 6: Per Capita Personal Income



	1980	1990	1995	1998
REGION	6,524	11,430	13,244	14,600
UTAH	8,021	14,213	18,054	21,096
US	10,205	19,614	23,571	27,195

Source: Bureau of Labor Statistics

According to 1998 census data, per capita income in the Six County region is only 69 percent of the State and 57 percent of the nation.

The lower per capita income can be attributed to the willingness of area residents to work for less in order to enjoy a rural life style. This coupled with the fastest growing employment sectors of *trade* and *services* account for the disparity in per capita income. As a result, the area's younger and educated workforce is being forced to locate in larger metropolitan areas in order to secure higher paying employment. Unfortunately, the majorities of jobs for those remaining are lower paying and require relatively no skills.

As this condition becomes more prevalent, many are commuting to take advantage of employment opportunities found in larger metropolitan areas and yet enjoy the rural lifestyle. Unfortunately for many small towns and cities, this dichotomy places a burden on local officials in determining a balance in industrial expansion and residential growth. A further dilemma associated with this movement is the lack of a sustainable tax base necessary to develop infrastructure for new and expanding industry.

LAND UTILIZATION

The Central Utah region is very diverse in nature. Traditional industries, such as farming, ranching, logging and mining all require utilization of both public and private lands. The impact public lands have on the region is relative to the makeup of land ownership in the District. To visually illustrate the current land ownership, in acres, relating to each county *see Table 3 - Land Ownership in Acres.* Counties within the SCAOG cannot be expected to mitigate problems without outside assistance and cooperation from surrounding federal land management agencies. With regards to

wildfire much progress has been made by the federal land managers to reduce the wildfire risk to communities within SCAOG, yet much progress needs to be made concerning additional identified natural hazards.

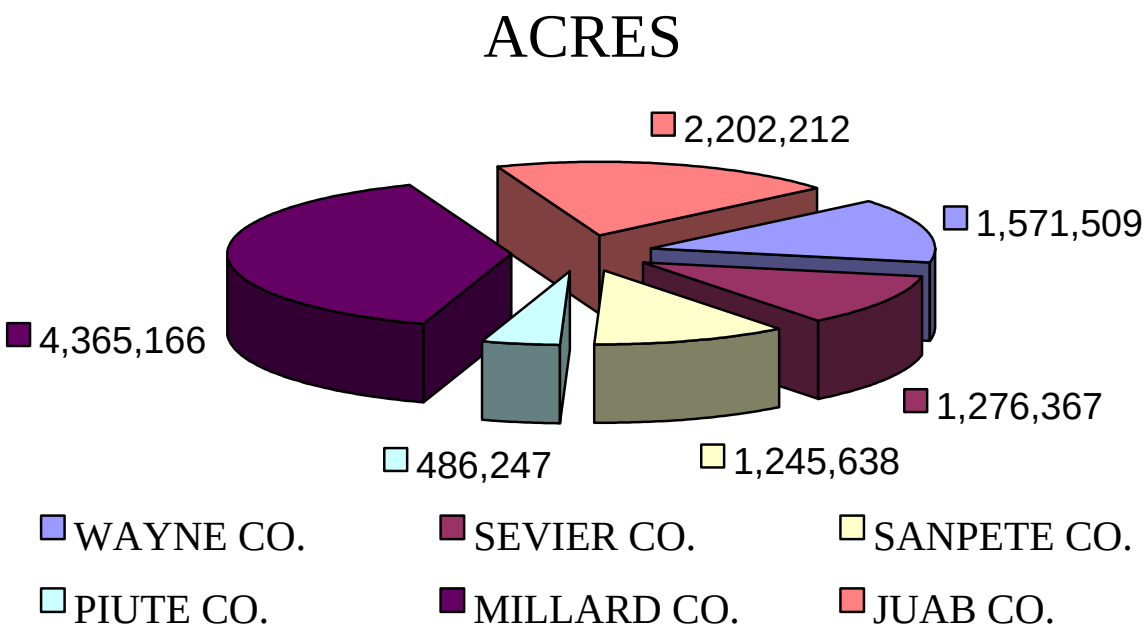
Table 3 – Land Ownership in Acres

	Private	State	BLM*	National Forest*	National Park*
Juab	733,971	128,239	1,503,115	70,319	0
Millard	618,409	379,597	3,028,240	305,315	0
Piute	67,015	60,041	157,537	191,518	0
Sanpete	727,057	51,136	201,239	382,543	0
Sevier	294,902	65,602	263,587	721,634	5,560
Wayne	65,051	140,942	988,739	160,349	139,888
Region Total	2,506,405	825,557	6,142,457	1,831,678	145,448

Source: Utah Facts/BLM/Forest Service/Canyonlands & Capitol Reef National Parks
Note: Areas are GIS Department Estimates as of 1998

The region encompasses a total of 11,147,139 Acres (approx. 16,931 square miles). Currently public lands dominate with Bureau of Land Management (BLM) and United States Forest Service (USFS) controlling 8,057,685 acres or 72 percent of the total acreage. Private ownership equals 1,672,107 acres equating to only 15 percent. State and other interests control 1,564,854 acres or 13 percent. This disparity in land ownership creates a unique and challenging obstacle in economic development. An objective of this mitigation plan is to communicate planning strategies of local officials with public land managers. This includes identifying mitigation activities that protect local communities yet support protection of public lands. The graph in *Figure 10 - Area in Acres* provides a break down and comparison of the area of each county within the region.

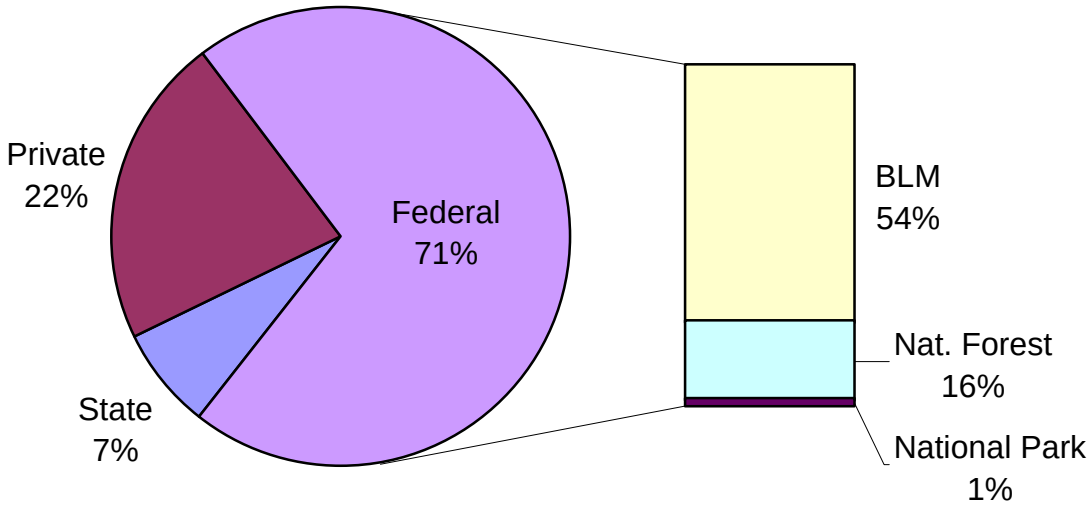
Figure 10 - Area in Acres



Source: U.S. Census Bureau

By comparing the graph with the counties shown on the map in *Figure 1 - Central Utah's Six Counties*, the relationship between acres and county size is evident. It also illustrates the geographical magnitude of the Six County Economic Development District.

Figure 11 – Regional Land Ownership Chart



Source: Utah Facts/BLM/Forest Service/Canyonlands & Capitol Reef National Parks

The Six County Region is rural. Moving from the industrial age to the high technological and innovative age has been slow. However, efforts on both the county and regional levels by key individuals are strengthening the area's economic base.

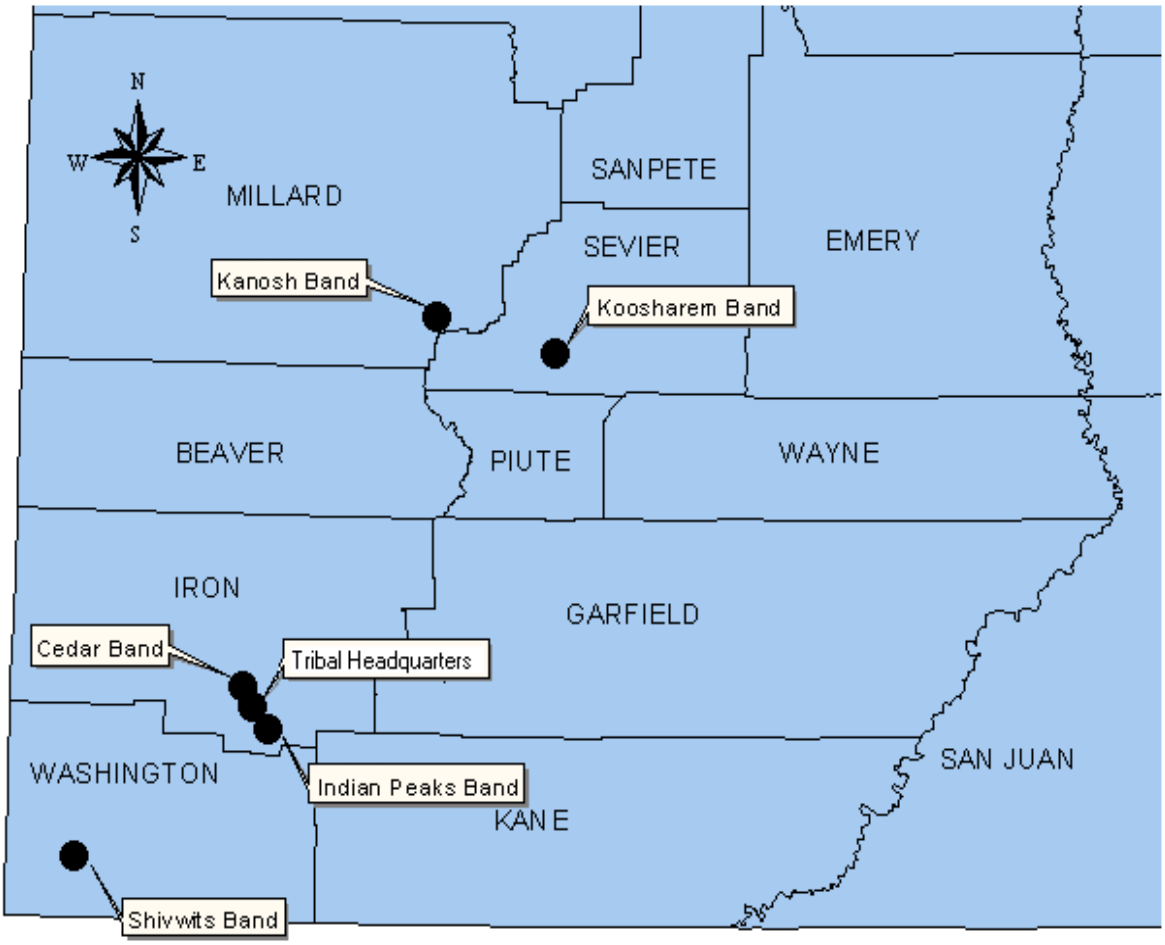
Appendix M

Paiute Indian Tribe of Utah (PITU)

INTRODUCTION

Location - The Tribal headquarters of the PITU is located in Southeastern Iron County approximately 280 miles South of Salt Lake City on Interstate Highway 15, and adjacent to Cedar City. The geographic location of Tribal Headquarters in relation to the five bands are approximately 84 miles from Shivwits, 5 miles from Indian Peaks and Cedar Band, 115 miles from Koosharem, and 105 miles from Kanosh. All are paved roads with good access. Figure 1, PITU Tribal Lands, shows the location of tribal lands in relation to Southern and Central Utah.

Figure 1: **PITU Tribal Lands**



Land Use - Reservation lands of the PITU encompass a total of 32,480 acres. Other than 35 acres of land housing the tribal headquarters and controlled by the Tribal Council, the other 32,445 acres are maintained and controlled by the five tribal bands. Results of a recent economic development survey revealed that tribal members feel their culture and land are their two greatest strengths. The majority of survey respondents felt that preservation of reservation lands was most important with planned industrial and community development.

Band Membership - According to the July 1999 PITU Tribal enrollment there are 741 members. This compares to 516 in 1980. Fifty-seven percent (57%) or 421 members are included in the workforce, which is sufficient to support a sizable business owned and employed by Tribal members. Currently 17% of Tribal members are living outside of the counties encompassing reservation lands. Tribal leadership would like to see improved conditions through economic and community development that would allow members to reside on the reservation. Lack of affordable housing and employment seem to be the major reasons for those leaving and living away from the reservation. Another major concern of Tribal leadership is the loss of heritage and cultural values that are disappearing as a result of members living and working outside of the area.

EMPLOYMENT

Unemployment - The "1997 Indian Labor Report" published by the Department of Interior shows the PITU with a labor force of 421. Of this number, 349 are employed and 72 are unemployed equating to a 17 percent unemployment rate. Of those employed, 239 tribal members or 68 percent are employed below poverty guidelines. Of those employed, 42 or 12 percent work in the public sector while 307 or 88 percent work in the private sector. This compares to a 4 percent average unemployment rate in the eleven county area and 3.4 percent state wide unemployment rate as reported by the September 1999 "Labor Market Report" by the Utah Department of Workforce Services. Table 5, PITU Unemployment compares Tribal member employment with the Five and Six County regions, the State of Utah, and United States.

Table 5 - PITU Unemployment

Entity	Workforce Employed	Workforce Unemployed	Percent Unemployed	Percent in Public	Percent in Private
PITU	**349**	**72**	**17.1**	**12**	**88**
Six County	21,370	936	4.8	12	88
Five County	55,991	2,031	3.5	7	93
State	1,051,600	37,013	3.4	7	93
U.S.	-	-	4.2	-	-

Sources: Utah Labor Market Report, September 1999,Vol. 9, Number 9; Utah Job Outlook - Statewide and Service Delivery Areas 1998-2003, Utah Department of Workforce Services, January 1998

Employment Opportunities - The tribal members were surveyed to determine the economic opportunities they perceived. The most popular choice, by Tribal members was to see resources spent on education and training programs for PITU members. The number one priority for job creation was providing "jobs for those adults who needed to support families". Survey respondents also felt investing tribal resources in well-managed businesses owned and managed by tribal members with good opportunity for return was very important. Light manufacturing, high tech industry, and convenience store development were ranked as the highest perceived economic development opportunities. Agriculture and truck stop development were also mentioned.

INCOME LEVELS

Per-capita income - Per-capita income is the level of income generated by individuals. Per-capita income among the residents of Central and Southern Utah is shown in Table 6, Per-capita Income. The table compares personal income between the counties of Central and Southern Utah in which the majority of PITU members reside.

Table 6 - Per-capita Income

County	1994	1995	1996	1997
Millard	$13,742.00	$14,101.00	$14,806.00	$14,700.00
Sevier	$13,962.00	$14,251.00	$14,965.00	$15,500.00
Beaver	$13,014.00	$13,090.00	$13,359.00	$13,500.00
Iron	$13,329.00	$13,884.00	$14,509.00	$15,300.00
Washington	$15,515.00	$16,348.00	$16,731.00	$17,000.00

(Per Capita Income was taken from the "1999 Economic Report to the Governor: pg. 87").*The Paiute Indian Tribe of Utah lacks Tribal member income status and other related information.

Median/Average Family Income - Another important economic indicator is the income generated by all members of a family household -- living under one roof. This income known as Median/Average Family Income clearly shows the economic vitality of a community by addressing the workforce in general. It references employment levels, signifies strength in education and skills among families. The most recent data for the PITU is 1980. Table 7, Average Family Income shows the average family income for the PITU and its bands.

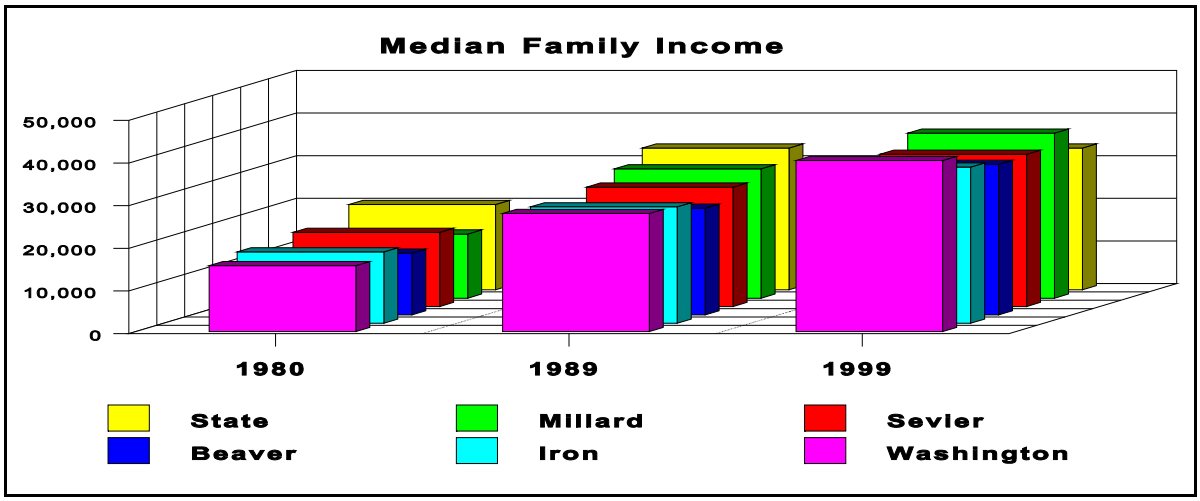
Table 7 - Average Family Income

Band	Average Family Income
Kanosh	$2,914.00
Indian Peaks	$2,774.00
Cedar	$2,215.00
Koosharem	$1,940.00
Shivwits	$3,015.00
Tribal Average	**$2,746.00**

Source: 1980 PITU Reservation Plan

In comparing Table 7, Average Family Income, with Figure 6, Median Family Income it is clear to see that the 1980 income levels for the counties is significantly higher than for the PITU. The graphics of Figure 6 show the trends from 1980 to 1999 for the counties in which the majority of tribal members live. Again because specific data is not available for the tribe a comparison is not made. However, because of the economic disparity in unemployment it is safe to assume the current median family income is much lower for tribal members. Table 8, County Median Family Income, shows the actual income levels of the counties referenced.

Figure 6 - Median Family Income



Source: 1999 Economic Report to the Governor

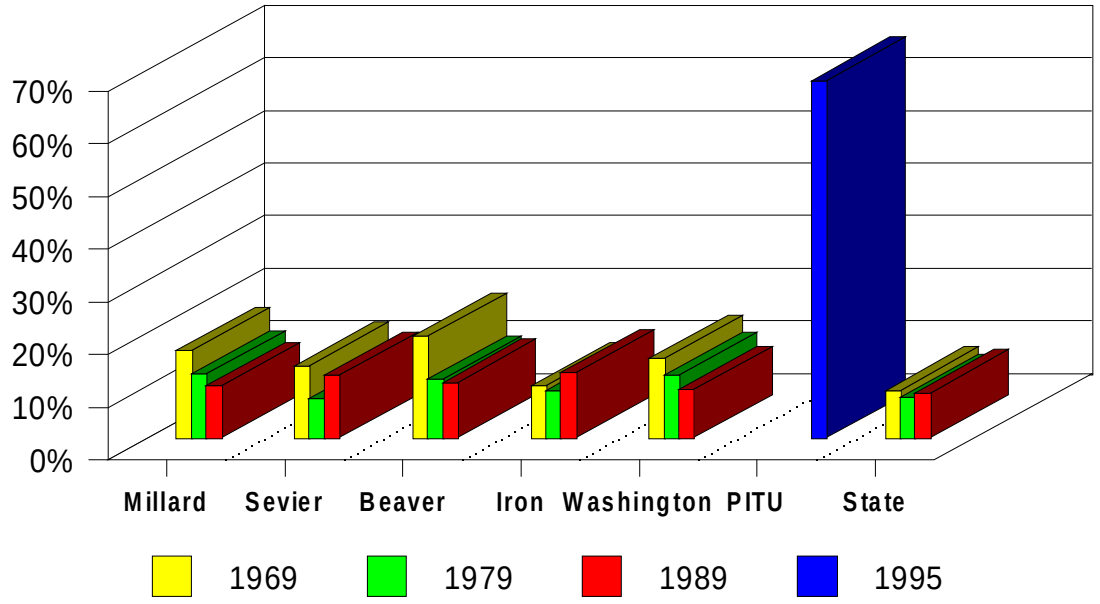
Table 8 - County Median Family Income

County	1980	1989	1999
Millard	$15,038.00	$30,342.00	$38,700.00
Sevier	$17,404.00	$27,986.00	$35,700.00
Beaver	$14,453.00	$25,000.00	$35,300.00
Iron	$16,726.00	$27,283.00	$36,600.00
Washington	$14,466.00	$27,690.00	$40,100.00

Source:1999 Economic Report to the Governor; *The PITU has no records on the Median Family income for Tribal members.

Poverty level - Those living in poverty are of great concern to PITU leadership. Except for 1995, no specific data for the PITU and its bands are available on poverty level. Again it is safe to assume that given the economic distress of unemployment the Tribe is much more vulnerable than their neighboring county residents. Figure 7, Families Below Poverty (%), shows graphically the poverty level trends for Central and Southern Utah between 1969 and 1995. Again, it is believed that the PITU is experiencing a much higher poverty rate than those shown. Table 9, County Poverty Levels (%) shows the actual poverty levels in percent for those counties in which the majority of PITU members reside.

Figure 7 - Families Below Poverty (%)



*1995 PITU data was from the "1997 Indian Labor Force Report," published by the Dept. Of Interior.

Table 9 – County Poverty Levels (%)

County	1969	1979	1989	1995
Millard	16.6	12.1	10.0	14.0
Sevier	13.8	7.4	11.9	14.9
Beaver	19.4	11.2	10.6	13.4
Iron	9.9	9.1	12.4	16.8
Washington	15.2	11.9	9.2	13.3
State	9.1	7.7	8.6	11.4
Paiute Tribe	**-**	**-**	**-**	**68.0**

*Source: 1995 Economic Development & Employer Planning System Ver. Utah 94.4

LAND UTILIZATION

The tribal government of PITU does not control reservation lands. Each of the five constituent bands is responsible for their respective land preservation or development. Needed infrastructure to support community and economic development are the responsibility of each band and supported by Tribal Council of the PITU. Concerns among tribal members include affordable housing, water development, industrial zoning, natural resource use and preservation. A general land use plan for the PITU has been developed. This document should be reviewed to understand current infrastructure and land utilization. Copies of the plan may be reviewed at the Tribal or band headquarters.

Appendix N

Flood Hazard Identification Study
Six County Association of Governments

By:
United States Army Corps of Engineers
Utah Division of Emergency Services and Homeland Security

August 1, 2003

Introduction

The US Army Corps of Engineers Sacramento District completed this flood hazard identification study through a contract with the seven Associations of Governments. Funding was provided under the USACE Planning Assistance to States Program (Section 22). The intent of the study is to aid in detailing natural hazards associated with fluvial process for entities within each AOG currently unmapped as part of the National Flood Insurance Program or mapped as D zone areas.

Acknowledgements

The following agencies aided in preparation, interpretation, and completion of this flood hazard investigation study.

Utah Associations of Governments
Six County Association of Governments
Sacramento District Corps of Engineers
Utah Division of Emergency Services and Homeland Security

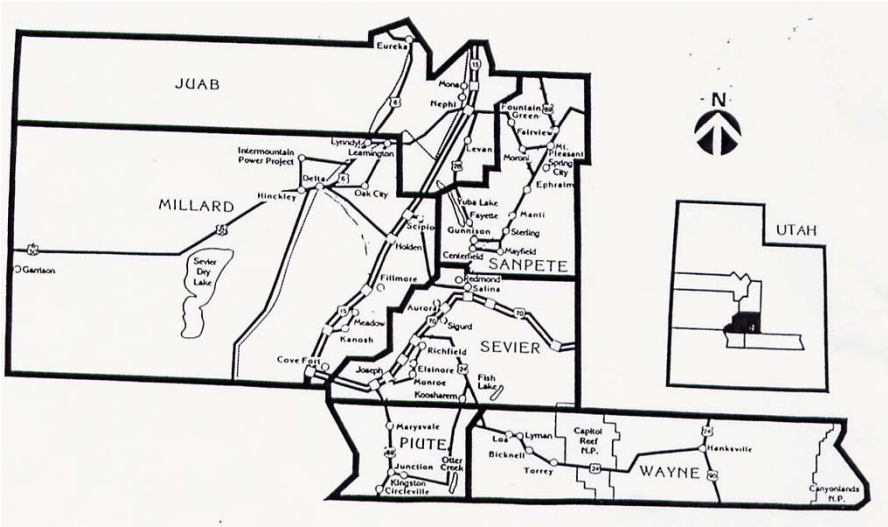
Scope of Work

This study will evaluate and identify areas with a high flood hazard and identify potential mitigation solutions. The areas evaluated in this study include the six unincorporated counties of Juab, Millard, Piute, Sanpete, Sevier, and Wayne. Municipalities within the six counties were studied if they met the following criteria:

1. Jurisdiction has not been mapped by FEMA,
2. Jurisdiction mapped by FEMA as a Zone D, area of undetermined flood hazard.

Fluvial hazards within the cities and towns of: Levan, Mona, Rocky Ridge, Lynndyl, Marysvale, Centerfield, Fayette, Fountain Green, Sterling, Wales, Monroe, Salina, Lyman, and Hanksville were studied.

Description of the Study Area



Six County Association of Governments and the counties and municipalities it serves, are comprised of the following counties Juab: population 8,238, Millard: population 12,405, Piute: population 1,435, Sanpete: population 22,763, Sevier: population 18,842, Wayne: population 2,509. The total population of the six counties is 66,192 (Census 2000). Land within Six County is drained by one of three basins: the West Colorado River Basin, Sevier River Basin, or the West Desert Basin. The majority of the land within the six county area drains into the Sevier River Basin. The six county area is subject

to periodical floods due to large and/or quick snow melts as well as micro-bursts from spring, summer, and fall rains. The above map illustrates the study area in relation to the state.

Discussion, Data, and Observations

Data presented in this study are from the following sources:

- West Colorado River Basin Plan
- West Desert Basin Plan
- Sevier River Basin Plan
- Manti City Flood Insurance Study
- Elsinore City Flood Insurance Study
- Town of Joseph Flood Insurance Study
- Richfield City Flood Insurance Study
- Salina City Flood Insurance Study
- Sevier River and Tributaries, Utah Reconnaissance Report US Army Corps of Engineers March 1994
- Flood Damage Prevention Study Sevier River Basin Investigation, Utah US Army Corp of Engineers January 1994.

In addition to incorporating existing studies and plans completed in the area, this flood hazard study also contains information from technical experts familiar with the study area. The mitigation projects are purely suggested actions, which based on past experience, will reduce or eliminate the identified fluvial hazard. These mitigation recommendations in no way represent the only measure to attain fluvial mitigation. In many cases the proposed or best solution is simply avoidance. This method of mitigation is implemented through the use of zoning, and represents in most cases the lowest cost mitigation measure.

Disclaimer

The information provided in this study was developed from a number of sources including:

- Past USACE studies done within the region and drainage basins,
- Personal knowledge,
- Limited onsite visits,
- Map interpolations,
- Current GIS work.

Even though care was taken to ensure a measure of correctness and field checks were preformed on the information and data gathered, it is important to note this flood hazard study is presented “as is”. The United States Army Corps of Engineers, Division of Emergency Service and Homeland Security, or any other agency assisting in completion of this study cannot accept any responsibilities for errors, omissions, or accuracy. There are no warranties, which accompany this product. Users are cautioned to field verify information provided in this product before making any decisions. In no way does the mapping presented in this study take the place of a regulatory FEMA Flood Insurance Rate Map (FIRM), or replace any flood hazard identification product developed by FEMA / National Flood Insurance Program (NFIP).

How Communities Where Ranked
The communities within this study were ranked based on a committee's evaluation. The evaluation committee consisted of the:

- Utah State Floodplain Program Manager
- Utah State Hazard Mitigation Officer,
- Natural Hazard Mitigation Planner,
- U.S. Army Corp of Engineers,
- State Earthquake Program Manager.

This committee researched each of the twenty-nine counties and all 269 incorporated areas within the State of Utah. Each jurisdiction was assigned one of five ratings: Very High, High, Moderate, Low, or Not Rated. These rating in no way reflect actual flood threat. The ratings were assigned based on the following variables:

- Perceived flood threat based on topography, past flooding occurrences, and experience of committee members.
- Participation in the National Flood Insurance Program (NFIP).
- Past studies included, but not limited to, regulatory FEMA/NFIP Flood Insurance Studies (FIS), other flood studies, and reconnaissance reports.
- Population growth within the jurisdiction.
- If the community is mapped by FEMA/National Flood Insurance Program NFIP), and type of map which identifies high, moderate and low flood threats

Ratings were used to set the scope of work for each community within this study**.** Information on excluded communities was added were available.

A Word about Wildfires
Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk associated with alluvial fans is always of concern. Post fire re-vegetation and stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

A Word About Dams
Dams are a critical support function for water managers in the State and also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 134 dams within Six County of those 26 have received an high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is

designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years.

Juab County

- Mona
- Sevier Bridge

Millard County

- Corn Creek
- Gunnison Bend
- DMAD

Piute County

- Otter Creek
- Piute
- Upper Beaver Creek
- Lower Beaver Creek

Sanpete County

- Ninemile
- Dairy Dam
- Fairview Lake
- Palisades Lake
- Huntington
- Rolfson
- Gunnison

Sevier County

- Forsyth
- Cottonwood Wash Detention Basin
- Dairy Canyon Detention Basin
- Glenwood Debris
- Johnson
- Rocky Ford
- Three Creeks
- Koosharem
- Sand H Debris

Wayne County

- Mill Meadow

A Word about Prevention and Preparedness

Communities need to pay attention to such things as topography and past flood history when designing and approving new construction. Cities need insure adequate storm drain systems are installed, and paved areas and streets do not intersect stream channels only to become new "rivers". Aged irrigation storage basins and canals represent a risk to down slope property should the canal fail.

Simple things like not storing valuables and keepsakes such as photographs in the basement (or other low lying areas), and raising your furnace, water heater, and electric panel can really lessen the impacts if a flood does occur. Consult with a professional for further information if this and other damage reduction measures can be taken.

Residents need to let their local officials know that flooding and the consequences it brings is a concern to the majority of the citizenry. Wherever a serious problem does exist, citizens could organize themselves, working to reduce or eliminate the flood threats that face the community.

Working together public officials and residents can make a BIG difference as to the outcome BEFORE floods threaten their community.

Juab County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Juab County		798		**Not Participating**	Salt, Currant, Tanner & Cherry Creeks & Tribs
Juab	Eureka	766	F4	490079 - 3/1/86(L)	
Juab	**Levan**	688	F4	490080 - **(NSFHA)**	**Moderate flood threat**
Juab	**Mona**	850	F5	**Not Participating**	Minor flood threats from Currant Creek & Mona Reservoir
Juab	Nephi	4733	F5	490229 - 11/4/87	
Juab	**Rocky Ridge**	403	E5	**Not Participating**	Pot. NSFHA Eligible no waterway

Juab County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Juab	July 31, 1936	Eureka/Tintic	Considerable flood damage to roads and streets. Mud covered rail tracks.	
Flood Juab	August 10, 1941	Mona/Jericho	Damaged railroad tracks, property and road network	
Flood Juab	July 21, 1943	Nephi	Property, roads, and bridges damaged	Salt Creek Canyon
Flood Juab	August 15, 1955	Nephi	Business establishments, farms and irrigation ditches. 7,000 turkeys were killed.	Bigelow Canyon Cloudburst

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Juab	August 4 1961	Jericho, Nephi, and Eureka	Utah Highways 11, 36, and 132 and U.S. 6 covered with water and debris	Heavy rains
Flood Juab	July 18, 1964	Eureka	Homes and streets	Worst storm in many years
Flood Juab	July 22, 1968	Tintic	Homes, roads, electric, and telephone lines.	
Flood Juab	August 2, 1968	Levan	City streets and irrigation ditches	Pigeon Creek Canyon over $15,000 in damages
Flood Juab Presidential	1983	Levan and Nephi although problem countywide.	Creek channels filled with sediment, damaged bridges, culverts, roads, water lines	Pigeon, Chicken, and salt, Creeks. Juab county agricultural losses totaled 8 million and public damage totals were 2 million.
Flood Juab Presidential	1984	County Wide	Creek channels filled with sediment, damaged bridges, culverts, roads, water lines	Public assistance total $1,310,566

(All dollar values for given are for year of disaster)

Unincorporated Juab County

Problem Identification:
Less than 10 percent of the county's population lives in unincorporated areas of Juab County. Many live in the area surrounding Nephi. Development should be avoided adjacent to Salt, Currant, Tanner and Cherry Creeks (and their tributaries) where the threat of flooding is present. Principle lakes/reservoirs include Yuba, Mona, and Chicken Creek; of these only Mona reservoir is listed as high hazard.

Objective: Minimize future flood damage in Unincorporated Juab County.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent
(100 ft minimum setback or greater) as well as not allowing development on alluvial fans. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances.

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing
Staff:

Action: New development near canals should also be discouraged. There have been several potentially deadly flood events in the state due to flooding caused by canal failures.

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing
Staff:

Eureka

Problem Identification:
Localized inundation occurs following high frequency rain events and snowmelt, due to inadequate storm water management system.

Objective: Minimize future flood damage due to flooding in Eureka

Action: Install curb, gutter and storm drain system in Eureka
Time frame:
Funding:
Estimated Cost:
Staff:

Levan

Problem Identification:
Although designated as a No Special Flood Hazard Area (NSFHA) by FEMA, this community has experienced several significant flood events, most notably in 1968 when an estimated 4,000

cfs came down Pigeon Creek. Flooding in 1983 on both Pigeon and Chicken Creeks were approximately a 50-year event. See attached Wasatch Front Flood Study (WFFS) excerpt.

Objective: Minimize future flood damage in Levan.

Alternative Action: Nonstructural measures such as zoning are likely the most cost effective (see narrative for the county's mitigation above).

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Alternative Structural Action: Potential structural mitigation includes debris basins on both Pigeon and Chicken Creeks and protection of the road and the Town's water line up Chicken Creek Canyon (if not already protected).

Time Frame:
Funding:
Estimated Cost: The total cost structural measures would likely be between $2.4 million and $3 million (see attached).
Staff:

Mona

Problem Identification:
Although there is a fairly large watershed east of town, the flood threat to Mona is fairly minimal since it is limited by the capacity of the culverts and underpass on Interstate 15. Currant Creek flows on the west side of town into Mona reservoir but these flooding sources also pose little threat so long as new development is not allowed to build adjacent to them, west of the railroad line.

Objective: Minimize future flood damage in Mona.

Alternative Action: Nonstructural measures such as zoning appear to be the most prudent approach (see narrative for the county's mitigation above) to minimize potential impacts from the eastside drainage, Currant Creek, and Mona Reservoir since the threat is relatively minor. Currant Creek and/or Mona Reservoir should allow no development in the area west of the railroad tracks, which could be flooded

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing
Staff:

Alternative Action: A structural action could consist of levees along the eastside drainage and constructing a dyke on the west side of town to prevent flooding from Currant Creek and Mona Reservoir.

Time Frame:
Funding:
Estimated Cost: about $400k
Staff:

Rocky Ridge

Problem Identification: Utah's newest town, Rocky Ridge was incorporated only a few years ago. It is located just west of I-15, just south of the Utah/Juab County line. The community sits at the base of a hill amidst several small ravines. However, the contributing watershed above the community is relatively small so the potential for catastrophic flooding is minimal. There exists the potential for a FEMA No Special Flood Hazard Area (NSFHA) designation. It appears that the east/west streets may have been intentionally located at the ends of these ravines to handle some storm water runoff. For the majority of rainfall events, this will be adequate. A few homes near the mouths of the ravines may be at more substantial risk.

Objective: Minimize future flood damage in Rocky Ridge.

Action: New homes/structures should be sited so as to be away from the streets and low points. Efforts to evaluate these homes and flood proof as needed would be advisable.

Time Frame:
Funding:
Estimated Cost: Minimal
Staff:

Millard County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Millard County		3815		490233 - 9/4/87	**Index panel only – All Zone D**
Millard	Delta	3209	G3	490206 - (NSFHA)	
Millard	Fillmore	2253	G4	490087 - (NSFHA)	
Millard	Hinckley	698	G3	490200 - (NSFHA)	
Millard	Holden	400	G4	490201 - 3/1/86(L)	
Millard	Kanosh	485	H4	490088 - (NSFHA)	
Millard	Leamington	217	F4	490246 - 9/4/87	
Millard	**Lynndyl**	134	F4	**Not Participating**	**NSFHA Eligible – no waterway**
Millard	Meadow	254	H4	490089NITP - 7/2/76	
Millard	Oak City	650	G4	490090 - (NSFHA)	
Millard	Scipio	290	G4	490091 - (NSFHA)	

Millard County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Dam Failure Millard	June 23, 1983	Near Delta DMAD	Unknown	16,000 acre feet of water inundated the town of Deseret killing one person.
Flood Millard	1896	Meadow	Unknown	Unknown
Flood Millard	1934	Meadow	Unknown	Unknown
Flood Millard	1938	Meadow	Unknown	Unknown

Flood Millard	1940	Meadow	Unknown	Unknown
Flood Millard	August 4-6, 1945	Oak City	Homes and fields in Oak City	Dry Creek and Oak Creek drainages
Flood Millard	July 18, 1951	Scipio	Damage to farms, crops, and residential areas	$25,000.00 in damages
Flood Millard	August 25, 1958	Scipio	Damage to farmlands and Highway 63	$3,000.00 in damages
Flood Millard	July 31, 1961	Fillmore	City homes and water lines	Chalk Creek Chalk Creek
Flood Millard Presidential	1983	Fillmore, Deseret, and Scipio	Loss of over 140 homes, rail lines, sewer lines, roads, etc.	Chalk Creek, Oak Creek, and the Sevier River. 1 million in public assistance.
Flood Millard Presidential	1984	County wide	All sectors	Public assistance total $492,204.
Flood Millard	August 2000	Holden	Damage to 4 structures and municipal roadways.	Unknown

(All dollar values for given are for year of disaster)

Unincorporated Millard County

Problem Identification:
About 30 percent of the Millard County's population lives in unincorporated areas of the county. Many live in the areas surrounding Delta and Fillmore. Development should be avoided adjacent to Sevier and Beaver Rivers (and their tributaries) where the threat of flooding is greatest. Unincorporated Millard County has a FEMA designation of Zone D, "Areas of undetermined but possible flood hazards". Principle Lakes/Reservoirs include DMAD, Fool Creek, Clear Lake, and Gunnison Bend, Scipio, and Sevier (Dry) Lake.

Objective: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be

discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances.

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing**.**
Staff:

Lynndyl

Problem Identification: This community is situated on a plateau well above and away from the Sevier River floodplain. It is definitely eligible for a FEMA No Special Flood Hazard Area designation.

Objective: Officially recognize Lynndyl as a NSFHA

Action: Draft and adopt a NSFHA ordinance
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:

Fillmore

Problem Identification: Chalk Creek at Fillmore has a drainage area of about 67 square miles. The creek channel is highly incised through much of the community. Structural inventory taken in 1994 indicates as many as 90 structures could be vulnerable to flooding. Vulnerable structures are primarily located where Chalk Creek crosses Highway 99 and downstream to I-15.

Objective: Reduce flood threat from Chalk Creek within Fillmore City

Action: Maintain and improve existing levee along Chalk Creek
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Flatten the side slopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Action: Add a levee or floodwall upstream from Highway 91 to prevent breakout flows
Time Frame:
Funding:

Estimated Cost: Minimal
Staff:

Action: Maintenance of channels and bridge openings
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Keep all bridge openings and upstream channels free of debris to prevent constriction during high flows.

Action: Initiate floodplain-mapping study to determine whether a flood threat does exist.
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Fillmore has a FEMA No Special Flood Hazard Areas (NSFHA) designation.

Action: Advise residents of the availability of flood insurance.
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Inform residents adjacent to the channel of the potential risk of flooding and advise them flood insurance is available. Because of Fillmore's designation flood insurance is priced very reasonable.

*Fillmore mitigation recommendations from Sevier River and Tributaries, Utah Reconnaissance Report prepared by the US Army Corp or Engineers Sacramento District March 1994.

Piute County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Piute County		230		490094 - 3/18/86(M)	Minor Threat
Piute	Circleville	505	I4	490095 - (NSFHA)	Minor Threat
Piute	Junction	177	I4	490096 - 1/16/87	Minor Threat
Piute	Kingston	142	I4	490087NITP - 2/4/77	Minor Threat
Piute	**Marysvale**	381	H4	490098 - 2/5/86(M)	High threat from Bullion Creek & others.

Piute County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Piute	July 7, 1949	Marysvale	Extensive flood damage to highway in Marysvale Canyon.	
Flood Piute	July 18, 1965	Marysvale	U.S. 89 damaged	
Flood Piute	August 6, 1967	Kingston	Highway 22 damaged	Source Kingston Canyon
Flood Piute	July 24, 1968	Marysvale	Damage to homes, crops, and U.S. 89.	
Flood Piute Presidential	1983	Marysvale	Damaged roads, bridges, culverts, and agricultural interests.	Source: Kingston, Bullion, and Cottonwood Canyons.
Flood Piute	August 22, 1997	Kingston Canyon	Damage to roads, waterlines, and stream channel	Source Monsoonal thunderstorm in Kinston Canyon

(All dollar values for given are for year of disaster)

Unincorporated Piute County

Problem Identification:
Only about 16 percent of the county's population lives in unincorporated areas of the county. Development should be avoided adjacent to Sevier River and Otter Creek (and their tributaries) where the threat of flooding is greatest. The FEMA Piute County FIRMs identify most areas as Zones C or X (little to no flood threat) with the areas adjacent to the rivers and creeks identified as Zone A – 100 year flood risk. The State Division of Water Resources, Dam Safety Section indicates there are four high hazard dams within Piute County. Although Piute County is small in both area and population size standards the majority of population lives below and within about thirty miles of the Otter Creek or Piute Dams both of which are considered high hazard.

Objective: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population, which will oppose any zoning or other changes in the regulations and ordinances.

Time Frame:
Funding:
Estimated Cost: Minimal – almost nothing
Staff:

Municipalities: Three of the 4 incorporated communities in Piute County - Circleville, Junction, and Kingston. The three identified have a relatively minor risk of flooding from the Sevier River and it's tributaries. Marysvale, however, has an extensive history of flooding.

Marysvale

Problem Identification: has an extensive history of flooding from Bullion (Pine) Creek and a high future flood threat - even greater than that shown on the FEMA map (see attached). The 100-year flow has been estimated at almost 900 cfs. There are also smaller threats from Beaver Creek on the north side of town and California Gulch through the center of town.

Objective: Minimize future flood damage in Marysvale.

Action: Construct a detention basin on Bullion Creek if a suitable site can be identified.

Time Frame:
Funding:
Estimated Cost: $300k
Staff:

Sanpete County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Sanpete Co.		3650		490111 - 6/1/86(L)	
Sanpete	**Centerfield**	1048	G5	**Not Participating**	NSFHA Eligible – no waterway
Sanpete	Ephraim	4505	G5	490112B - 4/3/87(M)	
Sanpete	Fairview	1160	F5	490113A - 2/1/87(L)	
Sanpete	**Fayette**	204	G4	**Not Participating**	Moderate threat from eastside drainages
Sanpete	**Fountain Green**	945	F5	**Not Participating**	Major threat from Westside drainages
Sanpete	Gunnison	2394	G5	490115 - (NSFHA)	
Sanpete	Manti	3040	G5	490116 - 8/4/87	
Sanpete	Mayfield	420	G5	490117 - NITP	
Sanpete	Moroni	1280	F5	490118 - 8/5/80(M)	
Sanpete	Mt Pleasant	2707	F5	490213 - 9/24/84(M)	
Sanpete	Spring City	956	F5	490119 - 8/5/80(M)	
Sanpete	**Sterling**	235	G5	**Not Participating**	Little threat to development – creek is located in a deep ravine
Sanpete	**Wales**	219	F5	**Not Participating**	Limited flood threat – south end only

Sanpete County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Sanpete	July 24, 1946	Mount Pleasant	Devastated city damaging homes, businesses, railroad tracks, water lines, livestock, and streets	$500,000 in damage. Flood originated from Mount Pleasant Canyon.
Flood Sanpete	August 7, 1952	Mount Pleasant	Irrigation systems and farmlands	$10,000 dollars in damage. Flooding from Birch Creek and North Creek
Flood Sanpete	July 30, 1956	Manti	Farms, irrigation canals, and roads.	Willow Creek
Flood Sanpete	August 5, 1961	Fountain Green	Farmlands, crops, and fish hatchery.	$31,000 in damage. Flood from Tidds and Log Canyons
Flood Sanpete	July 17-19, 1965	Ephraim	Damage to roads, canals, and a flood control dam.	Willow Creek
Flood Sanpete	July 31, 1965	Mount Pleasant/Wales/ Spring City	Roads and culinary water system	$10,000 in damage. Pleasant Creek and Twin Creek.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Sanpete Presidential	1983	Centerfield, Ephraim, Fairview, Fountain Green, Gunnison, Manti, Mayfield, Moroni, Mount Pleasant, Sterling, and Spring City.	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Source Twelve-mile, Cottonwood, Creeks, Pole Gamit, and Log Canyons, Peacock springs, San Pitch River. Public road damage amounted to $650,000.
Flood Sanpete Presidential	1984	County wide	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Public assistance totals $1,382,136.
Flood Sanpete	July 22, 1998	Spring City	Damage to road, bridges, water supply, diversion structures, and 12 homes.	$2.5 million est. damage from Canal and Oak Creeks.

(All dollar values for given are for year of disaster)

Unincorporated Sanpete County

Problem Identification: Only about 16 percent of this county's population lives in unincorporated areas of the county. Development should be avoided adjacent to the Sevier and San Pitch Rivers (and their tributaries) where the threat of flooding is greatest. The FEMA FIRMs identify most areas as Zones C and X (little to no flood threat) with the areas adjacent to the rivers and creeks identified as Zone A – 100 year flood risk. Lakes/Reservoirs include Sevier Bridge, Gunnison, Palisade, and Ferron.

Objective: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. Oppose any zoning or other changes in the cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances.

Time Frame:
Funding:
Estimated Cost: Minimal – almost no cost.
Staff:

Centerfield

Problem Identification: This community should be considered a No Special Flood Hazard Area (NSFHA) – eligible community, as there are NO rivers or creeks in the area.

Objective: Officially recognize Centerfield as a NSFHA

Action: Draft and adopt a NSFHA ordinance
Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Fayette

Problem Identification: Only a relatively minor flood threat exists from the very small eastside drainages. Also, there is a minimal threat from the Fayette Canal and Sevier Bridge Reservoir (Yuba Lake).

Objective: Minimize future flood damage in Fayette.

Alternative Action: As with similar small communities, the relatively low threat of flooding indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Time Frame:
Funding:
Estimated Cost:
Staff:

Alternative Action: A potentially viable alternative would be to flood proof those existing low-lying structures that are subject to flooding.

Time Frame:
Funding:
Estimated Cost: $10k-$30k per structure
Staff:

Fountain Green

Problem Identification: Major threat from drainages on the west and to a lesser extent from the north. Actions should be identified to warn residents of the substantial flood threat.

Objective: Minimize future flood damage in Fountain Green.

Alternative Action: Some form of structural mitigation on Uinta/Gammett and Fountain Green Creeks is needed. Levees or berms could be constructed on the creeks. It would require about 20,000 ft of levee as shown on the attached map.

Timeframe: Based on funding
Funding:
Estimated Cost: It would cost about $50 per lf or approximately $1 million total.
Staff:

Alternative Action: A potentially viable alternative would be to flood proof those existing low-lying structures that are subject to flooding.

Timeframe: Based on funding
Funding:
Estimated Cost: $10k - $30k per structure
Staff:

Sterling

Problem Identification: There is little threat to development. Sixmile Creek is located in a deep ravine on the north side of town. The upstream Palisade Reservoir also provides some incidental flood control to the community.

Objective: Minimize future flood damage in Sterling

Action: It appears that the most prudent mitigation is zoning to prevent development in the ravine.

Timeframe: Based on funding
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Wales

Problem Identification: Limited flood threat – south end only from Wales Canyon Creek.

Objective: Minimize future flood damage in Wales

Alternative Action: A short levee stretch would reduce what flood threat there is. The single levee on the north is approximately 3,000 ft.

Timeframe:
Funding:
Estimated Cost: About $150,000 (or double that if levee protection is desired on both sides).
Staff:

Alternative Action: An alternative to a levee would be to flood proof the few vulnerable structures.

Timeframe:
Funding:
Estimated Cost: $10 - $30 per structure
Staff:

Multi-Jurisdictional Flood Threats

Problem Identification: Residential areas of Ephraim, Spring City, Mt. Pleasant, and Manti experienced residential flooding in areas due to Canal Creek in 1998.

Objective: Minimize future flood damage due to flooding on Canal Creek.

Action: Install a SNOTEL site in the watershed of Canal Creek (7,500' elev.)

Timeframe: Based on funding
Funding: Undetermined
Estimated Cost:
Staff: DES staff will coordinate the effort between Natural Resource Conservation Service and Sanpete County.

Action: Place a Stream Gauge on Canal Creek at the upper diversion.

Timeframe: Based on funding

Funding:
Estimated Cost
Staff:

Action: Perform watershed calibration study and a FLO 2D study of Canal Creek alluvial fan.

Timeframe: Based on funding
Funding: Undetermined
Estimated Cost:
Staff:

Sevier County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Sevier Co		3314		490121 - 9/7/98	
Sevier	Annabella	603	H4	490122 - 10/30/79(M)	
Sevier	Aurora	947	G4	490123 - 1/12/82(M)	
Sevier	Elsinore	733	H4	490125 - 4/6/98(M)	
Sevier	Glenwood	437	H4	490126A - 7/1/86(L)	
Sevier	Joseph	269	H4	490127 - 6/2/95	
Sevier	**Koosharem**	276	H4	490128 - (NSFHA)	
Sevier	**Monroe**	1845	H4	490129 - 7/24/79(M)	
Sevier	Redmond	788	G4	490130 - (NSFHA)	
Sevier	Richfield	6847	H4	490131 - 9/29/86	
Sevier	**Salina**	2393	G4	490132 - 9/29/86	
Sevier	Sigurd	430	H4	490133A - 1/1/86(L)	

Sevier County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Sevier	July 11-17, 1896	Koosharem, Annabella, Elsinore, Joseph, Monroe, Richfield, Sevier, and Sigurd.	Widespread damage	Koosharem inundated.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Sevier	1896-1929	Monroe	Unknown	13 floods impacted Monroe over 33-year timeframe.
Flood Sevier	July 31, 1943	Monroe	Homes farmlands, crops, and livestock	$80,000 in damage. Canyon on East Mountain
Flood Sevier	August 5, 1943	Monroe	Extremely heavy rains damage homes, highways, canals, crops, city pipelines, and power plant.	$120,000 in damage city without power for two weeks
Flood Sevier	July 27, 1951	Salina	Property and residential areas	Source East Canyon
Flood Sevier	September 5, 1960	Glenwood/Sigurd	Roads, bridges, and property	$15,000 plus. Highway 119 and 24 extensively damaged
Flood Sevier	July, 31, 1961	Richfield	U.S. 89 damaged along with irrigation canal	Source Cottonwood Canyon
Flood Sevier	August 11, 1961	Richfield	Property damage in northeast section of city.	Source Cottonwood Canyon damage $3,700
Flood Sevier	August 15, 1964	Sigurd/Aurora	Crops and irrigation system.	Anderson Wash and Lost Creek $1,600

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Sevier	August 17, 1965	Annabella/Glenwood	Crops, farms, roads, and fences.	$38,000 in damage
Flood Sevier	August 6, 1967	Richfield/Central	Damage to homes, farms, and crops.	Source Flat and Cottonwood Canyons $30,000 in damage.
Flood Sevier	July 24, 1968	Richfield	Damage to homes	
Flood Sevier	July 30, 1968	Richfield/Elsinore	U.S. 89 covered with debris and water. Farmlands and buildings damaged.	Source Flat and Cottonwood Canyons
Flood Sevier	August 8, 1968	Richfield	Farmlands and buildings	Source: Cottonwood Creek, $2,000 + in damages.
Flood Sevier	July 24, 1969	Redmond/Sigurd	Farmlands and irrigation canals.	
Flood Sevier Presidential	1983	Monroe, Richfield, and Salina	Damage in all sectors	Source Sevier River, Monroe, Cottonwood, and Salina Creek.
Flood Sevier Presidential	1984	County wide	All sectors impacted by event loss to road, culverts, agriculture, sewer, infrastructure, flood controls, etc.	Public assistance totals $185,545 (1984 dollars)

(All dollar values for given are for year of disaster)

Unincorporated Sevier County

Problem Identification: Sevier County is one of the few counties in the state where every municipality participates in the NFIP. Only about 18 percent of this county's population lives in unincorporated areas of the county. Development should be avoided adjacent to the Sevier and other major rivers and creeks (and their tributaries) where the threat of flooding is greatest. The FEMA FIRMs identify most areas as Zones C and X (little to no flood threat) with the areas adjacent to the rivers and creeks identified as Zone A – 100 year flood risk. Lakes/Reservoirs include: Fish Lake, Johnson Valley, Koosharem, Rocky Ford, and Forsyth.

Objective: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Koosharem

Problem Identification: Koosharem Creek has a rather large drainage area of several square miles at Koosharem. According to the USGS quadrangle map, there is a weir/aqueduct diversion about 2 miles upstream of town.

Objective: Minimize future flood damage from Koosharem Creek through Koosharem.

Action: Improve existing dike along Koosharem Creek

Time Frame:
Funding:
Estimated Cost: about $300,000
Staff:
Background: Raise and extend the existing dike along the east side of town for a distance of approximately 6,000 ft. (Provisions will need to be made for low flows to enter the Koosharem Canal and riprap at the south end of the levee where diverted flood flows will pass.)

Monroe

Problem Identification: Monroe Creek with a drainage area of 39 square miles at Monroe. Monroe Creek has the potential of causing flood damage below Bohman Road, because of decreased channel capacity and constrictions. Constrictions include the culvert at Jones Road, and bridges at Jones Road, 8th South and 4th south.

Objective: Minimize future flood damage along Monroe Creek through Monroe City.

Action: Modify bridges along Monroe Creek

Timeframe:
Funding:
Estimated Cost:
Background: Enlarge or add to bridges especially Jones Road Bridge to increase the channel capacity to at least match the capacity of the Bohman Road bridge.

Action: Maintain and improve existing levee along Monroe Creek

Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Flatten the side slopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Action: Inform residents of the availability of flood insurance

Timeframe:
Funding:
Estimated Cost:
Background:

Salina

Problem Identification: Salina Creek has the potential of causing flood damage with in the City of Salina. Approximately 35 structures could be affected by a 100-year flood event. The majority of these structures are singe-family residences and a few small businesses. The Mayor of Salina indicated very little new development had occurred on the west side of town primarily due to the flood threat. The existing levee and channel appear to provide some flood protection. However some minor damage would take place for an event with a frequency of 50-years.

Objective: Minimize future flood damage along Salina Creek through Salina City.

Action: Maintain and improve existing levee along Salina Creek

Time Frame:
Funding:
Estimated Cost: Minimal

Staff:
Background: Flatten the side slopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Action: Maintenance of channels and bridge openings
Time Frame:
Funding:
Estimated Cost: Minimal
Staff:
Background: Keep all bridge openings and upstream channels free of debris to prevent constriction during high flows.

Wayne County

COUNTY	CITY/TOWN	POPULATION	LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Unincorporated Wayne County		986		**Not Participating**	Dirty Devil, Freemont, and Tribs
Wayne	Bicknell	353	I5	490184 - (NSFHA)	
Wayne	**Hanksville**	240	I6	**Not Participating**	Major flood threat from Bull Creek
Wayne	Loa	525	H5	490185 - NITP	
Wayne	**Lyman**	234	H5	**Not Participating**	Moderate flood threat from drainages to the east
Wayne	Torrey	171	I5	490186 - (NSFHA)	

Wayne County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Wayne	August 4, 1957	Caineville	Destroyed bridge west of town blocked Highway 24	Source Fremont River
Flood Wayne	August 25, 1961	Torrey	Highway 24 damaged	Source South Desert Wash
Flood Wayne	July 31, 1965	Bicknell/Lyman/ Teasdale/ Loa	Damage to homes, crops, ranches, and Highway 24 and 117	Heavy rains flooded area creeks.
Flood Wayne	August 18, 1965	Bicknell	Farmland, crops, orchards, and Highway 68 all damaged	10,000 acres of farmland destroyed.

(All dollar values for given are for year of disaster)

Unincorporated Wayne County

Problem Identification: Almost 40 percent of this county's population lives in unincorporated areas of the county. Development adjacent to the Dirty Devil and Fremont Rivers (and their tributaries) should be prevented. Areas adjacent to Green River are protected from development for the most part by Canyonlands National Park. There are no FEMA FIRMs for the unincorporated areas of the County although there are areas of risk. There are three high hazard dams, which would impact Wayne County, if failure were to occur. Two of these dams, Johnson Dam and Forsythe Dam, are physically located in Sevier County adjacent to the Wayne County line and upstream on the Fremont River from the third dam Mill Meadow, which is located in Wayne County. The possibility exists for failure of one dam resulting in failure of downstream dams. Wayne County is very large in area and very small in populations, however the majority of the population does live below and within about thirty miles of the above-mentioned dams and within a few miles of the Fremont River and its flood plain.

Objective: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the County to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Hanksville

Problem Identification: There is a major flood threat from Bull Creek – especially on the east side of town. The city has made some channel improvements but the culvert and crossing at Highway 24 is offset from the flow line of the channel by 6 ft or more (according to the city engineer). UDOT is looking into this problem.

Objective: Minimize future flood damage in Hanksville.

Action: Culvert improvements are needed at Highway 24 and additional channel work. Another alternative would be about 1 mile of levee.

Timeframe:
Funding:
Estimated Cost: On the order of $0.5 to $1 million.
Staff:

Lyman

Problem Identification: There is a moderate flood threat from the unnamed drainages to the east.

Objective: Minimize future flood damage in Lyman.

Alternative Action: There is a High Line Ditch located between the town and the east side drainages. It appears that the ditch when needed could convey some floodwaters. A structural project could consist of improving this ditch to increase its capacity.

Timeframe:
Funding:
Estimated Cost: Approximately $300,000.
Staff:

Alternative Action: An alternative structural project could consist of constructing about a mile long deflector levee.

Timeframe:
Funding:
Estimated Cost: Approximately $300,000.
Staff:

Need For Additional Research

Additional research should be conducted to better map communities currently mapped as a FEMA Zone D, or currently unmapped communities, and communities with out dated Flood Insurance Rate Maps. Communities would benefit from knowing peak flows and stages on tributaries of concern.

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Juab County 2500 Year Event***

Earthquake Scenario: ***Juab County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes one county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3,402.00 square miles and contains two census tracts. There are over two thousand households in the region and has a total population of 8,238 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated two thousand buildings in the region with a total building replacement value (excluding contents) of 386 (millions of dollars). Approximately 99.00 % of the buildings (and 83.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,276 and 65 (millions of dollars) respect.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are two thousand buildings in the region, which have an aggregate total replacement value of 386 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there is one (1) hospital in the region with a total bed capacity of 19 beds. There are six (6) schools, one (1) fire station, two (2) police stations and one (1) emergency operations facility. With respect to HPL facilities, there are eight (8) dams identified within the region. Of these, two (2) of the dams are classified as 'high hazard'. The inventory also includes six (6) hazardous material sites, zero (0) military installations and zero (0) nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,341.00 (millions of dollars). This inventory includes over 299 kilometers of highways, 80 bridges, 0 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	80	64.80
	Segments	23	1,065.00
	Tunnels	0	0.00
		Subtotal	**1,129.90**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	36	110.30
	Tunnels	0	0.00
		Subtotal	**110.30**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	5.30
	Runways	1	30.50
		Subtotal	**35.80**
		Total	**1,276.00**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	1	65.30
	Pipelines	0	0.00
		Subtotal	**65.30**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**65.30**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Juab County 2500Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 947 thousand buildings will be at least moderately damaged. This is over 40.00 % of the total number of buildings in the region. There are an estimated 85 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	1	0.16	1	0.16	2	0.32	2	0.75	1	1.19
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.01	0	0.02	0	0.05	0	0.13	0	0.20
Industrial	1	0.14	1	0.18	3	0.52	3	1.46	2	2.56
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	30	4.32	49	6.62	88	13.51	58	27.26	18	21.4
Single Family	664	95.37	689	93.02	556	85.60	149	70.40	64	74.6
Total	**696**		**741**		**650**		**212**		**85**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.01	0	0.01	0	0.02	0	0.04	0	0.05
MH*	30	4.25	48	6.48	86	13.31	57	26.95	18	20.97
Pre-cast	0	0.04	0	0.06	1	0.22	1	0.69	1	1.33
RM*	93	13.34	53	7.17	96	14.78	73	34.26	28	32.81
Steel	1	0.00	0	0.01	0	0.03	0	0.12	0	0.26
UM*	3	0.48	5	0.68	10	1.52	11	4.98	15	17.46
Wood	569	81.68	632	85.35	453	69.61	67	31.78	22	25.56
Total	**696**		**741**		**650**		**212**		**85**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 19 hospital beds available for use. On the day of the earthquake, the model estimates that only one hospital bed (9.00%) is available for use by patients already in the hospital and those injured by the earthquake. After one week, 39.00% of the beds will be back in service. By 30 days, 82.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	1	0	0
Schools	6	1	0	0
EOCs	1	0	0	1
Police Stations	2	0	0	0
Fire Stations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	23	0	0	23	23
	Bridges	80	16	0	64	64
	Tunnels	0	0	0	0	0
Railways	Segments	36	0	0	36	36
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	1	0	1	1
	Runways	1	0	0	1	1

Note: Roadway segments; railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8: Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	2,456	0	0	0	0	0
Electric Power		1,968	1,580	1,353	1,291	1,208

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be one (1) ignition that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about three (3) people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of zero (0) million tons of debris will be generated. Of the total amount, Brick/Wood comprises 32.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require zero truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (94 households to be displaced due to the earthquake. Of these, 22 people (out of a total population of 8,238 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows:

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum. The 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Residential	10	2	0	0
	Single Family	29	7	1	2
	Total	**40**	**10**	**1**	**3**
2 PM	Commercial	26	7	1	2
	Commuting	0	0	0	0
	Educational	11	3	1	1
	Hotels	0	0	0	0
	Industrial	2	1	0	0
	Residential	2	1	0	0
	Single Family	7	2	0	0
	Total	**48**	**13**	**2**	**4**
5 PM	Commercial	22	6	1	2
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Residential	4	1	0	0
	Single Family	11	3	0	1
	Total	**39**	**10**	**2**	**3**

Economic Loss

The total building-related economic loss estimated for the earthquake is $70.98 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 70.98 (millions of dollars); 7% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 63 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.21	0.89	0.17	0.04	1.31
	Capital-Related	0.00	0.09	0.71	0.10	0.01	0.91
	Rental	1.34	0.62	0.61	0.17	0.02	2.75
	Relocation	0.13	0.01	0.03	0.02	0.00	0.19
	Subtotal	**1.47**	**0.93**	**2.23**	**0.45**	**0.08**	**5.16**
Capital Stock Loses							
	Structural	6.64	1.18	1.80	1.96	0.19	11.77
	Non-Structural	23.36	4.76	4.39	6.84	0.57	39.91
	Content	5.77	0.92	1.97	4.66	0.24	13.55
	Inventory	0.00	0.00	0.08	0.50	0.00	0.59
	Subtotal	**35.77**	**6.86**	**8.24**	**13.96**	**1.00**	**65.82**
	Total	**37.24**	**7.79**	**10.47**	**14.41**	**1.08**	**70.98**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,065	0	0.00
	Bridges	65	11	17.06
	Tunnels	0	0	0.00
	Subtotal	**1129.90**	**11.10**	
Railways	Segments	110	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**110.30**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	5	2	40.34
	Runways	30	0	0.00
	Subtotal	**35.80**	**2.20**	
	Total	**1276.00**	**13.20**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	65.30	0.00	0.00
	Subtotal	**65.27**	**$0.00**	
	Total	**65.27**	**$0.00**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-4.46
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-13.57
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-17.46
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-17.46
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-17.46
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-17.46

Appendix A: County Listing for the Region

Juab, UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Juab	8,238	320	65	386
Total State		**8,238**	**320**	**65**	**386**
Total Region		**8,238**	**320**	**65**	**386**

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Millard County 2500 Year Event***

Earthquake Scenario: ***Millard County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes one county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 6,820.28 square miles and contains three census tracts. There are over three thousand households in the region and has a total population of 12,405 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated three thousand buildings in the region with a total building replacement value (excluding contents) of 599 (millions of dollars). Approximately 99.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,951 and 109(millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are three thousand buildings in the region which have an aggregate total replacement value of 599 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 72% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are two (2) hospitals in the region with a total bed capacity of 40 beds. There are 12 schools, five (5) fire stations, two (2) police stations and, zero (0) emergency operation facilities. With respect to HPL facilities, there are 14 dams identified within the region. Of these, three (3) of the dams are classified as 'high hazard'. The inventory also includes 22 hazardous material sites, zero (0) military installations and zero (0) nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 3,060.00 (millions of dollars). This inventory includes over 637 kilometers of highways, 93 bridges, zero kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	93	88.70
	Segments	64	2,600.90
	Tunnels	0	0.00
		Subtotal	**2,689.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	62	118.90
	Tunnels	0	0.00
		Subtotal	**118.90**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	4	21.40
	Runways	4	121.80
		Subtotal	**143.20**
		Total	**2,951.70**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Natural Gas	Facilities	1	1.10
	Pipelines	0	0.00
		Subtotal	**1.10**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	107.80
		Subtotal	**107.80**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**109.10**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Millard County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 1,215 thousand buildings will be at least moderately damaged. This is over 32.00 % of the total number of buildings in the region. There are an estimated 69 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.03	1	0.04	1	0.07	0	0.11	0	0.16
Commercial	4	0.28	4	0.34	6	0.67	3	1.17	1	1.54
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.03	0	0.04	1	0.08	0	0.15	0	0.18
Industrial	0	0.02	0	0.02	0	0.04	0	0.07	0	0.09
Religion	2	0.13	2	0.14	2	0.23	1	0.40	0	0.47
Residential	60	4.47	99	8.02	173	19.58	106	40.23	23	32.4
Single Family	1,275	95.03	1,123	91.41	700	79.33	153	57.87	45	65.1
Total	**1,342**		**1,229**		**883**		**264**		**69**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1	0.01	0	0.01	0	0.03	0	0.04	0	0.04
MH*	57	4.21	95	7.73	170	19.30	105	39.97	22	32.14
Pre-cast	0	0.02	0	0.02	1	0.07	0	0.15	0	0.22
RM*	181	13.49	101	8.26	151	17.08	85	32.30	16	22.40
Steel	2	0.01	0	0.01	0	0.03	0	0.08	0	0.07
UM*	7	0.51	10	0.85	19	2.14	17	6.46	15	21.57
Wood	1,094	81.44	1017	82.74	536	60.65	52	19.90	16	22.46
Total	**1,342**		**1,229**		**883**		**264**		**69**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 40 hospital beds available for use. On the day of the earthquake, the model estimates that only 14 hospital beds (35.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 73.00% of the beds will be back in service. By 30 days, 96.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	0	0	0
Schools	12	0	0	2
EOCs	0	0	0	0
Police Stations	2	0	0	0
Fire Stations	5	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	64	0	0	64	64
	Bridges	93	23	0	70	73
	Tunnels	0	0	0	0	0
Railways	Segments	62	0	0	62	62
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8: Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	1	0	0	1	1
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	2	0	0	1	2

Table 9: Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,840	0	0	0	0	0
Electric Power		3,840	3,840	3,840	3,840	3,840

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be one ignition that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about zero people and burn about zero (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of zero million tons of debris will be generated. Of the total amount, Brick/Wood comprises 36.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require zero truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (70 households to be displaced due to the earthquake. Of these, 16 people (out of a total population of 12,405 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life threatening.
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum; the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	10	2	0	0
	Single Family	26	6	1	1
	Total	**37**	**8**	**1**	**2**
2 PM	Commercial	27	7	1	2
	Commuting	0	0	0	0
	Educational	6	2	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Residential	2	0	0	0
	Single Family	5	1	0	0
	Total	**42**	**11**	**2**	**3**
5 PM	Commercial	21	6	1	2
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Residential	4	1	0	0
	Single Family	10	2	0	1
	Total	**36**	**9**	**1**	**2**

Economic Loss

The total building-related economic loss estimated for the earthquake is $68.19 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 68.19 (millions of dollars); 10 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 68 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.12	1.81	0.03	0.10	2.06
	Capital-Related	0.00	0.05	1.23	0.03	0.04	1.34
	Rental	1.41	0.52	0.90	0.01	0.08	2.92
	Relocation	0.14	0.02	0.05	0.00	0.02	0.23
	Subtotal	**1.55**	**0.70**	**3.99**	**0.07**	**0.24**	**6.55**
Capital Stock Loses							
	Structural	6.90	1.23	2.55	0.29	0.94	11.92
	Non-Structural	24.50	4.57	6.14	0.88	1.89	37.98
	Content	6.41	0.83	2.83	0.56	0.91	11.54
	Inventory	0.00	0.00	0.10	0.06	0.03	0.19
	Subtotal	**37.81**	**6.64**	**11.62**	**1.80**	**3.78**	**61.64**
	Total	**39.36**	**7.33**	**15.61**	**1.87**	**4.02**	**68.19**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	2,601	0	0.00
	Bridges	89	11	12.43
	Tunnels	0	0	0.00
	Subtotal	**2689.60**	**11.00**	
Railways	Segments	119	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**118.90**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	21	5	22.19
	Runways	122	0	0.00
	Subtotal	**143.20**	**4.70**	
	Total	**2951.70**	**15.80**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.20	0.01	6.99
	Subtotal	**0.20**	**$0.01**	
Electrical Power	Facilities	107.80	0.00	0.00
	Subtotal	**107.80**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	1.10	0.00	0.00
	Subtotal	**1.07**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**109.06**	**$0.01**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-1.81
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-5.52
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-7.10
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-7.10
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-7.10
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-7.10

Appendix A: County Listing for the Region

Millard, UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Millard	12,405	504	95	599
Total State		**12,405**	**504**	**95**	**599**
Total Region		**12,405**	**504**	**95**	**599**

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Piute County 2500 Year Event***

Earthquake Scenario: ***Piute County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes one county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 765.04 square miles and contains one census tract. There are over zero thousand households in the region and has a total population of 1,435 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated zero thousand buildings in the region with a total building replacement value (excluding contents) of 96 (millions of dollars). Approximately 99.00 % of the buildings (and 87.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 445 and zero (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are zero thousand buildings in the region, which have an aggregate total replacement value of 96 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are zero (0) hospitals in the region with a total bed capacity of zero (0) beds. There are three (3) schools, zero (0) fire stations, one (1) police station and zero (0) emergency operation facilities. With respect to HPL facilities, there are four (4) dams identified within the region. Of these, four (4) of the dams are classified as 'high hazard'. The inventory also includes zero (0) hazardous material sites, zero (0) military installations and zero (0) nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 445.00 (millions of dollars). This inventory includes over 117 kilometers of highways, 17 bridges, zero kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	17	4.50
	Segments	17	404.80
	Tunnels	0	0.00
		Subtotal	**409.30**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	5.30
	Runways	1	30.50
		Subtotal	**35.80**
		Total	**445.10**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**0.00**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Piute County 2500Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 0 thousand buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1	0.16	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	4	0.63	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	65	10.17	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	569	89.05	0	0.00	0	0.00	0	0.00	0	0.00
Total	**639**		**0**		**0**		**0**		**0**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00
MH*	65	10.18	0	0.00	0	0.00	0	0.00	0	0.00
Pre-cast	1	0.13	0	0.00	0	0.00	0	0.00	0	0.00
RM*	86	13.50	0	0.00	0	0.00	0	0.00	0	0.00
Steel	1	0.06	0	0.00	0	0.00	0	0.00	0	0.00
UM*	17	2.73	0	0.00	0	0.00	0	0.00	0	0.00
Wood	468	73.08	0	0.00	0	0.00	0	0.00	0	0.00
Total	**639**		**0**		**0**		**0**		**0**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had zero hospital beds available for use. On the day of the earthquake, the model estimates that only zero hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	3	3	0	0
EOCs	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	0	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	17	0	0	17	17
	Bridges	17	0	0	17	17
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	1	0	0	1	1
	Runways	1	0	0	1	1

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8: Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	509	0	0	0	0	0
Electric Power		509	509	509	509	509

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be zero ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about zero people and burn about zero (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of zero million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require zero truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (zero households to be displaced due to the earthquake. Of these, zero people (out of a total population of 1,435 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows:

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total building-related economic loss estimated for the earthquake is $0.00 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 0 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital Stock Loses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non-Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	405	0	0.00
	Bridges	4	0	3.53
	Tunnels	0	0	0.00
	Subtotal	**409.30**	**0.20**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	5	2	31.97
	Runways	30	0	0.00
	Subtotal	**35.80**	**1.70**	
	Total	**445.10**	**1.90**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**0.00**	**$0.00**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	0.00

Appendix A: County Listing for the Region

Piute,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Piute	1,435	83	12	96
Total State		**1,435**	**83**	**12**	**96**
Total Region		**1,435**	**83**	**12**	**96**

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Sanpete County 2500 Year Event***

Earthquake Scenario: ***Sanpete County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,600.76 square miles and contains five census tracts. There are over six thousand households in the region and has a total population of 22,763 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated six thousand buildings in the region with a total building replacement value (excluding contents) of 1,055 (millions of dollars). Approximately 99.00 % of the buildings (and 85.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,053 and 238 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 6 thousand buildings in the region, which have an aggregate total replacement value of 1,055 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are two hospitals in the region with a total bed capacity of 40 beds. There are 13 schools, one fire station, five police stations and zero emergency operation facilities. With respect to HPL facilities, there are 29 dams identified within the region. Of these, six of the dams are classified as 'high hazard'. The inventory also includes one hazardous material site, zero military installations and zero nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,291.00 (millions of dollars). This inventory includes over 293 kilometers of highways, 38 bridges, zero kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	38	6.10
	Segments	56	975.50
	Tunnels	0	0.00
		Subtotal	**981.70**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	10.70
	Runways	2	60.90
		Subtotal	**71.60**
		Total	**1,053.30**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	2	130.50
	Pipelines	0	0.00
		Subtotal	**130.50**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	107.80
		Subtotal	**107.80**
Communication	Facilities	5	0.50
		Subtotal	**0.50**
		Total	**238.80**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Sanpete County 2500Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 2,910 thousand buildings will be at least moderately damaged. This is over 46.00 % of the total number of buildings in the region. There are an estimated 250 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.03	1	0.02	1	0.03	0	0.05	0	0.06
Commercial	4	0.27	5	0.23	9	0.45	6	0.87	3	1.07
Education	1	0.04	1	0.03	1	0.05	1	0.09	0	0.11
Government	1	0.05	1	0.04	2	0.09	1	0.18	0	0.19
Industrial	1	0.08	1	0.06	2	0.12	2	0.24	1	0.29
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	38	2.86	104	4.85	249	12.55	226	33.65	83	33.1
Single Family	1,280	96.68	2,041	94.76	1,723	86.72	437	64.93	163	65.1
Total	**1,324**		**2,154**		**1,987**		**673**		**251**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	2	0.02	0	0.01	1	0.03	0	0.05	0	0.06
MH*	29	2.21	92	4.26	238	11.96	222	32.99	81	32.42
Pre-cast	1	0.03	1	0.03	1	0.07	1	0.16	1	0.22
RM*	157	11.86	156	7.24	308	15.52	226	33.55	68	27.06
Steel	2	0.01	0	0.01	1	0.03	1	0.08	0	0.07
UM*	5	0.35	11	0.52	27	1.37	33	4.84	42	16.69
Wood	1,128	85.17	1887	87.62	1,400	70.45	184	27.30	56	22.51
Total	**1,324**		**2,154**		**1,987**		**673**		**251**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 40 hospital beds available for use. On the day of the earthquake, the model estimates that only five hospital beds (13.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 46.00% of the beds will be back in service. By 30 days, 87.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	2	0	0
Schools	13	0	0	0
EOCs	0	0	0	0
Police Stations	5	0	0	0
Fire Stations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	56	0	0	56	56
	Bridges	38	2	0	36	36
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	2	0	0	2	2

Note: Roadway segments; railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8: Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	2	1	0	1	2
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	5	4	0	1	5

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,547	0	0	0	0	0
Electric Power		5,331	4,457	4,008	3,895	3,763

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be one ignition that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about zero people and burn about zero(millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of zero million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require zero truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (234 households to be displaced due to the earthquake. Of these, 56 people (out of a total population of 22,763 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows:

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	2	0	0	0
	Residential	34	8	1	1
	Single Family	79	19	2	5
	Total	**116**	**27**	**3**	**7**
2 PM	Commercial	38	11	2	3
	Commuting	0	0	0	0
	Educational	37	11	2	3
	Hotels	0	0	0	0
	Industrial	13	4	1	1
	Residential	6	1	0	0
	Single Family	17	4	1	1
	Total	**110**	**30**	**5**	**9**
5 PM	Commercial	44	13	2	4
	Commuting	0	0	0	0
	Educational	6	2	0	1
	Hotels	0	0	0	0
	Industrial	8	2	0	1
	Residential	13	3	0	1
	Single Family	31	7	1	2
	Total	**101**	**27**	**4**	**8**

Economic Loss

The total building-related economic loss estimated for the earthquake is $181.49 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 181.49 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 73 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.48	2.63	0.17	0.46	3.74
	Capital-Related	0.00	0.20	2.09	0.10	0.17	2.56
	Rental	3.91	1.65	1.40	0.08	0.18	7.22
	Relocation	0.37	0.05	0.07	0.01	0.07	0.56
	Subtotal	**4.27**	**2.38**	**6.20**	**0.36**	**0.87**	**14.09**
Capital Stock Loses							
	Structural	19.12	4.04	4.24	1.33	2.85	31.57
	Non-Structural	67.34	15.33	10.36	4.24	7.55	104.81
	Content	16.77	3.00	4.66	2.73	3.14	30.30
	Inventory	0.00	0.00	0.18	0.47	0.07	0.71
	Subtotal	**103.22**	**22.37**	**19.44**	**8.76**	**13.60**	**167.39**
	Total	**107.50**	**24.75**	**25.64**	**9.12**	**14.48**	**181.49**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	976	0	0.00
	Bridges	6	0	7.54
	Tunnels	0	0	0.00
	Subtotal	**981.70**	**0.50**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	11	3	31.60
	Runways	61	0	0.00
	Subtotal	**71.60**	**3.40**	
	Total	**1053.30**	**3.80**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.50	0.08	17.33
	Subtotal	**0.49**	**$0.08**	
Electrical Power	Facilities	107.80	0.00	0.00
	Subtotal	**107.80**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	130.50	12.89	9.87
	Subtotal	**130.54**	**$12.89**	
	Total	**238.83**	**$12.97**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(14)	-17.20
Second Year			
	Employment Impact	0	0.00
	Income Impact	(18)	-21.49
Third Year			
	Employment Impact	0	0.00
	Income Impact	(19)	-23.24
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(19)	-23.24
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(19)	-23.24
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(19)	-23.24

Appendix A: County Listing for the Region

Sanpete, UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Sanpete	22,763	893	162	1,055
Total State		**22,763**	**893**	**162**	**1,055**
Total Region		**22,763**	**893**	**162**	**1,055**

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Sevier County 2500 Year Event***

Earthquake Scenario: ***Sevier County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes one county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,916.31 square miles and contains five census tracts. There are over six thousand households in the region and has a total population of 18,842 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated five thousand buildings in the region with a total building replacement value (excluding contents) of 976 (millions of dollars). Approximately 99.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,843 and 65 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are five thousand buildings in the region which have an aggregate total replacement value of 976 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there is one hospital in the region with a total bed capacity of 42 beds. There are 17 schools, two fire stations, three police stations and, zero emergency operation facilities. With respect to HPL facilities, there are 14 dams identified within the region. Of these, seven of the dams are classified as 'high hazard'. The inventory also includes zero hazardous material sites, zero military installations and zero nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,908.00 (millions of dollars). This inventory includes over 401 kilometers of highways, 157 bridges, zero kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	157	144.40
	Segments	69	1,627.90
	Tunnels	0	0.00
		Subtotal	**1,772.30**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	10.70
	Runways	2	60.90
		Subtotal	**71.60**
		Total	**1,843.90**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	1	65.30
	Pipelines	0	0.00
		Subtotal	**65.30**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	3	0.30
		Subtotal	**0.30**
		Total	**65.60**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Sevier County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 2,816 thousand buildings will be at least moderately damaged. This is over 47.00 % of the total number of buildings in the region. There are an estimated 223 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	7	0.61	10	0.48	18	0.90	12	1.80	5	2.29
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.03	1	0.03	1	0.05	1	0.11	0	0.13
Industrial	1	0.08	1	0.06	2	0.11	1	0.21	1	0.25
Religion	0	0.03	0	0.02	1	0.03	0	0.06	0	0.08
Residential	34	2.91	95	4.70	226	11.55	197	30.84	67	29.8
Single Family	1,120	96.35	1,913	94.71	1,707	87.36	428	66.97	151	67.4
Total	**1,162**		**2,020**		**1,953**		**639**		**223**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	2	0.02	0	0.01	1	0.03	0	0.06	0	0.06
MH*	30	2.56	88	4.36	219	11.20	195	30.47	66	29.39
Pre-cast	1	0.05	1	0.04	2	0.12	2	0.28	1	0.41
RM*	158	13.57	152	7.52	292	14.97	207	32.39	56	25.04
Steel	3	0.01	0	0.01	1	0.03	0	0.07	0	0.05
UM*	5	0.44	12	0.57	27	1.39	31	4.84	37	16.48
Wood	964	82.85	1758	87.05	1,397	71.54	196	30.63	61	27.29
Total	**1,162**		**2,020**		**1,953**		**639**		**223**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 42 hospital beds available for use. On the day of the earthquake, the model estimates that only 42 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	1
Schools	17	0	0	0
EOCs	0	0	0	0
Police Stations	3	0	0	0
Fire Stations	2	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	69	0	0	69	69
	Bridges	157	4	0	153	157
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	2	0	2	2
	Runways	2	0	0	2	2

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	With Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	3	2	0	1	3

Table 9: Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,081	0	0	0	0	0
Electric Power		4,281	2,982	2,306	2,138	1,936

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 2 ignitions that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (208 households to be displaced due to the earthquake. Of these, 49 people (out of a total population of 18,842 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	3	1	0	0
	Industrial	1	0	0	0
	Residential	25	5	0	1
	Single Family	68	16	2	4
	Total	**97**	**22**	**3**	**5**
2 PM	Commercial	58	17	3	5
	Commuting	0	0	0	0
	Educational	21	6	1	2
	Hotels	0	0	0	0
	Industrial	7	2	0	1
	Residential	5	1	0	0
	Single Family	15	3	0	1
	Total	**106**	**29**	**5**	**9**
5 PM	Commercial	49	14	2	4
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	1	0	0	0
	Industrial	4	1	0	0
	Residential	9	2	0	0
	Single Family	27	6	1	2
	Total	**91**	**24**	**4**	**7**

Economic Loss

The total building-related economic loss estimated for the earthquake is $175.83 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 175.83 (millions of dollars); 10 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 71 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.74	3.94	0.19	0.19	5.06
	Capital-Related	0.00	0.31	3.41	0.11	0.04	3.87
	Rental	3.77	1.65	2.21	0.06	0.09	7.79
	Relocation	0.35	0.04	0.10	0.00	0.02	0.52
	Subtotal	**4.12**	**2.75**	**9.66**	**0.36**	**0.33**	**17.23**
Capital Stock Loses							
	Structural	18.50	3.03	6.67	0.95	0.88	30.03
	Non-Structural	65.80	11.94	16.03	3.08	2.06	98.92
	Content	16.44	2.32	7.26	1.95	0.96	28.94
	Inventory	0.00	0.00	0.29	0.39	0.03	0.71
	Subtotal	**100.74**	**17.30**	**30.25**	**6.37**	**3.93**	**158.59**
	Total	**104.87**	**20.05**	**39.91**	**6.73**	**4.27**	**175.83**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,628	0	0.00
	Bridges	144	10	7.13
	Tunnels	0	0	0.00
	Subtotal	**1772.30**	**10.30**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	11	4	35.12
	Runways	61	0	0.00
	Subtotal	**71.60**	**3.80**	
	Total	**1843.90**	**14.00**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.30	0.05	16.80
	Subtotal	**0.29**	**$0.05**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	65.30	0.00	0.00
	Subtotal	**65.27**	**$0.00**	
	Total	**65.56**	**$0.05**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-3.35
Second Year			
	Employment Impact	0	0.00
	Income Impact	(6)	-7.28
Third Year			
	Employment Impact	0	0.00
	Income Impact	(7)	-8.96
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(7)	-8.96
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(7)	-8.96
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(7)	-8.96

Appendix A: County Listing for the Region

Sevier,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Sevier	18,842	821	154	976
Total State		**18,842**	**821**	**154**	**976**
Total Region		**18,842**	**821**	**154**	**976**

Appendix O

HAZUS-MH: Earthquake Event Report

Region Name: ***Wayne County 2500 Year Event***

Earthquake Scenario: ***Wayne County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes one county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 2,464.16 square miles and contains one census tract. There are zero thousand households in the region and has a total population of 2,509 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated one thousand buildings in the region with a total building replacement value (excluding contents) of 168 (millions of dollars). Approximately 99.00 % of the buildings (and 88.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 621 and zero (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are one thousand buildings in the region, which have an aggregate total replacement value of 168 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 70% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are zero hospitals in the region with a total bed capacity of zero beds. There are one school, zero fire stations, one police station and zero emergency operation facilities. With respect to HPL facilities, there are six dams identified within the region. Of these, zero of the dams are classified as 'high hazard'. The inventory also includes zero hazardous material sites, zero military installations and zero nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 621.00 (millions of dollars). This inventory includes over 202 kilometers of highways, 15 bridges, zero (0) kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	15	7.20
	Segments	17	542.30
	Tunnels	0	0.00
		Subtotal	**549.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	10.70
	Runways	2	60.90
		Subtotal	**71.60**
		Total	**621.10**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**0.00**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Wayne County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 347 thousand buildings will be at least moderately damaged. This is over 31.00 % of the total number of buildings in the region. There are an estimated 12 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	2	0.53	2	0.50	2	0.97	1	1.47	0	2.28
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.07	0	0.06	0	0.12	0	0.19	0	0.27
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	31	7.11	37	11.03	61	24.23	28	33.65	4	34.6
Single Family	405	92.29	300	88.41	188	74.67	54	64.68	8	62.7
Total	**438**		**339**		**251**		**84**		**12**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.02	0	0.01	0	0.04	0	0.05	0	0.09
MH*	31	7.02	37	10.94	61	24.15	28	33.57	4	34.60
Pre-cast	0	0.03	0	0.03	0	0.08	0	0.20	0	0.31
RM*	53	12.02	23	6.69	41	16.30	26	30.89	3	22.08
Steel	1	0.09	0	0.08	0	0.16	0	0.19	0	0.43
UM*	5	1.21	6	1.79	9	3.45	6	7.05	3	27.14
Wood	348	79.31	272	80.14	139	55.28	23	27.39	2	14.56
Total	**438**		**339**		**251**		**84**		**12**	

*Note:

RM Reinforced Masonry
URM Un-reinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		Least Moderate Damage > 50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	0	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	17	0	0	17	17
	Bridges	15	0	0	15	15
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	2	0	0	2	2

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	With Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9: Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	890	0	0	0	0	0
Electric Power		890	890	890	890	890

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be zero (0) ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about zero (0) people and burn about zero (0) (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of zero (0) million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require zero (0) truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates seven (7) households to be displaced due to the earthquake. Of these, one (1) people out of a total population of 2,509 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake.

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Residential	2	0	0	0
	Single Family	4	1	0	0
	Total	**7**	**1**	**0**	**0**
2 PM	Commercial	3	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	1	0	0	0
	Total	**5**	**1**	**0**	**0**
5 PM	Commercial	3	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	1	0	0	0
	Single Family	2	0	0	0
	Total	**6**	**1**	**0**	**0**

Economic Loss

The total building-related economic loss estimated for the earthquake is $16.85 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 16.85 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 79 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.35	0.43	0.00	0.03	0.81
	Capital-Related	0.00	0.15	0.32	0.00	0.01	0.48
	Rental	0.38	0.39	0.15	0.00	0.02	0.93
	Relocation	0.04	0.01	0.01	0.00	0.00	0.05
	Subtotal	**0.42**	**0.89**	**0.91**	**0.01**	**0.06**	**2.28**
Capital Stock Loses							
	Structural	1.88	0.36	0.40	0.03	0.20	2.88
	Non-Structural	6.40	1.32	0.86	0.08	0.36	9.01
	Content	1.78	0.26	0.40	0.04	0.18	2.65
	Inventory	0.00	0.00	0.01	0.01	0.01	0.03
	Subtotal	**10.06**	**1.94**	**1.67**	**0.15**	**0.74**	**14.57**
	Total	**10.48**	**2.83**	**2.58**	**0.16**	**0.80**	**16.85**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	542	0	0.00
	Bridges	7	0	2.67
	Tunnels	0	0	0.00
	Subtotal	**549.50**	**0.20**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	11	3	24.69
	Runways	61	0	0.00
	Subtotal	**71.60**	**2.60**	
	Total	**621.10**	**2.80**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**0.00**	**$0.00**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-1.70
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-5.17
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-6.66
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-6.66
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-6.66
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-6.66

Appendix A: County Listing for the Region

Wayne, UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Wayne	2,509	148	19	168
Total State		**2,509**	**148**	**19**	**168**
Total Region		**2,509**	**148**	**19**	**168**

Appendix P -- Juab County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the cities and towns of: Eureka, Levan, Mona, Nephi, and Rocky Ridge.

Earthquake

Goal 1 Reduce Risk of Damage due to Earthquake

Objective 1.1 Minimize earthquake damage to culinary water pipeline east of Levan.

Action: Seismically fit pipeline to withstand earthquake.
Time Frame: Immediate
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: Culinary water head house on opposite side of fault line from Town.

Objective 1.2 Reduce structural damage from potential earthquakes in new buildings.

Action: Enforce Uniform Building Code on new construction countywide.
Time Frame: Continual
Funding: County
Estimated Cost: TBD
Staff: County
Background: None

Action: Limit new construction to within 100' of known fault lines by ordinance.
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual
Background: None

Objective 1.3 Reduce structural damage due to potential earthquake in existing buildings.

Action: Identify and retrofit existing buildings at risk of damage from earthquake.
Time frame: Depends on funding.
Funding: TBD
Estimated Cost: Unknown
Staff: TBD
Background: None

Flood

Goal 1 Reduce Risk of Potential Flooding

Problem Identification: Although designated as a No Special Flood Hazard Area (NSFHA) by FEMA, Levan has experienced several significant flood events, most notably in 1968 when an estimated 4,000 cubic feet per second (cfs) came down Pigeon Creek. Flooding in 1983 on both Pigeon and Chicken Creeks were approximately a 50-year event.

Objective 1.1 Minimize future flood damage due to flooding east of Levan.

Action: Build dike structure up to divert flood
Time Frame: Depends on Funding
Funding: FEMA
Estimated Cost: $5,000
Staff: Public Works
Background: This area has the propensity for the ditches to overflow and would require buildup of the concrete wall.

Action: Nonstructural measures such as zoning are likely the most cost effective (see narrative for the county's mitigation above).
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $25,000
Staff: County planning staff/contractual

Action: Potential structural mitigation includes debris basins on both Pigeon and Chicken Creeks and protection of the road and the Town's water line up Chicken Creek Canyon (if not already protected).
Time Frame: Depends on Funding
Funding: FEMA
Estimated Cost: The total cost structural measures would likely be between $2.4 million and $3 million.
Staff: Contractual
Background: Debris basins would alleviate flood damage to roads and water mains.

Problem Identification: Although there is a fairly large watershed east of town, the flood threat to Mona is fairly minimal since it is limited by the capacity of the culverts and underpass on Interstate 15. Currant Creek flows on the west side of town into Mona reservoir but these flooding sources also pose little threat so long as new development is not allowed to build adjacent to them, west of the railroad line.

Objective 1.2 Minimize future flood damage in Mona.

Action: Nonstructural measures such as zoning appears to be the most prudent approach (see narrative for the county's mitigation above) to minimize potential impacts from the eastside drainage, Currant Creek, and Mona Reservoir since the threat is relatively minor. No development should be allowed in the area west of the railroad tracks, which could be flooded by Currant Creek and/or Mona Reservoir.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $25,000.
Staff: TBD

Action: A structural action could consist of levees along the eastside drainage and constructing a dyke on the west side of town to prevent flooding from Currant Creek and Mona Reservoir.

Time Frame: Based on funding.
Funding: FEMA
Estimated Cost: about $400k
Staff: Contractual

Background: None

Objective 1.3 Minimize future flood damage due to flooding in Eureka

Action: Install curb, gutter and storm drain system in Eureka.

Time frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: None

Problem Identification: Utah's newest town, Rocky Ridge was incorporated only a few years ago. It is located just west of I-15, just south of the Utah/Juab County line. The community sits at the base of a hill amidst several small ravines. However, the contributing watershed above the community is relatively small so the potential for catastrophic flooding is minimal. There exists the potential for a FEMA No Special Flood Hazard Area (NSFHA) designation. It appears that the east/west streets may have been intentionally located at the ends of these ravines to handle some storm water runoff. For the majority of rainfall events, this will be adequate. A few homes near the mouths of the ravines may be at more substantial risk.

Objective 1.4: Minimize future flood damage in Rocky Ridge.

Action: New homes/structures should be sited so as to be away from the streets and low points. Efforts to evaluate these homes and flood proof as needed would be advisable.

Time Frame: Based on funding.
Funding: CIB/CDBG/FEMA
Estimated Cost: $20,000
Staff: County planning staff/Contractual

Background: On-site flood analysis to determine magnitude of hazard, i.e., mapping.

Problem Identification: Less than 10 percent of the county's population lives in unincorporated areas of Juab County. Many live in the area surrounding Nephi. Development should be avoided adjacent to Salt, Currant, Tanner and Cherry Creeks (and their tributaries) where the threat of flooding is present. Principle lakes/reservoirs include Yuba, Mona, and Chicken Creek; of these only Mona reservoir is listed as high hazard.

Objective 1.5: Minimize future flood damage in Unincorporated Juab County.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $25,000.
Staff: TBD

Action: New development near canals should also be discouraged. There have been several potentially deadly flood events in the state due to flooding caused by canal failures.

Time Frame: Depends on funding.

Funding: TBD
Estimated Cost: $25,000.
Staff: TBD
Background: None

Landslides

Goal 1 Reduce Risk of Damage due to Potential Landslides

Objective 1.1 Reduce structural damage due to landslides in new construction.

Action: Update zoning ordinances county-wide construction in identified landslide zones by ordinance

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County

Background: Utah County to the north has experienced alluvial landslides nearby.

Objective 1.2 Reduce structural damage due to landslides in existing buildings.

Action: Monitor landslide zones for movement threatening subdivisions to better warn inhabitants of danger.

Time frame: Depends on funding.
Funding: FEMA
Estimated Cost: TBD
Staff: Contractual

Background: None

Wildfire

Goal 1 Reduce Risk of Potential Fire

Objective 1.1 Reduce risk of damage by fire in Rocky Ridge.

Action: Construct Fire Break north and west of Rocky Ridge.
Time Frame: Depends on funding.
Funding: USFS/State Forestry, Fire, and State Lands
Estimated Cost: $100,000
Staff: Volunteers/Homeowners/State Forestry Staff

Action: Establish defensible space around at risk buildings in Rocky Ridge.
Time Frame: Depends on Funding
Funding: USFS/State Forestry, Fire, and State Lands
Estimated Cost: $30,000 per unit.
Staff: Volunteers/Homeowners/State Forestry Staff

Background: Rocky Ridge experienced a major grass fire recently that jeopardized the whole community.

Problem Soils

Goal 1 Reduce Risk of Damage due to Problem Soils

Objective 1.1 Reduce risk to new construction from problem soils

Action: Development in problem soil zones should be limited by ordinance.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual

Background: Zoning appears to be the best way to mitigate the problem soils hazard.

Dam Failure

Goal 1 Reduce Risk of Dam Failure

Objective 1.1 Minimize damage to new and existing buildings due to Dam Failure

Action: Regularly monitor dams and strengthen them when necessary.

Time Frame: Depends on Funding

Funding: TBD

Estimated Cost: Monitoring is minimal to moderate; strengthening dams could be high.

Staff: TBD

Background: Juab County has two high hazard dams, Mona and Sevier Bridge. Their failure would threaten only sparsely populated areas of the county.

Appendix Q -- Millard County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Robinson Ranch, Eskdale, Garrison, Gandy, Sugarville, Woodrow, Abraham, Lynndyl, Leamington, Oak City, Sutherland, Delta, Hinckley, Deseret, Oasis, Clear Lake, Greenwood, Black Rock, Holden, Scipio, Flowell, Fillmore, Meadow, Hatton, and Kanosh.

Dam Failure

County-wide

Problem Identification: Millard County has 14 dams with various amounts of impoundment. Most are earthen berm construction. Some would impact residential structures if failure occurred; all would have economic impact if lost.

Goal 1 – Priority HIGH

Objective 1.1 Reduce risk of catastrophic failure of dams

Action: Emergency Management active participation with Utah Department of Natural Resources on dam inspections

Time Frame: Ongoing
Funding: TBD
Estimated Cost: Minimal
Staff: Millard County Emergency Management & dam owners
Background: DNR annually inspects all dams within Millard County and suggests or mandates safety actions when necessary. With participation and follow up visits from local emergency management to ensure suggested and/or mandated actions are taken, dam owners may recognize local impact beyond loss of irrigation water.

Objective 1.2 Identify areas of impact

Action: Initiate review of dam inundation mapping to identify impact areas

Time frame: 3 years
Funding: TBD, possible FEMA grants
Estimated Cost: TBD
Staff: Emergency Management, Building Inspection, Planning/Zoning
Background: Current inundation maps need to be reviewed to make sure they reflect the risk.

Earthquake

County-wide

Problem Identification: Millard County has numerous identified earthquake faults, including populated areas.

Goal 1 - Priority MEDIUM

Objective 1.1 Reduce threat to population and structures from earthquake damage.

Action 1: Control new construction in known fault areas by ordinance and zoning
Time Frame: Ongoing
Funding: Existing planning/zoning budget funds, grants as identified and awarded
Estimated Cost: Minimal
Staff: Existing planning/zoning, Building Inspection, and Emergency Management departments
Background: Much of the identification of existing faults are identified and mapped in State of Utah and/or Federal Geologic surveys. Development of protective/restrictive ordinances to control building in those identified areas could be a natural extension of the above listed Millard County departments.

Action 2: Ban new construction within 100 feet of known fault lines by ordinance
Time Frame: Dependent on funding
Funding: Unknown
Estimated Cost: Unknown
Staff: County Building Officials, Planning and Zone, Attorney
Background: Land use ordinances have proven to be effect mitigation strategies

Action 3: Educate citizenry through existing Community Emergency Response Teams.
Time Frame: Ongoing
Funding: Millard County, DES/FEMA
Estimated Cost: $3,000
Staff: Millard County Emergency Management CERT Trainers
Background: Although an initial response to catastrophic damages/casualties may be limited by ongoing funding constraints, the citizenry can and is being educated to begin the process of taking care of themselves and neighbors until responders can be mobilized.

Objective 1.2 Minimize damage due to earthquake activity in existing buildings on faults

Action: Retrofit existing buildings on fault lines

Time frame: Dependant on funding available
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: Funding, costs, and staff requirements would be an unknown until these structures are identified as public, private, etc and the priorities determined.

Flooding

County-wide

Problem Identification: Many of Millard County residents, and much developed properties lie within the historic floodplain of the Sevier River and other streams in the county. This is mostly due to the need for water when the area was settled, and the agricultural background of the County.

Goal 1 – Priority HIGH

Objective 1.1 Identify and reduce flood risk in County

Action 1: Initiate flood plain mapping to identify threat areas based on historic and potential flood values that are currently mapped as Zone D. (Undetermined flood risk)

Time Frame: 1-3 years
Funding: FEMA-DES grants
Estimated Cost: TBD
Staff: Existing Planning/Zoning, Emergency Management
Background: Much information on historic and potential flooding on the Sevier River could be obtained from existing sources. Existing structures and exposures can be identified. Although it may not be possible to change the exposure on these existing properties due to private ownership, future development on the identified areas could be controlled through ordinance.

Action 2: Encourage 100 foot setbacks in areas of undetermined flood risk

Time Frame: 1-3 years
Funding: Unknown
Estimated Cost: Unknown
Staff: County Building Officials, County Planning and Zoning
Background: Defined setbacks will protect structures from flooding.

Objective 1.2 Encourage 100% participation in the National Flood Insurance Program (NFIP).

Action: Assist Town of Meadow in joining NFIP

Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Engineer, State Floodplain Manager
Background: Town of Meadow has been mapped with Special Flood Hazard Areas, but does not participate in the NFIP. The community does not participate in the NFIP therefore flood insurance is not available.

Objective 1.3 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Objective 1.4 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.5 Ensure EOC(s) are equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.
Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: An alternate EOC is being considered in Kamas. Adequate communication capabilities is essential between all response agencies within the County.

Objective 1.6 Official recognize Lynndyl as a FEMA NSFHA

Action: With FEMA approval, draft and adopt a NSFHA Flood Loss Prevention Ordinance

Time Frame: Dependent on FEMA review and approval
Funding: None required
Estimated Cost: None
Staff: County, Town, and State Floodplain Manager

Severe Weather

County-wide

Problem Identification: Millard County is subject to severe weather such as; summer thunderstorms, hail, winter storms causing temporary closure of the Interstate Highway System, windstorms causing property damage and closing of highways. These types of storms, although of relatively short duration, usually initiate the impact with little or no warning to the citizens and traveling public. In addition to the obvious possibility of property damage and injury to persons, these storms impact communities in the County with sheltering needs for displaced travelers.

Goal 1 – Priority HIGH

Objective 1.1 Increase planning, warning and sheltering capabilities for highways and communities in Millard County

Action: Continue ongoing planning efforts through existing Local Emergency Planning Committee with representatives from communities, Red Cross, Utah Department of Transportation, etc.

Time Frame: Ongoing, this committee currently meets on odd numbered months
Funding: Existing funding streams from impacted public agencies, grants as identified
Estimated Cost: Minimal
Staff: Existing staff
Background: Much of the response necessary for response to these types of incidents exists, although in a fractured state between the individual agencies/parties. Ongoing planning, communication and coordination through a group effort using the existing LEPC will streamline the processes and materials necessary to have an efficient, safe and coordinated response to these types of occurrences.

Objective 1.2 Protect County from adverse affects of severe weather

Action 1: County participate in the StormReady program.

Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action 2: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time Frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning

Objective 1.3 - Reduce risk of damage to windstorms in Hinckley, Lynndyl and Oak City

Action: Plant trees west of the Towns to serve as a windbreak
Time Frame: Depends on funding source
Funding: Unknown
Estimated Cost: Unknown, depends on scope of project
Staff: Unknown
Background: This will serve as a natural wind buffer

Infestation

County-wide

Problem Identification: Infestation by Mormon Crickets and grasshoppers damaging agriculture and private property.

Goal 1 – Priority HIGH

Objective 1.1 Minimize property damage due to infestation.

Action: Reduce numbers of Mormon Crickets/grasshoppers through the use of oison bait on adjacent State/Federal lands.
Time Frame: Ongoing
Funding: Millard County, State, and Federal
Estimated Cost: $10,000

Staff: Existing State/Federal, Private landowners
Background: Millard County agricultural producers and landowners suffer from a cyclical infestation of Mormon Crickets. Some success has been noted by involving agencies controlling adjacent lands in baiting the insects, at the proper time in their life cycle, through a coalition of government and private applications of the bait.

Drought

County-wide

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority HIGH

Objective 1.1 Conserve culinary water by educating the public

Action 1: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State and Federal
Estimated Cost: Minimal
Staff: Water Districts
Background: Use a newsletter to educate the public

Action 2: Coordinate with current water systems and develop a secondary water systems plan for drought
Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

Wildfire

County-wide

Problem Identification: Millard County has a Moderate wildfire risk in the County. Areas of concern include: Delta, Leamington, Holden and Scipio. Range fires are also of concern.

Goal 1 – Priority - HIGH

Objective 1.1 - Reduce threat and impact of wildland fire at the local level

Action: Create community fire safe councils and implement the "Community Fire Planning" process.

Time Frame: On going
Funding: Obtain grant monies and alternative sources of funding through various grants and foundation.
Estimated Cost: $5,000.00 per plan
Staff: Unknown
Background: The "Community Fire Planning" process was implemented through the Utah Division of Forestry, Fire, and StateLands in support of on-going efforts under the National Fire Plan to educate and empower landowners to take action to reduce the threat of wildfires within a community.

Objective 1.2 - Develop fuel modification program

Action: Implement fuel modification program and projects

Time Frame: On going
Funding: Grants and private landowners
Estimated Cost: Variable based on acreage and type of materials being removed.
Staff: State, County, Cities, Towns and residents
Background: Through the creation of defensible space in and around communities, the threat of catastrophic wildfires will be greatly reduced.

Objective 1.3 – To educate and inform the community of fire prevention

Action: Develop and implement community outreach fire prevention program

Time Frame: Immediate and on going
Funding: Unknown
Estimated Cost: $5,000.00 per year
Staff: County Planning and Zoning, Building Department, Fire Warden
Background: Education is the key to informing homeowners about the risk of wildfires. Through a comprehensive education, program homeowners can take action independent to protect values at risk and understand the effects of wildfires.

Landslides

County-wide

Problem Identification: Landslides most often occur during spring months with higher than normal amounts of precipitation in the area of the Pahvant Valley in eastern Millard County

Objective 1.2- Obtain better and more detailed in areas of landslides

Action: Required Geological and Geotechnical reports for any proposed developments in the designated landslide areas with the possibility of independent reviews of the reports.

Time Frame: With development engineering plans for the area
Funding: Developer
Estimated Cost:
Staff: Licensed Geology and Geotechnical Firms
Background: This should be required through an Ordinance.

Objective 1.3- Ensure development in areas of landslide concern are protect utilizing scientific data.

Action: Require developers to install developments according to recommends for the Geological and Geotechnical reports provided and approved.

Time Frame: As landslide areas develop
Funding: Developer
Estimated Cost:
Staff: Developer and Contractor

Problem Soils - Regional

Appendix R -- Piute County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the towns of: Circleville, Junction, Kingston, and Marysvale.

Earthquake

Goal 1 Reduce Risk of Damage due to Earthquake

Objective 1.1 Reduce structural damage from potential earthquakes in new buildings.

Action: Enforce Uniform Building Code on new construction countywide.
Time Frame: Continual
Funding: County
Estimated Cost: TBD
Staff: County
Background: None

Action: Control new construction in known fault areas by ordinance and zoning.
Time Frame: Continual
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual
Background: None

Objective 1.3 Reduce structural damage due to potential earthquake in existing buildings.

Action: Identify and retrofit existing buildings at risk of damage from earthquake.
Time frame: Depends on funding.
Funding: TBD
Estimated Cost: Unknown
Staff: TBD
Background: None

Flood

Goal 1 Reduce Risk of Potential Flooding

Municipalities: Three of the 4 incorporated communities in Piute County - Circleville, Junction, and Kingston have a relatively minor risk of flooding from the Sevier River and its tributaries. Marysvale, however, has an extensive history of flooding.

Problem Identification: Marysvale has an extensive history of flooding from Bullion (Pine) Creek and a high future flood threat - even greater than that shown on the FEMA map (see attached). The 100-year flow has been estimated at almost 900 cfs. There are also smaller threats from Beaver Creek on the north side of town and California Gulch through the center of town.

Objective 1.1: Minimize future flood damage in Marysvale.

Action: Construct a detention basin on Bullion Creek if a suitable site can be identified.

Time Frame: TBD
Funding: FEMA
Estimated Cost: $300k
Staff: Contractual

Action: Construct flood control channel to divert flood from Revenue Gulch over to Bullion Creek.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: Marysvale has seen several floods, which these projects would effectively mitigate.

Objective 1.2 Minimize future flood damage due to flooding in Circleville.

Action: Construct flood control dykes between Circleville and Sevier River

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: Dredge Sevier River near Circleville.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: None.

Objective 1.3 Minimize future flood damage due to flooding in Kingston.

Action: Construct flood control pond in Kingston Canyon.
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None.

Problem Identification: Only about 16 percent of the county's population lives in unincorporated areas of the county. Development should be avoided adjacent to Sevier River and Otter Creek (and their tributaries) where the threat of flooding is greatest. The FEMA Piute County FIRMs identify most areas as Zones C or X (little to no flood threat) with the areas adjacent to the rivers and creeks identified as Zone A – 100 year flood risk. The State Division of Water Resources, Dam Safety Section indicates there are four high hazard dams within Piute County. Although Piute County is small in both area and population size standards the majority of population lives below and within about thirty miles of the Otter Creek or Piute Dams both of which are considered high hazard.

Objective 1.4: Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population, which will oppose any zoning or other changes in the regulations and ordinances.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: $25,000
Staff: Contractual

Landslides

Goal 1 Reduce Risk of Damage due to Potential Landslides

Objective 1.1 Reduce structural damage due to landslides in new construction.

Action: Control new construction in identified landslide zones by ordinance

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County

Background: None.

Objective 1.2 Reduce casualties due to landslides by having better warning system.

Action: Monitor landslide areas for movement.

Time frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: None

Wildfire

Goal 1 Reduce Risk of Potential Fire

Objective 1.1 Reduce risk of damage by fire in Bullion Canyon (Marysvale).

Action: Establish defensible space around at risk buildings in Bullion Canyon.

Time Frame: Depends on funding.
Funding: National Fire Plan
Estimated Cost: TBD
Staff: TBD

Background: The Bullion Canyon community is currently organizing a fire planning committee in order to write a community fire plan facilitated by Six County AOG Planning Staff.

Problem Soils

Goal 1 Reduce Risk of Damage due to Problem Soils

Objective 1.1 Reduce risk to new construction from problem soils

Action: As better data becomes available, control new construction in problem soil zones by ordinance.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County

Background: None

Dam Failure

Goal 1 Reduce Risk of Dam Failure

Objective 1.1 Minimize damage to new and existing buildings due to Dam Failure

Action: Regularly monitor dams and strengthen them when necessary.

Time Frame: Depends on Funding

Funding: TBD

Estimated Cost: Monitoring is minimal to moderate; strengthening dams could be high.

Staff: TBD

Background: The Utah Department of Natural Resources annually inspects all dams within Piute County and suggests or mandates safety actions when necessary.

Appendix S -- Sanpete County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Manti, Ephraim, Moroni, Fountain Green, Wales, Mayfield, Mt Pleasant, Spring City, Gunnison, Centerfield, Sterling, Fayette, Fairview

Wildfire Urban Interface

County-Wide

Problem Identification: Wild land fires are becoming a greater threat to the community as Sanpete County continues its growth and expansion into wild land areas. Wild land fires are one of the biggest threats to the loss of life, property and natural resources located in Sanpete County. The probability is high and impact of a wild land fire in many parts of our county would be catastrophic therefore the rating for this occurrence will be high on the Risk Assessment Summary.

Goal 1 – Priority - HIGH

Objective 1.1

Action: Public Education and Awareness

Time Frame: 5 Years
Funding: Healthy Forest Initiative, National Fire Plan, Sanpete County
Estimated Cost: $25,000 over five years
Staff: County Fire Warden and Emergency Manager, State Fire, and Forest Service
Background: The county Fire Warden and County Emergency Manager are engaged in this education process now but can not addrees it to the level it requires.

Objective 1.2

Action: Wild Land Fire Zoning Ordinances

Time frame: 5 Years
Funding: Sanpete County
Estimated Cost: 5,000
Staff: County Zoning Committee, County Commissioners, County Fire Warden, and County Emergency Manager
Background: We currently have a dry subdivision ordinance is in effect.

Objective 1.3

Action: Mitigation of existing hazards like defendable space, road width and escape routes.

Time Frame: 15 years
Funding: Health Forest Initiative and National Fire Plan
Estimated Cost: $10,000,000 over 15 years
Staff: Forest Service, State and County Fire Warden, Home Owner Associations, State and County Emergency Management.
Background: The county has begun but have a long way to go and will also require the a level of maintenance.

Earthquake

County-Wide

Goal 1 – Priority - MEDIUM

Problem Identification: One of Sanpete County's natural hazard threats with the potential for catastrophic consequences is a large earthquake. Earthquakes on the Gunnison Fault of a 6.5 rating or greater occur on average of once every 500 + years. Earthquakes on the Wasatch Fault that extends into Nephi appear to have a grater potential for being larger. It is estimated that 7 + rated quakes occur in this area every 1500 to 3000 years. Sanpete County is at risk from both faults. The last large earthquake took place on the Nephi segment approximately 400 years ago. We estimate that the probability of the event greater than 6.5 would be low and the consequences to building loss to be high especially due to the large amount of mobile homes and non-reinforced block buildings in the area. Analysis done by the State of Utah shows a low probability for high losses of life. However, this data is based on computer models and could be inaccurate for a specific event. Due to the large areas affected by earth quakes and the amount of devastation that can occur earthquakes will be given a moderate risk rating on the Risk Assessment Matrix.

Objective 1.1

Action: Education of General Public
Time Frame: Ongoing
Funding: Division of Emergency Services, Local School Districts, Emergency Management.
Estimated Cost: $2,000 per year
Staff: teachers, emergency manager and state earthquake staff
Background: We use the program provided us by the state in which we have our school teachers teach the class to 5th graders in the county.

Objective 1.2

Action: Developing CERT teams in the county.
Time Frame: 5 years
Funding: State DES, County Emergency Management, and Local School Districts
Estimated Cost: $3,000 per year
Staff: DES Earthquake Representatives, Instuctors, Members of the community and County Emergency Manager
Background: We have trained a few Citizen Emergency Response Teams.

Objective 1.3

Action: Retrofit high risk public buildings and churches
Time Frame: Unknown
Funding: Unknown
Estimated Cost: To be determined
Staff: Building inspectors, Emergency Manager, County Zoning and Commission
Background: None

Slope Failure and Flooding

County-Wide

Goal 1 – Priority - HIGH

Problem Identification: In terms of loss of life, the greatest flood risk in Utah is associated with flash floods, which cascade down steep mountain canyons with little or no warning. However, in terms of property damage and loss, the greatest flood threat occurs when mountain canyons discharge water, mud and debris resulting from heavy rain and/or rapid snow pack melting.

The most dramatic example of flooding occurred in the Springs of 1983 and 1984. Several streams coming from the mountain canyons, discharged water, mud and debris as a result of heavy Spring rains and rapid melting of the snow pack. Landslides, mudslides and high runoff resulted in over 750 million in property loss and three deaths in the state during that period.

During this period of flooding, the Great Salt Lake reached a historic high of 4210 feet above sea level. Historically the lake reached a high of 4211.5 feet above sea level in 1873 and an historic low of 4191.35 in 1963.

Following those floods, several mitigation projects have been undertaken to minimize damage from similar scenarios. Catch basins, flood dams, and diversions have been constructed at the mouths of some of the canyons to catch future debris flows or flash floods. The spill way at the Gunnison Reservoir has also been significantly improved. Flash flooding from thunderstorms does occur from time to time, but that threat is highly localized. In Utah, over 360 flash floods and more than 170 snow melt floods have occurred since 1853. Since 1950, floods and flash floods have killed 25 people, making such floods the second greatest weather-related killer in the state (after lightning). In Utah, flash floods typically occur when slow moving thunderstorms produce torrential rainfall. These floods can roll boulders, uproot trees, wash away roads and automobiles, destroy buildings and bridges and scour out new channels. Rapidly rising water can reach heights of 30 feet or more. Furthermore, flash flood-producing rains can also trigger catastrophic mudslides. Often there is no warning that these sudden, deadly floods are coming. Floods and mud streams will continue to plague our area and have as recently as 1999 with the floods in Spring City, Utah and the land slide in the Narrows up 12 Mile Canyon above Mayfield. There are approximately 600 landslide areas identified in Utah.

These occurrences topically create a significant hazard for those individuals that are in the immediate area and past history has shown that the threat to property loss is greater than the treat to human life. The assessment is that the probability for the floods and mudslides is high but the consequences are usually restricted limited areas and has a relatively low risk for loss of life. The risk has been assessed as Moderate for these events.

Goal 2 – Priority HIGH

Problem Identification: More detailed information is needed to assess risk and to develop land use mitigation measures.

Objective 1.1

Action: Educate the County Commissioners
Time Frame: 5 Years
Funding: Emergency Management, State and Federal Gov.
Estimated Cost: $10,000 over 5 years
Staff: Emergency Management Director
Background: Little has been done.

Objective 1.2

Action: Conduct a professional analysis of areas of highest risk.
Time Frame: 5 Years
Funding: Undetermined
Estimated Cost: $100,000
Staff: Independent Contractor and Emergency Manager
Background: This has been done in several specific areas but

should be done for the whole county.

Objective 1.3

Action: Restrict development in land slide, debris flow and flood areas or provide for diversion structures when viable.
Timeframe: 5 Years
Funding: Undetermined
Estimated Cost Undetermined
Staff: County Commissioners, County Zoning, City Councils and Zoning Emergency Manager and Building Inspectors Office.
Background: Some areas have been analyzed and structures have been built.

Goal 2 – Priority HIGH

Problem Identification: Reduce flood losses due to flooding

Objective 1.1 Encourage 100% participation in the National Flood Insurance Program (NFIP).

Action: Assist Town of Fountain Green, Town of Wales, Town of Centerfield, Town of Sterling, Town of Fayette and the Town of Mayfield in joining NFIP
Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Floodplain Administrator, State Floodplain Manager
Background: FEMA has yet to map the Town of Fountain Green, Town of Wales, Town of Centerfield, Town of Sterling, and the Town of Fayette Town of Fountain Green with Special Flood Hazards (SFHA). These communities do not participate in the NFIP therefore flood insurance is not available. The Town of Mayfield has mapped Special Flood Hazard Areas (SFHAs), but does not participate in the NFIP.

Objective 1.2 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Floodplain Administrator, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Objective 1.3 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management

Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.4 Reduce flooding threat in Fairview, Mt. Pleasant, Gunnison, Mayfield, Ephraim, Sterling, Fayette, Wales, Fountain Green, Spring City, Moroni, and Manti.

Action: Clear debris and other material from streams prior to spring snow melt.
Time Frame: Ongoing
Funding: None
Estimated Cost: Unknown
Staff: County Public Works
Background: Most flooding is attributed to debris-laden streams.

Objective 1.5 Ensure EOC(s) are equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.
Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: Alternate EOCs need to be considered during flood events.. Adequate communication capabilities is essential between all response agencies within the County.

Objective 1.6 Support updating of flood hazard data

Action: Support and encourage participation in the NFIP Flood Map Mod Program.
Time Frame: Ongoing
Funding: Federal
Estimated Cost: Unknown
Staff: County Floodplain Administrator County Engineer, State Floodplain Manager

Background: Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.

Severe Weather

County-Wide

Goal 1 – Priority - HIGH

Problem Identification: Snowstorms, summer thunderstorms, hail, and high winds over central Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participate in the StormReady program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action 2: Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Sanpete County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOCs to ensure they are grounded lightning, to include b uildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown

Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOCs, Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.

Drought

County-Wide

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority LOW

Objective 1.1 Conserve culinary water by educating the public

Action 1: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State and Federal
Estimated Cost: Minimal
Staff: Water Districts
Background: Use a newsletter to educate the public

Action 2: Coordinate with current water systems and develop a secondary water systems plan for drought
Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

Appendix T -- Sevier County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the cities and towns of: Annabella, Aurora, Elsinore, Glenwood, Joseph, Koosharem, Monroe, Redmond, Richfield, Salina, and Sigurd.

Earthquake

Goal 1 Reduce Risk of Damage due to Earthquake

Objective 1.1 Minimize damage and casualties due to earthquake throughout county including the Koosharem Band of the Paiute Tribe of Utah.

Action: Public education and regular earthquake drills
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: County/Tribal Emergency Mgmt.
Background: Elsinore was the site of a 6.0 Richter Magnitude earthquake in 1921. Picture 1 on p.3 of *Annex 6* shows some of the earthquake's damage.

Objective 1.2 Reduce structural damage from potential earthquakes in new buildings.

Action: Enforce Uniform Building Code on new construction throughout county.
Time Frame: Continual
Funding: County
Estimated Cost: TBD
Staff: County

Action: Update zoning ordinances to avoid new construction within 100 feet of known fault lines.
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual
Background: None

Objective 1.3 Reduce structural damage due to potential earthquake in high risk buildings throughout county.

Action: Identify and retrofit high-risk public buildings and churches at risk of damage from earthquake.
Time frame: Depends on funding.
Funding: Unknown
Estimated Cost: $100,000,000
Staff: Emergency Mgr., State, and Contractual.
Background: None

Flood

Goal 1 Reduce Risk of Potential Flooding

Problem Identification: Sevier County is one of the few counties in the state where every municipality participates in the NFIP. Only about 18 percent of this county's population lives in unincorporated areas of the county. Development should be avoided adjacent to the Sevier and other major rivers and creeks (and their tributaries) where the threat of flooding is greatest. The FEMA FIRMs identify most areas as Zones C and X (little to no flood threat) with the areas adjacent to the rivers and creeks identified as Zone A – 100 year flood risk. Lakes/Reservoirs include: Fish Lake, Johnson Valley, Koosharem, Rocky Ford, and Forsyth.

Objective 1.1 Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances

Timeframe: Depends on Funding
Funding: TBD
Estimated Cost: Minimal – almost nothing.
Staff: County/Contractual
Background: None

Problem Identification: Koosharem Creek has a rather large drainage area of several square miles at Koosharem. According to the USGS quadrangle map, there is a weir/aqueduct diversion about 2 miles upstream of town.

Objective 1.2 Minimize future flood damage from Koosharem Creek through Koosharem.

Action: Improve existing dike along Koosharem Creek
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: about $300,000
Staff: Contractual
Background: Raise and extend the existing dike along the east side of town for a distance of approximately 6,000 ft. (Provisions will need to be made for low

flows to enter the Koosharem Canal and riprap at the south end of the levee where diverted flood flows will pass.)

Problem Identification: Monroe Creek with a drainage area of 39 square miles at Monroe. Monroe Creek has the potential of causing flood damage below Bohman Road, because of decreased channel capacity and constrictions. Constrictions include the culvert at Jones Road, and bridges at Jones Road, 8th South and 4th south.

Objective 1.3 Minimize future flood damage along Monroe Creek through Monroe City.

Action: Modify bridges along Monroe Creek
Timeframe: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: Contractual
Background: Enlarge or add to bridges especially Jones Road Bridge to increase the channel capacity to at least match the capacity of the Bohman Road bridge.

Action: Maintain and improve existing levee along Monroe Creek
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: Minimal
Staff: Unknown
Background: Flatten the side slopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Action: Inform residents of the availability of flood insurance
Timeframe: Immediate
Funding: TBD
Estimated Cost: Minimal
Staff: County/Contractual
Background: None

Problem Identification: Salina Creek has the potential of causing flood damage with in the City of Salina. Approximately 35 structures could be affected by a 100-year flood event. The majority of these structures are singe-family residences and a few small businesses. The Mayor of Salina indicated very little new development had occurred on the west side of town primarily due to the flood threat. The existing levee and channel appear to provide some flood protection. However some minor damage would take place for an event with a frequency of 50-years.

Objective 1.4 Minimize future flood damage along Salina Creek through Salina City.

Action: Maintain and improve existing levee along Salina Creek
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: Minimal
Staff: Unknown
Background: Flatten the side slopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Action: Maintenance of channels and bridge openings
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: Minimal
Staff: Unknown
Background: Keep all bridge openings and upstream channels free of debris to prevent constriction during high flows.

Objective 1.5 Minimize future flood damage due to flooding in Aurora

Action: Strengthen canal, which mitigates flooding since it catches spring runoff.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: North of Aurora-build UDOT bridge above state canal.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.6 Minimize future flood damage due to flooding in Koosharem

Action: Perform a Flood Engineering Study for Koosharem
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None.

Objective: 1.7 Minimize future flood damage due to flooding in Glenwood

Action: Rebuild flood retention ponds in Glenwood
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: Update flood map-resurvey
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.8 Minimize future flood damage due to flooding in Joseph

Action: Construct concrete barriers and built up beams in Joseph
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.9 Minimize future flood damage due to flooding on culverts near Salina

Action: Upgrade existing culverts to mitigate flood.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.10 Minimize future flood damage due to flooding in Redmond

Action: Install storm drain system in Redmond
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.11 Minimize future flood damage due to flooding in Richfield

Action: Maintain flood retention walls for Richfield
Time Frame: Depends on Funding

Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: Upgrade storm drain system
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Objective 1.12 Minimize future flood damage due to flooding down Bertelson Canyon.

Action: Construct small debris basin in Bertelson Canyon to mitigate flooding in Monroe.
Time Frame: Depends on Funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Landslides

Goal 1 Reduce Risk of Damage due to Potential Landslides

Objective 1.1 Reduce structural damage to new construction due to landslides.

Action: Update zoning ordinances to avoid new construction in identified landslide zones.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual

Background: None

Objective 1.2 Reduce structural damage and casualties due to landslides in existing buildings.

Action: Monitor landslides for movement in order to warn inhabitants of impending danger.

Time frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: None

Wildfire

Goal 1 Reduce Risk of Potential Fire

Objective 1.1 Reduce risk of damage by fire.

Action: Establish defensible space around at risk buildings and educate communities about "Living with Fire" program.

Time Frame: Depends on Funding
Funding: National Fire Plan
Estimated Cost: Minimal
Staff: TBD

Background: Six County AOG Planning Staff are currently facilitating the organization of community fire councils for Monroe Mountain (east of Monroe), Burrville (north of Koosharem), and Daniels Canyon/Sevenmile area (northeast of Koosharem) in order to write fire plans.

Problem Soils

Goal 1 Reduce Risk of Damage due to Problem Soils

Objective 1.1 Reduce risk to new construction from problem soils

Action: Update county/municipal zoning ordinances to avoid new construction in problem soil zones.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000 per jurisdiction
Staff: County/Municipal/Contractual

Background: None

Dam Failure

Goal 1 Reduce Risk of Dam Failure

Objective 1.1 Minimize damage to new and existing buildings due to Dam Failure

Action: Regularly monitor dams and strengthen them when necessary.

Time Frame: Depends on Funding

Funding: TBD

Estimated Cost: Monitoring is minimal to moderate; strengthening dams could be high.

Staff: TBD

Background: The Utah Department of Natural Resources annually inspects all dams within Sevier County and suggests or mandates safety actions when necessary.

Appendix U -- Wayne County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the towns of: Bicknell, Hanksville, Loa, Lyman, and Torrey.

Earthquake

Goal 1 Reduce Risk of Damage due to Earthquake

Objective 1.1 Reduce structural damage from potential earthquakes in new buildings.

Action: Enforce Uniform Building Code on new construction throughout county.
Time Frame: Continual
Funding: County
Estimated Cost: TBD
Staff: County

Action: Update zoning ordinances to avoid new construction within 100 feet of known fault lines.
Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual
Background: None

Objective 1.2 Reduce structural damage due to potential earthquake in existing buildings.

Action: Identify and retrofit high-risk public buildings and churches at risk of damage from earthquake.
Time frame: Depends on funding.
Funding: Unknown
Estimated Cost: $20,000,000
Staff: Emergency Mgr., State, and Contractual.
Background: None

Flood

Goal 1 Reduce Risk of Potential Flooding

Problem Identification: Almost 40 percent of this county's population lives in unincorporated areas of the county. Development adjacent to the Dirty Devil and Fremont Rivers (and their tributaries) should be prevented. Areas adjacent to Green River are protected from development for the most part by Canyonlands National Park. There are no FEMA FIRMs for the unincorporated areas of the County although there are areas of risk. There are three high hazard dams, which would impact Wayne County, if failure were to occur. Two of these dams, Johnson Dam and Forsythe Dam, are physically located in Sevier County adjacent to the Wayne County line and upstream on the Fremont River from the third dam Mill Meadow, which is located in Wayne County. The possibility exists for failure of one dam resulting in failure of downstream dams. Wayne County is very large in area and very small in populations, however the majority of the population does live below and within about thirty miles of the above-mentioned dams and within a few miles of the Fremont River and its flood plain.

Objective 1.1 Minimize future flood damage in the unincorporated county.

Action: Nonstructural measures appear to be the most prudent option for the County to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county regulations and ordinances to include these recommendations is minimal and the benefits substantial. It should be anticipated that there would be a small percentage of the population that will oppose any zoning or other changes in the regulations and ordinances

Timeframe: Depends on Funding
Funding: TBD
Estimated Cost: Minimal – almost nothing.
Staff: County/Contractual

Problem Identification: There is a major flood threat in Hanksville from Bull Creek – especially on the east side of town. The town has made some channel improvements but the culvert and crossing at Highway 24 is offset from the flow line of the channel by 6 ft or more (according to the city engineer). UDOT is looking into this problem.

Objective 1.2 Minimize future flood damage due to flooding in Hanksville.

Action: Install larger pipe on Bull Creek in Hanksville.

Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: Upgrade flood dyke that drains into Bull Creek.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Action: Improve drainage system to prevent flooding in town.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: Flooding occurs on both Bull Creek and in the town itself after a heavy monsoonal rain.

Action: Culvert improvements are needed at Highway 24 and additional channel work. Another alternative would be about 1 mile of levee.
Timeframe: Depends on Funding
Funding: TBD
Estimated Cost: On the order of $0.5 to $1 million.
Staff: UDOT/Contractual
Background: None

Problem Identification: There is a moderate flood threat from the unnamed drainages to the east of Lyman Town.

Objective 1.3 Minimize future flood damage in Lyman.

Action: Construct new reservoir to prevent flooding in Lyman
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Alternative Action: There is a High Line Ditch located between the town and the east side drainages. It appears that the ditch when needed could convey some floodwaters. A structural project could consist of improving this ditch to increase its capacity.
Timeframe: Depends on Funding
Funding: TBD
Estimated Cost: Approximately $300,000.
Staff: Contractual

Alternative Action: An alternative structural project could consist of constructing about a mile long deflector levee.
Timeframe: Depends on Funding
Funding: TBD

Estimated Cost: Approximately $300,000.
Staff: Contractual
Background: None

Objective 1.4 Minimize future flood damage due to flooding on Sand Creek near Torrey.

Action: Span culinary water lines over Sand Creek to avoid flood damage to lines.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: Previous floods have washed out culinary water lines.

Objective 1.5 Minimize future flood damage due to flooding north of Bicknell

Action: Construct culverts to prevent washing out north of Bicknell.
Time Frame: Depends on Funding
Funding: TBD
Estimated Cost: TBD
Staff: TBD
Background: None

Need for Additional Research

Additional research should be conducted to better map communities currently mapped as a FEMA Zone D, or currently unmapped communities, and communities with out dated Flood Insurance Rate Maps. Communities would benefit from knowing peak flows and stages on tributaries of concern.

Landslides

Goal 1 Reduce Risk of Damage due to Potential Landslides

Objective 1.1 Reduce structural damage to new construction due to landslides.

Action: Update zoning ordinances to avoid new construction in identified landslide zones.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000
Staff: County/Contractual

Background: None

Objective 1.2 Reduce structural damage due to landslides in existing buildings.

Action: Remove existing buildings from landslide zones; Resettle population in safer zone.

Time frame: Depends on funding.
Funding: TBD
Estimated Cost: TBD
Staff: TBD

Background: None

Wildfire

Goal 1 Reduce Risk of Potential Fire

Objective 1.1 Reduce risk of damage by fire.

Action: Establish defensible space around at risk buildings and educate communities about "Living with Fire" program.

Time Frame: Depends on Funding
Funding: National Fire Plan
Estimated Cost: Minimal
Staff: TBD

Background: Six County AOG Planning Staff are currently facilitating the organization of community fire councils for the Torrey, Teasdale, Grover area and Mytoge Mountain (northwest of Loa) in order to write fire plans.

Problem Soils

Goal 1 Reduce Risk of Damage due to Problem Soils

Objective 1.1 Reduce risk to new construction from problem soils

Action: Update county/municipal zoning ordinances to avoid new construction in problem soil zones.

Time Frame: Depends on funding.
Funding: TBD
Estimated Cost: $20,000 per jurisdiction
Staff: County/Municipal/Contractual

Background: None

Dam Failure

Goal 1 Reduce Risk of Dam Failure

Objective 1.1 Minimize damage to new and existing buildings due to Dam Failure

Action: Regularly monitor dams and strengthen them when necessary.

Time Frame: Depends on Funding

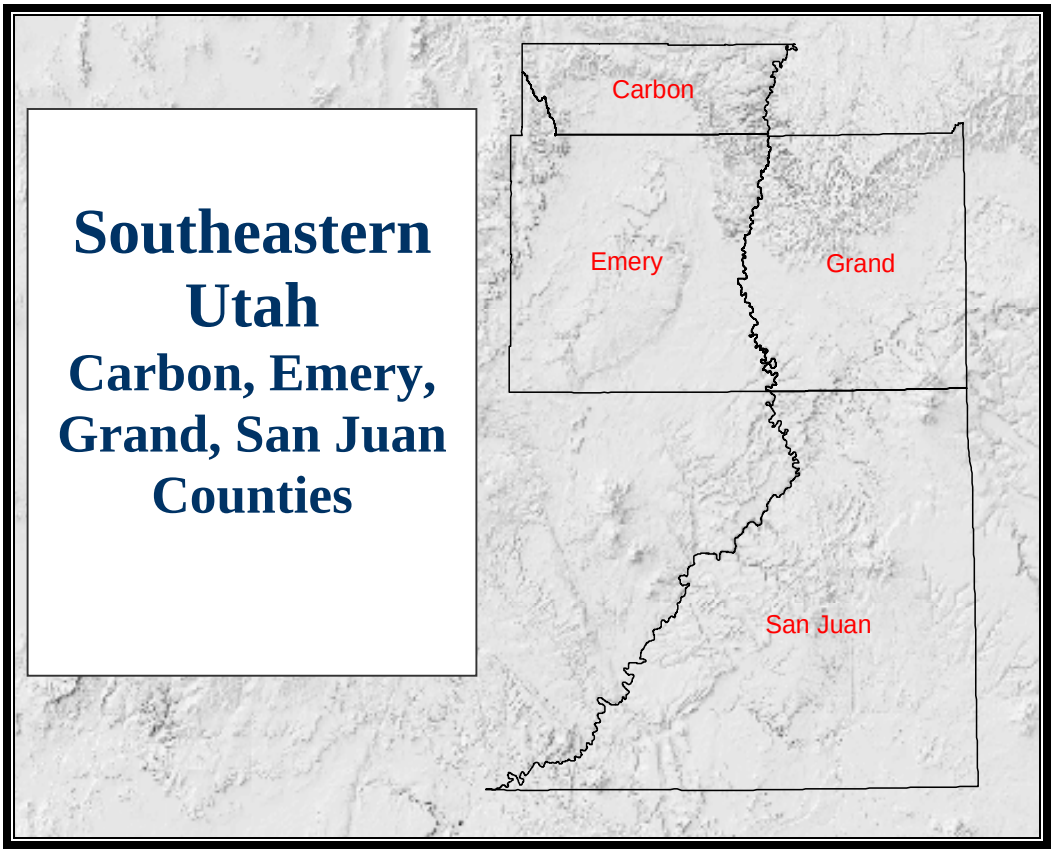
Funding: TBD

Estimated Cost: Monitoring is minimal to moderate; strengthening dams could be high.

Staff: TBD

Background: The Utah Department of Natural Resources annually inspects all dams within Wayne County and suggests or mandates safety actions when necessary.

Natural Hazard Pre-Disaster Mitigation Plan



Southeastern Utah

Carbon, Emery, Grand, San Juan Counties

Southeastern Utah Association of Local Governments in association with the Wasatch Front Regional Council

Natural Hazard Pre-Disaster Mitigation Plan

Prepared by LaNiece Dustman with assistance from Jim Boes and Bill Howell, Jeff Adams in the offices of the Wasatch Front Regional Council. Guidance provided by Ryan Pietramali from the Utah Division of Emergency Services and Homeland Security.

December 2003

Executive Summary

Plan Mission
The mission of the Southeastern Utah Association of Local Governments (SEUALG) Pre-Disaster Mitigation Plan (PDM) is to substantially and permanently reduce the region's vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer more sustainable community.

Plan Organization
The SEUALG plan was developed and organized within the rules and regulations established under CFR Title 44, Part 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within SEUALG, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This plan is intended to improve the communities within the SEUALG planning district ability to handle disasters, and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing
The SEUALG PDM Plan has been financed and developed under the PDM Program provided by the Federal Emergency Management Agency (FEMA) and the Utah Department of Public Safety Division of Emergency Services and Homeland Security (DESHS). The SEUALG aided in funding by providing in-kind assistance to local governments.

Plan Participation
The SEUALG PDM Plan has been completed as a result of a collaborative effort between The Wasatch Front Regional Council, Southeastern Utah Association of Local Governments, the Utah Department of Public Safety Division of Emergency Services and Homeland Security, City and County Emergency Managers, Fire Departments, Sheriff Departments, Public Works Departments, Planning Commissions, Assessor's Offices, City and County GIS Departments, Elected Officials, Public Employees, and Citizens of the cities and towns within Carbon, Emery, Grand, and San Juan Counties. Interviews were conducted with stakeholders from the communities, and a workshop was conducted during the plan development. Additionally, through public hearings, workshops, and draft plan displays ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan.

Hazards Identified
It was suggested by the DESHS that, at minimum, SEUALG address the hazards of: earthquake, flood, landslide, problem soils, wildfire, dam failure, severe weather, and drought. However, there are other hazards that were identified which are not in the minimum criteria established by DESHS that were added to the discussion.

The hazard identification study recognized the following hazards as being the most prevalent and posing the most potential risk to the counties and towns within the SEUALG four county planning districts.

- Dam Failure
- Drought
- Earthquake
- Flood
- Infestation
- Landslide
- Problem Soil

- Severe Weather
- Wildfire

Plan Goals
In an effort to ensure that the mission of the SEUALG PDM Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan.

The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

Acknowledgements

The Southeastern Utah Association of Local Governments in conjunction with the Wasatch Front Regional Council would like to thank the employees of each jurisdiction in the SEUALG region. We would also like to extend our appreciation to the following agencies, which assisted in the development of this plan.

- Utah Division of Emergency Services and Homeland Security
- Federal Emergency Management Agency
- National Weather Service
- National Climate Data Center
- Utah Army Corps of Engineers
- Utah Geologic Survey
- Utah Division of Forestry Fire, and State Lands
- Division of Water Rights Dam Safety Section
- Utah Division of Water Resources
- Utah Department of Agriculture
- Utah Avalanche Center
- Utah Automated Geographic Resource Center
- University of Utah
- University of Utah Seismic Station
- Utah State University
- Councils of Governments
- Association of Governments
- Carbon County and municipalities including East Carbon City, City of Helper, Price City, Scofield Town, Sunnyside City, and Wellington City
- Carbon County elected officials and planners
- Carbon County GIS staff member Benjamin Clement
- Carbon County residents and other interested members
- Carbon County agencies including; public works, GIS office, assessors office, LEPC, emergency services division, fire and sheriff's office
- Emery County and municipalities including Castle Dale City, Clawson Town, Cleveland Town, Elmo Town, Emery Town, Ferron City, Green River City, Huntington City, and Orangeville City
- Emery County emergency manager Martin Wilson
- Emery County elected officials
- Emery County agencies including; GIS department, public works, and assessors office
- Emery County residents and other interested members of the public
- Grand County and municipalities including Castle Valley and Moab City
- Grand County emergency manager Mary Hofine
- Grand County elected officials
- Grand County agencies including engineering, planning, assessors office, GIS department
- Grand County public and other interested members
- San Juan County and municipalities Monticello and Blanding
- San Juan County emergency manager Rick Bailey
- San Juan County elected officials
- San Juan County agencies including GIS, engineers, planners, assessors
- San Juan County public and interested members
- In addition, we offer sincere thanks to the Town of Merrimack, Clackamas County, Dunkerton, Iowa, Dunn County North Dakota, Jefferson County West Virginia, Moab City, and Salt Lake City.

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Part 1. Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be substantially reduced when attention is turned to mitigating their impacts and effects before they occur or re-occur.

Hazard mitigation is defined as any cost-effective action that has the effect of reducing, limiting, or preventing vulnerability of people, property, and/or the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation actions, which can be used to eliminate or minimize the risk to life and property, fall into three categories: first, those that keeps the hazard away from people, property, and structures: second, those that keeps people, property, and structures away from the hazard: and third, those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation actions must be practical, cost effective, environmentally, and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

Capital investment decisions must be considered in conjunction with natural hazard vulnerability. Capital investments can include; homes, roads, public utilities, pipelines, power plants, chemical plants, warehouses, and public works. These decisions can influence the degree of hazard vulnerability of a community. Once a capital facility is in place very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which ensure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

In the past, mitigation has been the most neglected aspect within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures are neglected in favor of high-profile events. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to greatly reducing long-term risk to people and property living in Utah from natural hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

A. Purpose

The purposes of this plan are as follows: to fulfill federal, state, and local hazard mitigation planning obligations; to engage in long-term mitigation planning, and to direct mitigation actions which would serve to minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan enhances the awareness of city and county officials, agencies, and the public to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability of each Utah jurisdiction.

B. Scope

The SEUALG PDM plan was developed in accordance with the requirements of the FEMA Section 322 regulations, DESHS, local planning agencies, the Southeastern Utah Association of Local Governments, and the Wasatch Front Regional Council.

The goal of this plan is to assist the area consisting of the Carbon, Emery, Grand, and San Juan counties in reducing their costs of natural disasters through mitigation practices. This plan provides comprehensive hazard identification, risk assessment, vulnerability analysis, mitigation actions, and an implementation schedule for the region.

Regulations set forth by FEMA in were followed during development of this plan. Future monitoring, evaluating, updating and implementation will take place as new incidents occur or every five years.

C. Authority

Federal: Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 (DMA 2000) into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation, if they submit a mitigation plan (which is a summary of local and/or regional mitigation plans) that identifies natural hazards, risks, vulnerabilities, and which describes proposed actions to mitigate the hazards risks and vulnerabilities in that plan.

State: The Governor's Emergency Operation Directive, The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title 44, CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code 53-2, 63-5, Disaster Response Recovery Act, 63-5A, Executive Order of the Governor, Executive Order 11, Emergency Interim Succession Act, 63-5B.

Local: Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In the counties and cities making up the SEUALG, the local executive responsible for carrying out plans and policies are the county Commissioners and city or town Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

Association of Governments: The Association of Governments have been duly constituted under the authority of Title XI, Chapter 13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act); and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

D. Goals and Objectives

The goals and objectives of the PDM plan included coordination with local governments to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document, DESHS planning expectation, and local input. And meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

Local Goals: These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains

Long Term Goals:

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks
- Avoid risk of exposure to identified hazards
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized
- Provide a basis for funding of projects outlined as hazard mitigation strategies
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources

Objectives: The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation
- Projecting a time frame for implementation
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available
- Identifying alternative measures, should financing not be available
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options

- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal
- Property, damage to critical facilities, economic loss, and hardship or human suffering
- Meet applicable permit requirements
- Not encourage development in hazardous areas
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation
- Have manageable maintenance and modification costs
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement
- Whenever possible, use existing resources, agencies and programs to implement the project

Part 2. Adoption Process and Documentation

The SEUALG PDM plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 of the local hazard planning regulations the final plan was to be adopted by each of the municipalities as well as the four counties. This section documents the adoption process of each local government in order to demonstrate compliance with this requirement. The plan was adopted prior to being submitted to FEMA region VIII for final review. Table 2-1 identifies the communities that participated in the planning process and have adopted the plan. The following is a sample of the Adoption Resolutions.

Table 2-1 Participating Communities

Counties	Participated (Yes/ No)	Date
Carbon County		
East Carbon City		
City of Helper		
Price City		
Scofield Town		
Sunnyside City		
Wellington City		
Emery County		
Castle Dale City		
Clawson Town		
Cleveland Town		
Elmo Town		
Emery Town		
Ferron City		
Green River City		
Huntington City		
Orangeville City		
Grand County		
Castle Valley		
Moab City		
San Juan County		
Monticello City		
Blanding City		

RESOLUTION NO._____

A RESOLUTION ADOPTING THE SOUTHEASTERN UTAH ASSOCIATION OF LOCAL GOVERNMENTS (SEUALG) NATURAL HAZARD PRE-DISASTER MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

WHEREAS, President William J. Clinton signed H.R. 707, the Disaster Mitigation and Cost Reduction Act of 2000, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Southeastern Utah Association of Local Governments has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the SEUALG area, and

WHEREAS, the WFRC Executive Council approved WFRC staff to write the plan on February 21, 2002, and

WHEREAS, XXX City is within the SEUALG Area, and

WHEREAS, the XXX City Council is concerned about mitigating potential losses from natural hazards/ disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential losses and potential mitigation measures to limit losses, and

WHEREAS, the XXX City Council has determined that it would be in the best interest of the community as a whole to adopt the Natural Hazard Pre-Disaster Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY THE XXX CITY COUNCIL THAT:

The attached "Southeastern Utah Association of Local Governments Natural Hazard Pre-Disaster Mitigation Plan" be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This resolution shall be effective on the date it is adopted.

DATED this _____ day of _____, 2003.

_____
Mayor
XXX City

ATTEST:

_____
Recorder

Part 3. Planning Process

This plan was prepared in the offices of the Wasatch Front Regional Council (WFRC) by appointed staff members Lane Nielson, LaNiece Dustman, and Jim Boes, and was supported by the local planning team members Bill Howell, and Jeff Adams of SEUALG. Input from the following agencies was critical in completing this plan: city and county emergency managers, fire departments, sheriff departments, public works departments, planning commissions, assessor's offices, city and county GIS departments, elected officials, public employees, and citizens of the cities and towns within Carbon, Emery, Grand, and San Juan Counties. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and supporting guidance documents developed by FEMA and the Utah DESHS.

The planning process included the following steps:

1. Resource Organization
2. Public Officials Outreach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. Hazard Risk Identification and Analysis
6. County Vulnerability Assessment
7. Community Goals Assessment
8. Formation of County Mitigation Steering Committee
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

Step 1: Resource Organization

The seven regional Associations of Government (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah DESHS contracted with the seven AOG's as sub-grantees to coordinate, develop, and write the seven regional hazard mitigation plans under planning guidelines included in the DMA 2000.

SEUALG contracted with WFRC to conduct the planning for its four county region based on WFRC's technical capabilities. For coordination, WFRC has assigned a staff member to act as a SEUALG liaison. The two associations have worked closely together to ensure local coordination and input.

WFRC and SEUALG designated a core planning team. The core planning team, see Table 3-1, was the main agent of the planning process from the initiation of the plan to the development and coordination to the resolution of the plan's adoption. In conjunction with the core planning team a technical team committee was created (Table 3-2). Local committees were established to provide a central point of contract with each county see Table 3-3. These local communities were instrumental in providing detailed knowledge of there county, political make, capabilities, and above all both hazard and area specific mitigation.

Table 3-1 Core Planning Team

Name	Organization/Title
Lane Nielson	Wasatch Front Regional Council, Community Development and Planner
LaNiece Dustman	Wasatch Front Regional Council, Hazard Mitigation Planner
Bill Howell	Southeastern Utah Association of Local Governments, Executive Director
Jeff Adams	Southeastern Utah Association of Local Governments, Community Planner Director
Jim Boes	Wasatch Front Regional Council, Planner
Ryan Pietramali	State Natural Hazard Mitigation Planner

Table 3-2 Technical Team Committee

Name	Organization
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council
Jeff Adams	Southeastern Utah Association of Local Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Table 3-3 Local Planning Team

Carbon County	**Organization**
Clyde Larsen	Chairman
Gary Sontag	Price City
Nick Tatton	Price City
Guy Norton	Price City Fire Department
Ray Labauhn	Carbon Power Plant
Dan Reevley	Price City Council
Ben Clement	Carbon County GIS
Emery County	
Martin Wilson	LEPC Chair/County Sheriff
Terrie C. Wright	Emery Preparedness Planner/Coordinator
Diane Chandler	EMT/Green River City
Kyle Ekker	Deputy Emery Co. Sheriff's Dept.
J.J. Grant	Emery Co. School District
Judy Lang	Emery Co. Sheriff's Dept.
Dennis Dooley	Co. Dir./LEPC Chair
John Rokich	Dept. of Emergency Safety
Carey Bloomer	Clawson City Mayor
W. Brent Langston	Emery Co. Attorney's Office
Dave Warner	Road Department
Brent Williams	Public Works

Dale Pierson	Water/Sewer Supervisor
Grand County	
Jim Nyland	Grand County Sheriff
Mike NaVarre	Moab City Police Dept.
Corky Brewster	Moab Valley Fire Chief
Judy Bane	Grand County Administrator
Dave Sakrison	Mayor of Moab City
Donna Messler	City Administrator
Jim Lewis	County Council
Dave Warner	Road Department
Brent Williams	Public Works
Dale Pierson	Water/Sewer Supervisor
San Juan County	
Rick Bailey	County Administrator
Tammy Gallegos	County IT Specialist
Bret Hosler	Blanding planner
Greg Martin	Monticello Planner/Assistant City administrator
Patrick McDermott	Bluff Town Council

Step 2: Public Officials Outreach
To ensure the planning process had backing from the elected officials, a representative from SEUALG met with each County Commission and each city mayor to inform them of the need for the plan and how it can better help the communities. With local support in place, the intent of the plan was introduced to commissioners and other elected officials along with public entities through an informational brochure that was created by the WFRC.

Step 3: Establish Continuity in the Planning Process
To meet the requirements set forth by DMA 2000, the seven AOG's were contracted by the DESHS to assist all counties within Utah in completing the seven multi-regional PDM plans. The seven AOG's formed a Technical Team Planning Committee to share ideas and ensure the plans were similar and that there was little duplication of effort. Planners from the SEUALG were involved with this committee (Table 2).

Step 4: Data Acquisition
Contact was made with the GIS technician or planning commission in each city and county to assess what data was available on a local level. Agreements were put in place to allow the exchange of data between the local jurisdictions, SEUALG, and WFRC. Data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs, and land development data. This step also included a survey sent to each jurisdiction to ascertain what hazards each jurisdiction felt they were vulnerable to, what natural disaster had occurred, and what mitigation plans and ordinances are in place.

Step 5: Hazard Risk Identification and Analysis
These steps were conducted by gathering data on the hazards that occurred within the planning region. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations with the public and local officials, surveys, interviews, and meetings with key informants within the planning area. Mitigation planning meetings were held during this process and are explained in further detail in Table 3-4. During these meetings attendees had the opportunity to review the general information on previous hazards and comment on them in a more specific manner. These meetings also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation, natural resources, and water resources of the planning region. These initial contacts with local entities also provided visual understanding of the planning region for planners of the core planning team.

Step 6: County Vulnerability Assessment
This step was conducted through a review of local base maps, topographical maps, floodplain maps, USGS and UGS maps, AGRC maps, FEMA hazard maps, and county hazard maps. A detailed vulnerability assessment was completed with the use of GIS software for each county within the SEUALG planning region. HAZUS MH was used to determine vulnerability to earthquakes, floods, landslides, and wildfire. Loss estimation methodology was developed by the core planning team, with assistance from the technical team, to determine vulnerability from each identified hazard. When available county parcel data was used to estimate the number of residents that could be affected by the hazard. If county parcel data was unavailable then Census 2000 block data was used. During these meetings attendees had the opportunity to review the specific information generated by GIS products and to review areas of vulnerability in association with specific hazards.

Step 7: Community Goals Assessment
This step was conducted through a review of the governing documents of the planning region, as well as, conversations, interviews, and meetings with interested community members. This step identified what goals are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

Step 8: Formation of County Mitigation Steering Committee
Carbon County (in conjunction with Price City), Emery County, Grand County and San Juan County all set up mitigation planning steering committees. These committees were formed of individuals with an interest in mitigation and public employees with technical expertise pertinent to mitigation. These committees included elected officials, city planners, city engineers, county and city GIS staff, floodplain managers, and emergency managers. Committee members were tasked with completing the Mitigation Strategies Workbook issued by the DESHS.

Step 9: Mitigation Strategy Development
Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each County that participated in the County PDM Planning Grant was asked to evaluate the vulnerability assessment completed by SEUALG and complete a Mitigation Strategies Workbook (Appendix F).

A County PDM Mitigation Strategies Workbook team was formed consisting of the local planning team members identified in Table 3. Mitigation strategies were determined on a community and countywide level. To obtain a better understanding of the risks that each jurisdiction and/or county faces, each participant reviewed maps created by WFRC and local GIS specialists that profiled hazards and vulnerability assessments.

Step 10: Prioritization of Identified Mitigation Strategies
The DMA 2000 requires state, tribal, and local governments to show how mitigation actions were evaluated and prioritized. This was completed by the AOG with assistance from each county and city. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, 386-3.

Step 11: State Review
The DESHS pulled together a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003 and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

Step 12: Adoption
The plan went through a public hearing process on (date) and was adopted by: (insert names of all counties, towns and cities).

Table 3-4 Southeastern Utah Association of Local Governments Pre-Disaster Mitigation Planning Process Timeline

Date	Activity	Purpose
March 29, 2002	Letter of Intent that identifies the seven Association of Governments as sub-grantees of the state to write the PDM plans. The AOG's were chosen by the Utah Interagency Technical Team who is part of Nature-Safe Utah (Utah's Pre-Disaster Mitigation Program).	Continue the relationship with local council members and municipalities.
May 15-16, 2002	Utah's first regional mitigation planning training piloted toward the seven AOG's	Establish a guideline and timeframe.
July 12,2002	News Release from Governor Michael Leavitt announcing the new program to develop local hazard mitigation plans statewide.	Conduct public awareness and involvement.
August, 2002	Gather information.	Data Collection.
September 10, 2002	Meeting. Met with all AOG's and DESHS to discuss the planning process.	Identify planning team and available resources.
September 30, 2002	Public Meeting. Met with Emergency Managers in the Southeastern region.	Identify level of involvement.
October 31, 2002	Meeting. Met with DESHS.	Discuss timeline and planning process.
November 2002	Gathered community data for regional data section of the plan.	Data Collection.
November 18, 2002	Public Meeting. Carbon County meeting with local and state DESHS, city and county officials including Helper City Fire Department, Wellington community member, Price City Emergency Preparation Committee, Carbon County emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 18, 2002	Public Meeting. Emery County meeting with public safety officials from Orangeville City, Building Inspector from Huntington City, Emery City, Clawson City, Cleveland City, Elmo City and Ferron City mayor's. Sheriff and Road Department from Emery County, Castle Dale city planning and zoning, Huntington City and Green River City local community members.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 22, 2002	Meeting. Met with technical team members.	Solicit public involvement, Army Corps proposal for flood study, GIS training, timeline, review the regional plans
December, 2002	Gathering data.	Data Collection
January, 2003	Gathering data.	Data Collection.
January 22, 2003	Public Meeting. AOG executive director's meeting.	Signed contracts for Army Corps flood proposal.
February 13, 2003	Public Meeting. Grand County (in Moab City). Local community member	Kick off meeting. Handed out questionnaires and brochures for local

	meeting. GIS staff, geologist, planning commission, hydrologist, state DESHS, AOG's staff members all attended the meeting.	comment and awareness.
February 13, 2003	Public Meeting. San Juan County community member meeting. Met with GIS staff, state DESHS, local AOG members, and county emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
February 27, 2003	Meeting. Met with technical team members in St. George.	Review of plans, mapping.
March, 2003	Information gathering	Data Collection, plan
April 21, 2003	Meeting. AOG executive director's meeting.	PDM extension and additional money.
April, 2003	Drafting of the plan.	For review.
May 16, 2003	Meeting. AOG executive directors meeting.	Discussion of progress; plans to DESHS by December with additional money.
May 22, 2003	Meeting. Met with technical team members at DESHS.	Progress report, deadlines, mapping, mitigation actions, internal web page.
May, 2003	Gather mapping data.	Complete hazard identification and profile.
June, 2003	Website addressing natural hazards.	Public involvement and comment.
July 17, 2003	Meeting. Met with technical team members in Orem City.	Discussed mapping and plan review.
August, 2003	Public meetings. Handed out pamphlets about PDM.	Public involvement.
September 8, 2003	Meeting with WFRC GIS representatives.	Discussion of PDM plan and mapping technical issues.
September 8, 2003	Meeting with Price City PDM group.	Discussion of current regional PDM document draft and regional maps.
September 11, 2003	Meeting with Carbon County Planning Director.	Collection of development data for PDM regional plan (building permits data).
September 11, 2003	Meeting with Carbon County GIS Specialist.	Discussion of hazard map overlay format.
September 17, 2003	Submitted a byline on Pre-Disaster Mitigation.	Price Sun Advocate newspaper for Emergency Preparedness Supplement.
September 18, 2003	Training Meeting. Utah Division of Water Resources auditorium, SLC	
September 23, 2003	Pre-Meeting Emery County PDM coordinator and Emery County GIS team.	Discussed mapping technical issues.
September 23, 2003	Meeting with Emery County LEPC.	
September 24, 2003	Meeting with Blanding City GIS specialist.	Discussed PDM data and mapping technical issues.

September 24, 2003	Meeting with Grand County Planning Director and PDM representatives from Grand county and Moab City.	Discussed hazard identification and mitigation strategies.
September 25, 2003	Technical Meeting at Mountainland AOG.	Discussed PDM plan progress and technical issues.
September 25, 2003	Meeting with WFRC contact.	Discussed PDM plan draft issues and mapping.
September 29, 2003	Meeting with SEUALG executive director.	Talked about action plans for upcoming PDM meetings.
September 29, 2003	Strategy Meeting with Price City administrator, Carbon County GIS specialist, Price City PDM contact and SEUALG Executive Director.	Talked about action plans for upcoming PDM meetings.
October 7, 2003	Meeting with San Juan County Administrator.	Discussed PDM data collection and meeting coordination, open house plans, and fund allocation issues.
October 7, 2003	Meeting with Carbon county Commissioner and Price City PDM Contact.	Discussed coordination of PDM efforts and distribution of grant funds.
October 15, 2003	Training Meeting in St George.	PDM training Conference.
October 17, 2003	Meeting with Price City PDM representative.	Discussed Price/Carbon county PDM issues.
October 21, 2003	Meeting with Emery County PDM coordinator and Sheriff, et al.	Discussed mapping issues.
October 21, 2003	Meeting with Emery County LEPC.	Presented PDM progress report. Worked on PDM issues.
October 23, 2003	Open House. Grand County.	Display PDM maps and plan draft to public for review.
October 27, 2003	Meeting with Emery County PDM coordinator and Sheriff, et al.	Discussed mapping issues in preparation for Emery County PDM open house; worked out mitigation goals and objectives.
October 27, 2003	Meeting with Price/Carbon County PDM committee.	Viewed maps and worked out mitigation goals and objectives.
October 29, 2003	Open House. Emery County	Display PDM maps and plan draft to public for review.
October 30, 2003	Meeting with Carbon County GIS director.	Discussed PDM maps.
November 3, 2003	Open House. Price City/Carbon County.	Display PDM maps and plan draft to public for review.
November 4, 2003	Meeting with Green River City recorder and Mayor.	Discussed local PDM issues.
November 4, 2003	Meeting with Grand County Planner.	Discussed PDM mapping and mitigation strategies.

November 4, 2003	Meeting with San Juan county administrator.	Prepared for the San Juan County PDM open house.
November 4, 2003	Open House. San Juan County.	Display PDM maps and plan draft to public for review.
November 11, 2003	Public Hearing. Grand County.	Receive public comment on PDM maps and plan draft.
November 19, 2003	Meeting with Green River LEPC, Emery County Sheriff and PDM representative, Green River Mayor, and Green River City staff.	Discuss local PDM issues, view maps, and plan mitigation strategies.
November 20, 2003	Public Meeting. Price City and Carbon County.	Receive public comment on PDM maps and plan draft.
December 4, 2003	Meeting with Carbon County GIS specialist, Price City PDM representative, and Carbon County planner, et al.	Discussed remaining mapping issues and PDM mitigation strategies for Carbon County.
December 8, 2003	Meeting with Emery county Sheriff and PDM representative and PDM assistant.	Worked over PDM documentation issues and to set meetings with LEPC group members.
December 8, 2003	Meeting with Emery county IT and GIS specialist.	Discussed Emery county PDM mapping issues.
December 8, 2003	Meeting with East Carbon City Mayor and city recorder.	Viewed PDM maps and worked through Mitigation strategies for East Carbon and Sunnyside cities.
December 10, 2003	Met with Sunnyside Mayor and Recorder.	Viewed PDM maps and discussed Mitigation strategies for East Carbon and Sunnyside cities.
December 12, 2003	Meeting with Emery County LEPC group members et al.	Discussed PDM mapping and mitigation strategies.

A. Public Involvement

Public involvement opportunities were available throughout the drafting of this plan. Such opportunities included a public website for comment and review, public meetings, and newspaper articles announcing the public meetings. Each plan of the seven natural hazard mitigation plans was placed on the DES website. This website allowed viewers to submit comments electronically by clicking on a submit comments button. Emergency managers, fire departments, sheriff departments, state and local agencies, community members, business leaders, educators, non-profit organizations, private organizations, and other interested people were all a part of the planning process. Intent to complete a mitigation plan was presented at each of the four county commissions, which were open to the public. The state presented the concept of PDM planning at the elected officials conference in August of 2002 and received numerous comments. Appropriate measures were taken to include those comments that would benefit the plan. The following is a copy of an article written by SEUALG community planning director Jeff Adams, taken from a local paper (Price Sun Advocate, Figure 3-1). Also attached are public notices and information related to natural hazards and mitigation planning from the local newspapers (Figure 3-2, 3-3, 3-4).

Figure 3-1 Price Sun Advocate Newspaper Clipping

8 • Emergency Preparedness • October 2003

Hazard Mitigation

Hazard Mitigation can be defined as reducing or "softening" the effects of hazards on people and property. Where emergency response is primarily concerned with reacting to events, pre-disaster mitigation works to identify and reduce the risk of potential hazards before they occur.

Hazard Mitigation comes in two basic flavors; those things designed to separate hazards from people, property, and structures, (like retaining walls and fire breaks) and those that keep people, property and structures away from hazards (such as zoning codes that don't let people build in floodplains).

Price City and Carbon County are working together to create maps showing where catastrophic events might occur. They do this by taking one "layer" of data such as the route of a flood or dam failure deluge might take, and placing it over another "layer" on the same map that shows where houses and buildings are located. When these two layers are combined, it is easy to tell which houses and stores will be in the path of the flood.

Once the hazards are mapped, city and county leaders, engineers, planners, and other experts come together to prioritize the hazards. This is done by taking two ideas, namely, the risk factor ("is this really likely to happen?") and the damage potential ("how many people could this hurt?") and creating a priority table. Those hazards that have *both* a high risk factor *and* a high damage potential have the highest priority and are addressed first.

The team then takes these high priority items and sets very broad goals. For example, if dam failure was identified as both highly likely and dangerous to many people, a goal might be as follows: "to decrease the potential of flood-related deaths and injuries."

When hazards are identified and Goals are spelled out, the plan is submitted to the state and to the Federal Emergency Management Agency (FEMA) for approval. Once approved, this plan allows state and local communities to obtain FEMA grants to be used for mitigation measures.

Figure 3-2 Article found in the October 7th 2003 Emery County Progress Internet Newspaper

County Prepares for Emergencies

By PATSY STODDARD
Editor

Is Emery County prepared for a disaster? That is exactly the question that the Local Emergency Planning Committee is trying to answer. The LEPC is made up of representatives from local agencies such as the Emery County Sheriff's Office, mayors of local communities, school board representative, neighborhood watch, health department, road department, water conservancy district and many others.

You might wonder what all of these organizations have in common. In the event of a disaster these agencies all need to coordinate and cooperate to facilitate an organized effective response to whatever situation arises.

Martin Wilson is a sergeant from the Emery County Sheriff's Office and is chairman of the LEPC committee. He recently named Jed Jensen as the co-chairman for the committee.

The committee meets monthly to coordinate efforts and address needs.

A the recent LEPC meeting, Sgt. Wilson called for a list of items on hand in each of the cities that would be available for use should an emergency situation arise. This inventory of items would include ambulances, heavy equipment- type and amount and other items.

Part of the planning procedure is the development of a list of hazards and a history of past emergencies to develop a current list and develop as part of the hazard plan. Identifying and prioritizing possible hazards such as earthquakes, flooding and others to identify those most likely to happen in Emery County and to prepare accordingly. The Association of Governments has listed hazards as a starting point for evaluation by the LEPC committee. Areas where flood plains have been identified and maps of such plains are in existence with the AOG and can be utilized in emergency planning. Planning ahead to remedy flood situations or at least being aware of where floods will occur is part of the process.

Daryl Wilcox, Elmo mayor, was also concerned about maps, which show the power lines and gas transmission lines in the event of a disaster. He said these types of maps would be helpful to have on hand and in place in emergency response vehicles. His concern also was for other areas of the country, which rely on the Emery County power plants for their power supply.

He also said that overlays of these transmission lines can be obtained from the various utility companies and can be used on geographic reference visual maps, which they already have.

A part of the disaster plan should also include who is responsible for the costs associated with a hazardous chemical spill from trucking or railroad.

Terry Wright from the health department said that she will be working on a list of nurses, EMT's, firefighters and mental health workers who might be available to help in a disaster, even if they are not currently working in the medical field, but who are trained to do so.

Sgt. Wilson reported that as always they are looking for avenues of funding to increase the EMT skills of already practicing EMT's in the county.

SEUALG Community Planning Director Jeff Adams talked about the steps toward having a workable emergency plan. One step is to have a valuation of property in any given emergency situation and to be able to prioritize risk factors and situations. For example with a wildfire the priority could be low, but a wildfire near a subdivision of mountain homes becomes top priority for action. These risk factors would be identified and gauged by probability of its occurrence in our area. A tornado for example would be listed as low risk and low priority, but a flood would be given much higher priority in the plan and appropriate action plans identified and implemented.

Each strategy for each hazard has goals. The goal in a flood situation would be to keep people from drowning. Human life is the first priority and property comes in second. Goals also include action plans for preventing flooding, such as shoring up a canal or other measures which would involve the road department and the water conservancy district. Funding to complete these goals also must be looked into.

Plans for what should be done in the event of a dam break will also be addressed in the plan and determining the flood zone for each of the dams. Mayor Wilcox also requested that plans for the surveying of the dams and data and information be kept as well as seismic analysis of the dams in the county.

There is an emergency preparedness fair in Carbon County on Oct. 9 at the St. Matthew's church beginning at 2 p.m., which should provide useful information for interested county residents.

Figure 3-3 Public Notice found in the October 28th 2003 Emery County Progress and Price Sun Advocate Newspapers

Public Notice:

PUBLIC HEARING NOTICE

The Southeastern Utah Association of Local Governments will hold a public hearing to consider potential projects for which funding may be applied under the CDBG Small Cities Program for FY2004-2005. Suggestions for potential projects will be solicited, both verbally and in writing from all interested parties. The expected amount of CDBG funds for this funding year will be discussed along with the range of projects eligible under this program and a review of previously funded projects. The hearing will begin at 10:00am on November 6, 2003 and will be held in the Board Room of the Carbon Credit Union at 675 E. 100 N. Price, UT 84501. Further information can be obtained by contacting Debbie Hatt at 435-637-5444. In compliance with the Americans with Disabilities Act, individuals needing special accommodations (including auxiliary communicative aids and services) during the hearing should notify Debbie Hatt at the SEUALG, 375 S. Carbon Ave., Price, Utah 84501, 435-637-5444 at least 5 working days prior to the hearing.
Published in the Emery County Progress October 28, 2003.

Public Notice ID: 2241910.HTM

Top of Form

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Figure 3-4 Article found in the October 29th 2003 San Juan Record Newspaper

Wednesday, October 29, 2003 - Page 3

Open House for hazards plan

San Juan County announces an Open House to be held in the San Juan County Administrative Building, located at 117 South Main Street #200 on Tuesday, November 4 at 7 p.m.

The purpose of this open house is to make the public aware of Natural Hazards that affect San Juan County residents and to propose mitigation strategies for dealing with these hazards.

A new federal law administered by the Federal Emergency Management Agency (FEMA) requires municipal governments to participate in developing a Regional Hazard Mitigation Plan in order to be eligible for future FEMA assistance.

The State of Utah has opted to develop regional hazard mitigation plans rather than asking each county and city/town to develop individual plans. But, for the regional plan to be meaningful, participation and input from the counties and cities is essential (our region includes Carbon, Emery, Grand, and San Juan counties).

The Southeastern Association of Local Governments (SEUALG), has been assigned the task of coordinating and developing the regional plan for our area.

For more information, please contact San Juan County Administrator Rick Bailey at (435) 587-3225 or SEUALG Community Planning Director Jeff Adams at (435) 637-5444.

B. Information Sources

The following information sources and plans were reviewed during the completion of this plan.

- National Weather Service (hazard profile).
- National Climate Data Center (drought, severe weather)
- Army Corps of Engineers (flood data).
- Utah Division of Emergency Services and Homeland Security (Salt Lake City Mitigation Plan, GIS data, flood data, HAZUS data for flood and earthquake).
- Utah Geologic Survey (GIS data, geologic information).
- Utah Division of Forestry Fire and State Lands (fire data).
- Utah Avalanche Center, Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service.
- Utah Automated Geographic Resource Center (GIS data).
- University of Utah (drought climate charts from internship students).
- University of Utah Seismic Station (earthquake data).
- Utah State University (climate data).
- Councils of Government
- Association of Governments
- Elected of Officials from participating communities
- Carbon County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Emery County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Grand County and municipalities (Grand County Storm Drainage Master Plan, Moab City Project Impact 2000, Moab City Hazard Mitigation Plan 2000, Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- San Juan County and municipalities (San Juan County Drought Plan, San Juan County Water Master Plan, Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Private individuals from the community

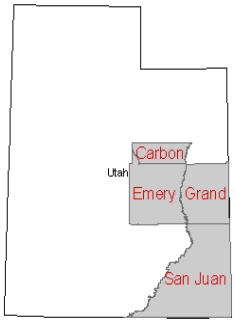
Other Plans:

- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah
- Natural Disaster Analysis, State of Utah Office of Emergency Services 1976
- State of Utah Mitigation Plan 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Salt Lake City Mitigation Plan 2002
- Planning for a Sustainable Future
- Town of Merrimack, NH Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Hazard Mitigation Plan Dunkerton, Iowa
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001
- Jefferson County West Virginia All Hazard Mitigation Plan 2003

Part 4. Regional Data

Southeastern Region

The Southeastern Utah Association of Local Governments (SEUALG) encompasses Carbon, Emery, Grand, and San Juan Counties. The Southeastern region, known as Canyon Country, is part of the Colorado Plateau Physiographic province. This region is known for its colorful high desert plateaus and extreme elevation changes from deep river gorges to high mountain peaks.



A. Geographic and Physiographic Background

Carbon County

Carbon County is in the eastern central portion of the state, surrounded by the Book Cliff range to the north, the San Rafael Swell to the south, and the Wasatch Plateau to the west. The area topography includes both mountainous regions and desert terrain. Price City sits at an elevation of approximately 5,500 feet above sea level. Mancos shale is abundant, consisting of calcite, aragonite, marine fossils, coal, jet and carbonized plant life. The Green River Formation of the Roan Cliffs contains untapped oil shale, which is "a mixture of organic and mineral sediments that were deposited in a large lake" (Barnes 125).

Price City, incorporated in 1911, is the county seat and the largest town in Carbon County with a population of approximately 9,086. Carbon County comprises 1,479 square miles of land area and is ranked 20th in the State. In terms of arable land, the county is ranked thirteenth in the state, with 291,860 acres (Carbon County).

Emery County

Emery County is comprised of unique geography consisting of high desert plateaus, buttes, valleys, as well as mountainous regions, fertile valleys, and desert. Castle Valley is the most populated area in the county and is characterized by its high desert plateaus and buttes. Castle Dale is 5,771 feet above sea level. The highest point in Emery County, East Mountain, is 10,743 feet above sea level (Emery County). The San Rafael Swell desert is a unique geographic area within Emery County. It is distinguished by its desert canyons and occupies an area 80 miles north/south and 40 miles east/west. Emery County is bordered by Grand County and the Green River on the East, Carbon County on the North, Sanpete and Sevier Counties on the west, and Wayne County to the South (Emery County Utah). The Book Cliffs are made up of Cretaceous rocks and Mancos shale, also known as the Mesa Verde group. The Roan Cliffs are Tertiary lake deposits from the Paleocene and Eocene Epochs. The Roan Cliffs have the largest deposit of tar sand in the United States in beds 10 to 300 feet thick. The Mesa Verde escarpment as well as the Mancos shale found here provides coal for nearby power plants. The Cleveland-Lloyd Dinosaur quarry houses bones of Jurassic reptiles found in the Morrison formations; they are thought to be about 147 million years old (Chronic, Halka). The county seat is located in the population center of Castle Dale City, with a Census 2000 population of 1,657.

Grand County
Grand County has a total area of 3,694 square miles; Moab city is the most populated and most traveled to city in Grand County. Elevations range from approximately 4,000 feet above sea level in Moab to over 12,000 feet above sea level in the La Sal Mountains, just 18 miles east of Moab. The geography is diverse and is distinguished by meadows, lakes, and streams within aspen forests and mountainous regions to desert canyons of the Moab Area. Oil, gas, propane, butane, natural gas, uranium, vanadium, and copper are all found in Grand County. The Lisbon Valley hosts several salt anticlines that trap oil and gas. Petroleum products, uranium, and vanadium are drawn from these formations (Lisbon Valley also in San Juan County). Copper has been mined in nearby faults along the edge of the Lisbon Valley salt anticline (Chronic, Halka).

San Juan County
San Juan County is the largest county in the State of Utah, encompassing 7,800 square miles. The physiographic features of the area include high mountains and plateaus, desert, high desert mountains, and rugged canyons. Elevations range from 3,160 feet above sea level along the Colorado River to 13,089 feet above sea level on Mt. Paele in the La Sal Mountains. San Juan County is part of the four corners region and is bordered by Arizona on the South; Colorado on the East; Wayne, Kane and Garfield Counties on the West; and Grand County on the North. Two Indian reservations are located within the county, namely the Navajo Nation and the Ute Indian Reservation on White Mesa. San Juan County vegetation consists of Douglas fir, sub alpine forb, grassland, Engelmann spruce/ sub alpine fir, aspen, ponderosa Pine, mountain brush, pinyon-juniper, sagebrush, oak brush, and riparian types including willow, cottonwood, cacti and alder. The principle topographic geologic features include the Four Corners Platform in the east; the Paradox Salt Basin and attendant fold and fault belt in the northeast; and the Monument Upwarp with linked Comb Ridge monocline and Blanding sub-basin in the central portion and in the extreme southwest. Igneous intrusions of Tertiary age core the La Sal and Abajo mountains. The La Sal and Abajo mountains are important sources of surface water during the spring runoff (San Juan County Emergency).

B. Geology

Rock types in the Canyon Country are composed mainly of sedimentary rocks including: sandstone, mudstone, siltstone, shale, limestone, gypsum, sand dunes, and conglomerates. The oldest sedimentary rocks date back to Paleozoic time and can be found at Monument Upwarp, the San Rafael Swell, and near the eastern border of Utah in smaller anticlines. Most of the sediment of which the rocks are comprised of was deposited during the Triassic, Jurassic, and Cretaceous periods. The Roan Plateau in the Uintah Basin contains Tertiary and Quaternary rocks. Tertiary rocks include members of the Wasatch Group, namely the North Horn Formation, Flagstaff Limestone, Colton Formation, and Green River Shale. The Abajo Mountains, the Henry (near Hanksville in Wayne County), and the Navajo Mountains (south of Lake Powell) are all laccolith mountains, created by molten rock that forced its way upward along crustal faults and horizontally along the layers of weaker compressed sedimentary strata. Igneous activity can be easily identified in the area by the volcanic necks, conduits, dikes and lava-capped plateaus (Refer to Table 4-1 “Geologic Time Scale” for explanation of geologic time.)

Moab and Lisbon Valley are salt anticlines. They are the result of glacial like sand including gypsum and potash being pushed up along faults. Gypsum and potash are less dense than the surrounding rocks and generally result in very unstable areas. Salt anticlines in this region trap upward migrating oil and gas. Oil, uranium, natural gas and some copper, potash, and gypsum are the main types of extracted resource in the southeastern area of the state. (Barnes 32-61, 91)

Table 4-1. Geologic Time Scale

Ages or Eras	Millions of Years Ago	Period		Epoch
CENOZOIC	0-1.8	QUATERNARY		Holocene
				Pleistocene
	1.8-65	TERTIARY		Pliocene
				Miocene
				Oligocene
				Eocene
				Paleocene
MESOZOIC	65-145	CRETACEOUS		Late
				Early
	145-213	JURASSIC		Late
				Middle
				Early
	213-248	TRIASSIC		Late
				Middle
				Early
PALEOZOIC	248-286	PERMIAN		Late
				Early
	286-360	CARBONIFEROUS	PENNSYLVANIAN	Late
			MISSISSIPIAN	Early
	360-410	DEVONIAN		Late
				Middle
				Early
	410-440	SILURIAN		Late
				Middle
				Early
	440-505	ORDOVICIAN		Late
				Middle
				Early
	505-544	CAMBRIAN		Late
				Middle
				Early
PRE-CAMBRIAN	544-4.5 billion years ago, time from the beginning of earth.			
Source: U. S. Geological Survey, Paleontology website: http://geology.er.usgs.gov/paleo/				

C. Climate

Southeastern Utah's climate is arid/semi-arid, characterized by cold and dry winters and warm summers at elevations less than 5,000 feet above sea level. Summer temperatures usually reach into the high 90s and winter temperatures generally are between 10 degrees to 20 degrees Fahrenheit. The average annual precipitation is approximately 10 inches but can range from 6 to 30 depending on elevation, while the average annual snowfall is about 15 inches. Frost-free days vary from 231 at the Hite Marina to 119 days at the La Sal Mountain Range.

D. Major Rivers

The main source of surface water generated in the planning area is from laccolithic mountains such as the La Sal and Abajo's. These mountains rise above the sandstone basin and create uplift and greater precipitation. The Colorado River and the two main tributaries, the Green River and San Juan River flow through the planning area southwesterly into Lake Powell. In the mid-1960s, the Glen Canyon Dam was completed impounding the Colorado River and creating Lake Powell. This dam was very controversial and the opposition helped shape policies toward the concept of water management and environmental protection (Colorado River Basin). Other major rivers in the region include the San Rafael, Green, Dolores River, and many smaller tributaries. Groundwater is withdrawn from two types of aquifers in this region, consolidated rock and unconsolidated deposits. Most of the water is utilized for irrigation. As the water demand increases with the growing population, water management will need to become more efficient. The main rivers as well as the ephemeral rivers are all subject to flooding in southeastern Utah.

E. Regional Hazards

Due to the geographic extent these hazards have not been mapped and risk assessments were unable to be compiled. Therefore all of the information for the following regional hazards is in the narrative below. The entire region is subject to these hazards with no unique risk affecting a single jurisdiction. Refer to each county section for a list of historical hazard events.

1. Severe Weather

Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	Occur in very localized areas throughout the region, unable to identify exactly when and where the next event will take place.		
Seasonal Pattern or Conditions	Based on climate, elevation, and precipitation.		
Duration	Severe Weather hazards generally last hours and can last days.		
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah DESHS, local input, and review of historic events and scientific records.		

Description of Location and Extent

Severe weather includes High Winds, Severe Storms (Thunderstorms, Lightning, Hailstorms, Heavy Snow or Rain, Extreme Cold), Tornado, and Avalanche.

High Winds

High winds can occur with or without the presence of another storm and are determined to be unpredictable in regards to time and place. Each of the four counties that make up Southeastern Utah has experienced high winds in the past, generally during the spring and summer months. These counties can expect regional high wind events in the future. Winds are usually strongest near the mouths of canyons and have resulted in the loss of power and the inability to heat homes and businesses. Winds in the past have damaged roofs, destroyed and knocked down large trees and fences, overturned tractor -trailers, railroad cars, and small airplanes.

Severe Storm

Severe storms can include thunderstorms, hailstorms, heavy snow or rain, and extreme cold. They are generally related to high precipitation events during the summer and winter months. Severe storms can happen anywhere in the region and the damage can be extensive especially for agriculture, farming, and transportation systems. They can also disrupt business due to power outages.

Thunderstorms

A thunderstorm is a storm made up of heavy rain or hail along with thunder and lightning resulting from strong rising air currents. Based on historical evidence thunderstorms can strike anywhere in the region mainly during the spring and summer months

Lightning

Lightning is the electric discharge accompanied by light between clouds or from a cloud to the earth. In Utah, lightning is the number one natural hazard killer. Lightning can also start wildland fires, which could be potentially fatal or disruptive.

Hailstorms
Hailstorms occur when freezing water in thunderstorm type clouds accumulates in layers around an icy core generally during the warmer months of May through September. Hail causes damage by battering crops, structures, and automobiles. When hailstorms are large (especially when combined with high winds), damage can be extensive. The risk of hailstorms is not targeted to any particular areas within the region.

Heavy Snow or Rainfall
Heavy amounts of precipitation from rain or snow can result in flash flood events. Historically, This region has been susceptible to these types of storms in the past. Major winter storms can produce five to ten times the amount of snow in the mountains than in the valley locations.

Most of the valley's development occurs on old alluvial fans from the canyon mouths. During heavy precipitation flood waters and debris will occur on these same alluvial fans, damaging residential and commercial property along with infrastructure. The associated threat with heavy snowfall is avalanches.

Extreme Cold
Sub-zero temperatures occur during most winters, however prolonged periods of extremely cold weather are infrequent. January is generally the coldest month of the year. Historically extreme cold in the region has disrupted agriculture, farming, and crops. Extreme cold also affects life, especially vulnerable are the young and elderly and animals.

Avalanche
Avalanches occur on steep slopes and therefore the mountainous areas as well as the foothills around the region are all vulnerable. Even though most avalanches occur on forested lands they affect mostly city and county dwellers. Therefore, avalanches should be given a priority in Utah due the number of historical occurrences. The money spent to respond, and recover from an avalanche in addition to the man-hours and property affected by a slide is usually on or given by the city and/ or county.

The probability of a future event is likely dependant on the amount of heavy snowfall during a given year. Most deadly avalanches occur in the backcountry away from developed areas. Avalanche control is performed regularly in developed ski areas to minimize the threat and increase awareness. The Avalanche Center was initiated as another resource for measuring risk and increasing awareness to the residents of the Southeastern region.

Tornado
Historically, atmospheric conditions have not been favorable for the development of tornadoes in Utah due to the dry climate and mountainous terrain. Utah averages about two tornados per year. Utah tornados are usually no more than 60 feet wide at the base and last up to 15 seconds. Tornadoes occur during the months of May, June, July, and August usually preceding a cold front. Utah is one of the lowest ranked nations for incidences of tornadoes with only one F2 or stronger tornado every seven years.

2. Drought

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Countywide		
Seasonal Pattern or Conditions	Summer		
Duration	Months, Years		
Analysis Used	National Weather Service, Utah Climate Center, National Geophysical Data center- Natural Hazards Database, Newspapers, Local input.		

Description of Location and Extent

Drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. The entire region is currently experiencing a drought from 1999- present. Drought dramatically affects this area because of the lack of water for agriculture and industry, which limits economic activity, irrigation and culinary uses. The severity of the drought results in depletion of agriculture lands and deterioration of soils. In the Southeastern region the risk of drought is high.

Drought is not targeted to any particular area within the region and the geographic extent of drought is hard to identify or map on a local or even county level. During the making of this plan, drought related GIS layers were unavailable to complete the mapping and analysis portions of the plan. Therefore, a vulnerability analysis including types and numbers of buildings, critical facilities, and infrastructure affected by drought were unable to be determined.

The secondary threats associated with drought include infestation and wildfire, all of which the region as historically been susceptible to. For a further explanation of infestation and wildfire refer to the Part 6 Risk Assessment, Section E Hazard Description.

The Palmer Drought Severity Index developed by Wayne Palmer in the 1960's, measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is "standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc. Figure 4-1 is a map of Utah’s climate divisions. Refer to Figure 4-2 for a complete Palmer Drought history for Southeastern Utah.

Figure 4-1 Utah Climate Divisions

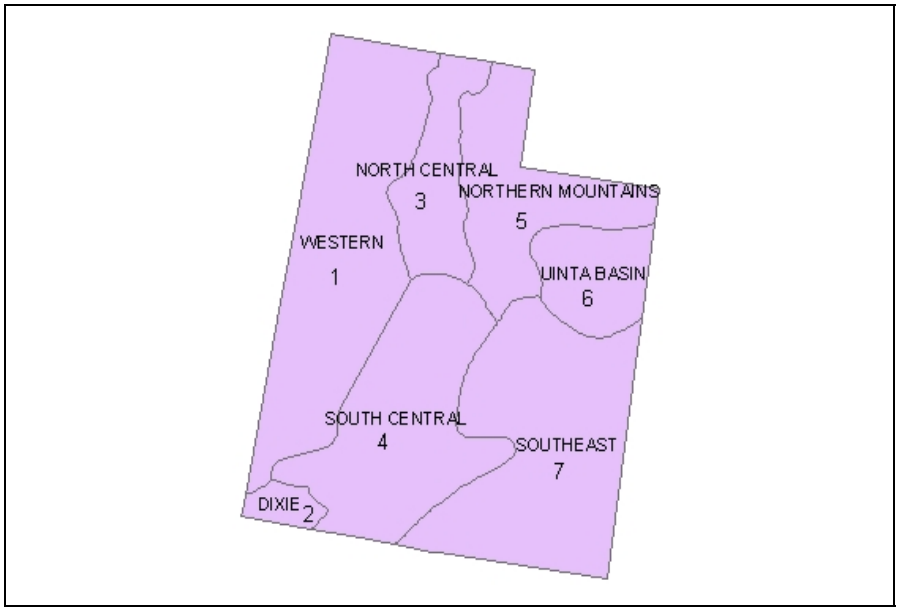
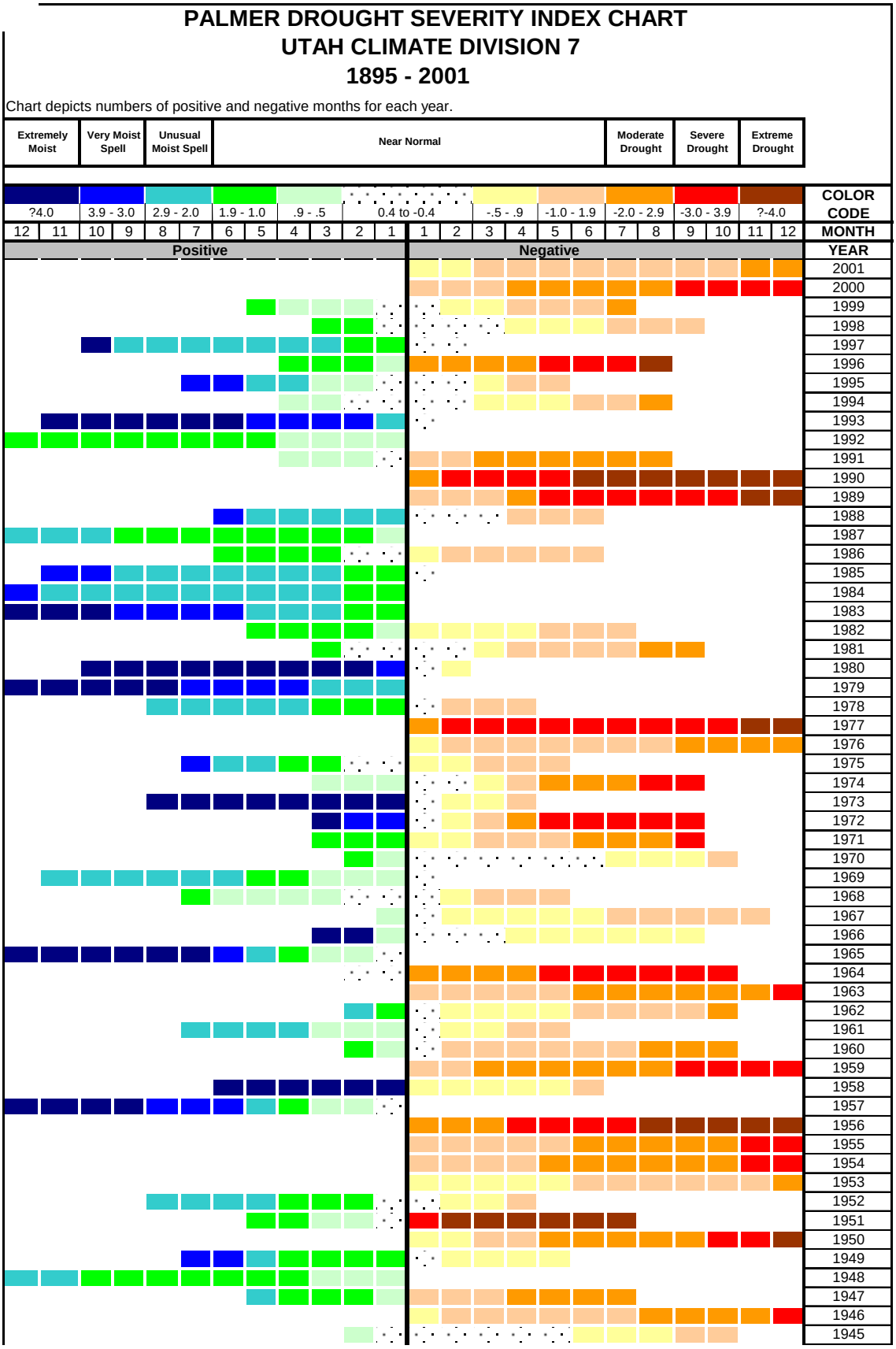
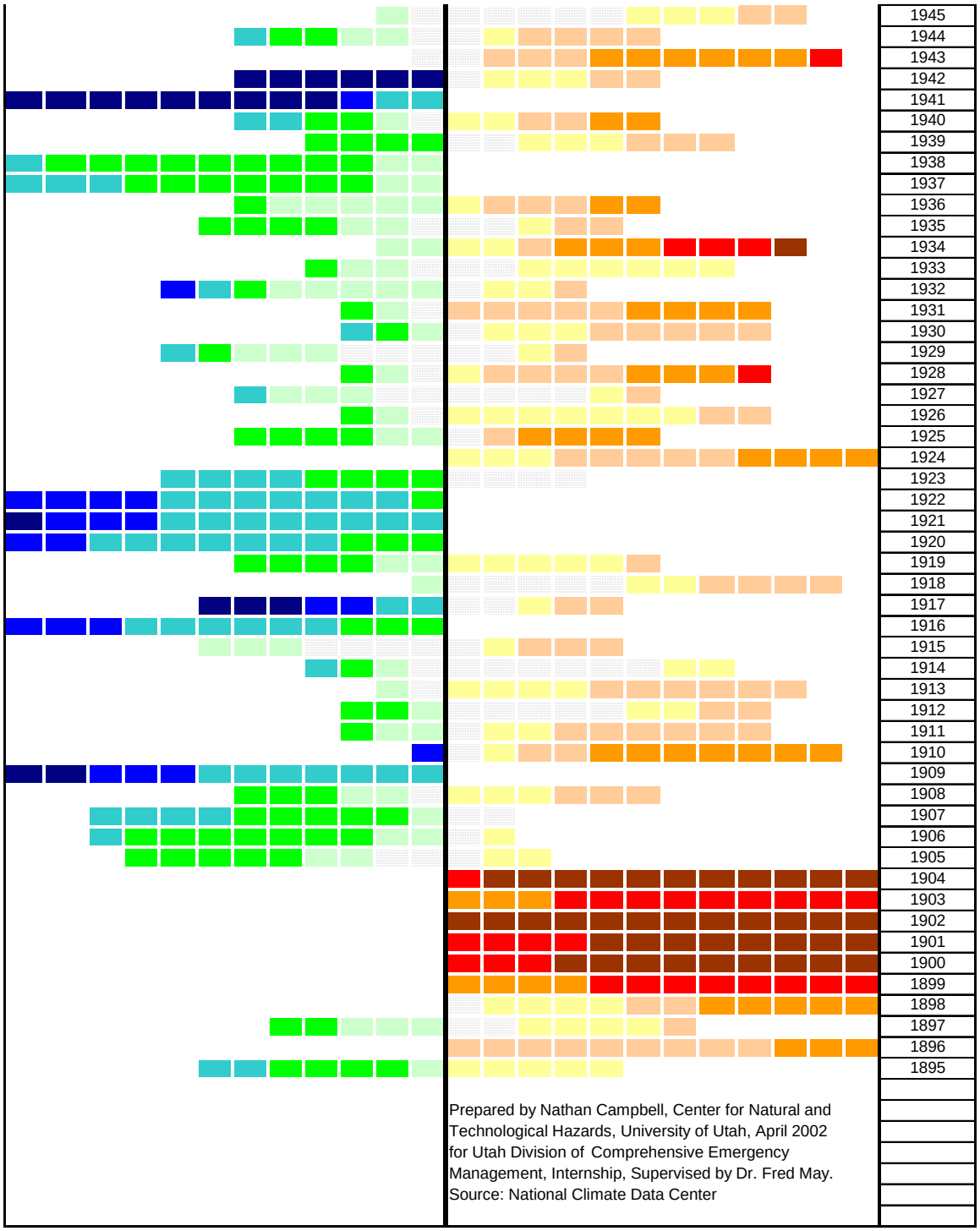


Figure 4-2 Climate Division Number 7 Southeast

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Prepared by Nathan Campbell, Center for Natural and Technological Hazards, University of Utah, April 2002 for Utah Division of Comprehensive Emergency Management, Internship, Supervised by Dr. Fred May.
Source: National Climate Data Center

3. Earthquake

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Seismic clustering. Ground shaking can be felt throughout the entire region. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See maps in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

The Southeastern region's earthquake threat from the Intermountain Seismic Belt and other crustal rock strain release areas is minimal, with a limited risk due to the large areas of undeveloped lands and smaller number of faults. During historic time the largest recorded earthquake has not reached above 5.3 on the Richter magnitude scale, yet geologic investigation has determined much larger events have happened in the recent geologic past and could happen in the future. These events are associated with numerous faults, which exhibit signs of prior movement during the quaternary time period or last 1.6 million years: These faults are listed below:

- Little Delores River
- Ryan Creek fault zone
- Granite Creek fault zone
- Sinbad Valley Graben
- Paradox Valley
- Pleasant Valley
- Joes Valley fault zone (<15,000 years)
- Southern Joes Valley fault zone
- Price River
- Ten Mile Graben
- Salt and Cache Valleys faults
- Sand Flat Graben
- Moab and Spanish Valley
- Castle Valley
- Fisher Valley
- Needles fault zone (<15,000 years)
- Lockhart fault
- Lisbon Valley Fault zone
- Pine Ridge
- Shay Graben
- Bright Angel fault system

Seismic clustering is evident throughout most of the region and is mainly associated with underground mining, most of the recorded earthquake activity is coal mining related.

Risk assessments were completed for part of the region and can be found below under each county heading.

Building Damage by Count
Building damage is classified by HAZUS MH in five damage states: none, slight, moderate, extensive and complete. The Building Damage Tables list the number buildings by occupancy, which are estimated to have moderate to complete levels of damage.

Debris Removal
The Debris Removal table's show how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Fire Following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. The fire tables provide estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake. These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

A. Carbon County

The active coalfields near East Carbon/ Sunnyside, Hiawatha/ Wattis, Castlegate, and Soldier Canyon all affect the earthquake seismicity due to the underground coal extraction methods, creating numerous small earthquakes. The following tables generated using HAZUS MH demonstrate numbers of at risk for of people and property damaged in an earthquake.

Vulnerability Assessment

Table 4-1 Casualties

Casualties	Nighttime –Minor	3
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	90
	Daytime –Major	3
	Daytime- Fatalities	6
	Commute –Minor	63
	Commute –Major	2
	Commute-Fatalities	3

Table 4-2 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	765
Commercial	38
Industrial	0
Totals	2,952*

*****Includes all building categories with moderate to complete damage

Table 4-3 Critical Facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	0
Schools	14	0	0	2
EOC's	0	0	0	0
Police Stations	5	0	0	1
Fire Stations	4	0	0	1

Table 4-4 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	108
Loads (25 tons per load)	4,320

Table 4-5 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	2
People Displaced	12
Value Exposed (thousands $)	752

B. Emery County

Most of the earthquake activity in Emery County is located northwest of Orangeville and Castle Dale. None of these seismic clusters registered above a 3.0 on the Richter scale. Fault Zones are located along the western border of the county as well as in the northeastern half of the county. The Joe's Valley Fault is still active and has shown surface movement within the past 10,000 years. It has the potential of producing an earthquake with a Richter magnitude between 6.5 and 7.5, and causing damage to communities just east of the fault. A significant number of the recorded earthquakes in the county are associated with mining activities. The largest recorded earthquakes were 5.3 and 4.4,on the Richter scale, recorded on August 14 and 18th 1988 respectively. Both earthquakes were located in the southwestern area of Buckhorn Flat.

Vulnerability Assessment

Table 4-6 Casualties

Casualties	Nighttime –Minor	83
	Nighttime –Major	2
	Nighttime -Fatalities	3
	Daytime –Minor	78
	Daytime –Major	3
	Daytime- Fatalities	5
	Commute –Minor	69
	Commute –Major	2
	Commute-Fatalities	4

Table 4-7 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	677
Commercial	23
Industrial	2
Totals	1,970*

*****Includes all building categories with moderate to complete damage

Table 4-8 Critical Facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	10	1	0	1
EOC's	0	0	0	0
Police Stations	4	0	0	2
Fire Stations	7	2	0	1

Table 4-9 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	65
Loads (25 tons per load)	2,600

Table 4-10 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

C. Grand County

The following faults within Grand County showing signs of movement during the quaternary period: Fisher Valley, Ryan Creek, Granite Creek, Sinbad Valley Graben, Ten Mile Graben, Salt and Cache Valleys, Moab Fault and Spanish Valley, Castle Valley,

Vulnerability Assessment

Table 4-11 Casualties

Casualties	Nighttime –Minor	1
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	9
	Daytime –Major	0
	Daytime- Fatalities	0
	Commute –Minor	6
	Commute –Major	0
	Commute-Fatalities	0

Buildings/Structures

Table 4-12 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	431
Commercial	8
Industrial	0
Totals	661*

*****Includes all building categories with moderate to complete damage

Table 4-13 Critical Facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	1
Schools	6	0	0	6
EOC's	0	0	0	0
Police Stations	2	0	0	2
Fire Stations	3	0	0	3

Table 4-14 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	14
Loads (25 tons per load)	560

Table 4-15 Fire Following Event, Population Exposed, and Building Stock Exposed
No post-quake fire population or building stock has been identified.

D. San Juan County

There have been 28 recorded earthquakes in the County larger than 2.0 with 8 of them larger than 3.0 in the last 40 years. The largest earthquake was a 3.37 on May 13 1993 near Monticello.

San Juan County is made up of the following active faults along the northwestern boundary of the County: Needles Fault Zone, Bright Angel Fault Zone, Lisbon Valley Fault Zone, Lockhart Fault, Pine Ridge Fault, Moab Fault, and the Spanish Valley Fault. The Needles Fault Zone is a Holocene fault that runs from the confluence of the Green and Colorado Rivers and continues downstream to Gypsum Canyon. Holocene faults are known to be active and can generate an earthquake at any time. The Bright Angel Fault system extends from Mt. Holmes and the Mt. Ellsworth area southeast to Red Rock Plateau southwest to Navajo Mountain. The Lisbon Valley Fault Zone runs southeast from La Sal Junction. The Lockhart Fault cuts across Lockhart Canyon. The Pine Ridge Faults are east of La Sal. The Moab and Spanish Valley Faults run southeast into Moab. These faults are considered to be Quaternary and still are capable of generating earthquakes but the chances are significantly less.

Vulnerability Assessment

Table 4-16 Casualties

Casualties	Nighttime –Minor	8
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	6
	Daytime –Major	0
	Daytime- Fatalities	0
	Commute –Minor	6
	Commute –Major	0
	Commute-Fatalities	0

Table 4-17 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	223
Commercial	4
Industrial	0
Totals	427*

*****Includes all building categories with moderate to complete damage

Table 4-18 Critical Facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	0	0	0	0
Schools	15	0	0	15
EOC's	0	0	0	0
Police Stations	6	0	0	6
Fire Stations	2	0	0	2

Table 4-19 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	8
Loads (25 tons per load)	320

Table 4-20 Fire Following Event, Population Exposed, and Building Stock Exposed
No post-quake fire population or building stock has been identified.

Part 5. Capabilities Assessment

Within the SEUALG region, local governments have a diverse and strong capability to accomplish hazard mitigation. The purpose of this section is to analyze gaps and potential capability weaknesses for local level jurisdictions in the region. This assessment analyzes current capacity to mitigate the effects of natural hazards and emphasizes the positive capabilities that should be continued. The following areas were assessed to determine mitigation capabilities:

1. **Local Organizational and Technical Capability**
2. **Policy and Program Capability**
3. **Fiscal Capability**
4. **Political Willpower**
5. **Legal Authority**
6. **Political Willpower**

1. Local Organizational and Technical Capability

Only a handful of communities in the Southeastern region have fulltime professional staff of any kind. In many cases a limited tax base means that hiring full time professional staff in the smaller cities and towns is financially unfeasible. Often these smaller communities rely on local volunteers or elected and appointed officials to perform many of the tasks normally handled by professional staff. It is not uncommon for volunteer city council persons or planning commissioners to carry out assigned tasks of emergency management, grant writing or long range planning. Professional staff members at SEUALG (and each of the four counties to some degree) help provide some technical and planning assistance to these smaller communities. Staffing capacity and funding often limit this regional assistance. As funding allows, some communities are able to contract for professional services from private consultants (Table 5-1).

While a few of the cities have a full-time police and fire chiefs, most do not have staffs that are, for the most part, dedicated fulltime to other emergency management related tasks (Table 5-2). And even though each of the counties has an emergency manager, all of these individuals have other responsibilities in addition to core emergency management functions.

Table 5-1 State and Regional Hazard Mitigation Resources

Agency/Group	Description
Utah Div. of Emergency Services and Homeland Security	Training, technical assistance and funding.
Utah League of Cities and Towns	Training, technical assistance and planning assistance
Utah Geologic Survey	Technical assistance, plan review
Southeastern Utah Association of Local Governments (SEUALG)	Technical assistance, plan review, Community Development Block Grants.
Southeastern Utah Health Department	Emergency preparedness and response. Homeland security planning.
Utah Association of Conservation Districts	Technical assistance and planning assistance.
Utah Highway Patrol	Situation and damage assessment -- provide transportation resources for movement of state personnel, supplies, and equipment to include air and ground reconnaissance, and traffic control.

College of Eastern Utah	Information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc. Assist with damage assessment related to agriculture
College of Eastern Utah San Juan Center	Information resource in dealing with drought, winter storms, summer storms etc. in relation to agriculture, environment, water resources, etc. Assist with damage assessment related to agriculture
University Extension Service (Utah State University)	Damage assessment related to agriculture
Army Corps of Engineers	Water and dam management within the county. Provide technical expertise
State Fire Marshal	Hazmat route utilization; HAZMAT technical assistance; situation and damage assessment.
Utah Division of Wildlife Resources	Technical assistance; debris removal from recreational facilities; facility improvements; situation and damage assessment.
State Radio Communications	Exercise readiness of warning systems and communication support.
Department of Agriculture	Assists with situation and damage assessment; coordination with USDA; HAZMAT technical assistance; state land use program.
Department of Workforce Services	Situation assessment and administration of disaster unemployment assistance programs.
State Historical Society	Project screening and situation assessment.

Table 5-2 Local Level Hazard Mitigation Capability

Jurisdiction	**Professional Staffing (e.g. City Manger, Engineer, Planner)**	**Technical Capacity (In House)**
Carbon County	County Emergency Management Coordinator, County Planner, Public Works, Road Department, Building Inspector	GIS Staffing and equipment
East Carbon City	City Clerk, Recorder, Police Chief, Fire Chief	None
Helper City	City Clerk, Recorder, Police Chief, Fire Chief	None
Price City	City Administrator, Public Safety, Police Chief, Fire Chief, Public Works	None
Scofield Town	Volunteer Fire Department	None
Sunnyside City	City Clerk, Recorder, Police Chief, Fire Chief	None
Wellington city	City Clerk, Recorder, Police Chief	None

Emery County	County Emergency Management Coordinator, Planner, Public Works, Road Department, Building Inspector	GIS Staffing and equipment
Castle Dale City	City Clerk, Recorder, Fire Chief	None
Clawson Town	Volunteer\contracted consultant	None
Cleveland Town	City Clerk, Recorder, Fire Chief	None
Elmo Town	Volunteer\contracted consultant	None
Emery Town	City Clerk, Recorder, Fire Chief	None
Ferron City	City Clerk, Recorder, Fire Chief	None
Green River City	City Clerk, Recorder, Fire Chief	None
Huntington city	City Clerk, Recorder, Fire Chief	None
Orangeville City	City Clerk, Recorder, Fire Chief	None
Grand County	County Administrator, Sheriff, Planner, Public Works, Building Inspector	Some GIS Capability
Moab City	City Manager\Planner, Police Chief, Fire Chief	Some GIS Capability
San Juan County	County Administrator, Sheriff, Public Works, Road Department, Building Inspector	Some GIS Capability
Blanding City	City Manager\Planner, Police Chief, Fire Chief	Some GIS Capability
Bluff Town	Volunteer\contracted consultant	None
Monticello City	City Manager\Planner, Police	None

2. Policy and Program Capability

Most of the municipalities in the Southeastern region have an adopted General Plan as required by state code. Although many communities have recently updated their General Plan, many are very outdated and have not been revised in years. Generally speaking, if these plans address natural hazards at all, it is usually limited to flood related hazards.

All of the municipalities have an adopted zoning ordinance. Again, often these ordinances are outdated and often are not consistent with the jurisdiction's General Plan. Most zoning ordnances do not address natural hazards in any way. A few communities have a "sensitive area" or "hazard area" overlay zone. All communities issue building permits and enforce local building codes. Often this service is contracted for with the county.

Of the nineteen municipalities and four counties, seventeen are participating in the National Flood Insurance Policy program (Appendix D). However, much of the flood map data is inaccurate and/or out of date.

Building Codes
International and national building codes have been adopted by all jurisdictions in the region. These codes are constantly in review for reasonable preparedness for disasters. Locally, building officials lobby for additions or exceptions to international and/or national building codes according to local conditions. Most insurance policies rely on the international and national building code standards for assurance.

The Insurance Services Office, Inc performs Building Code Effectiveness Grading Reports (BCEGS). The program implemented in 1995 assesses the building codes in effect in a particular community and how well the community enforces its building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with one showing exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. FEMA also uses these scores in their competitive grant programs giving a higher ranking to those projects with lower scores. The following table highlights the BCEGS scores for Wasatch Front Region jurisdictions (Table 5-3).

Table 5-3 Building Code Effectiveness Grading Reports

Community	**County**	**BCEGS Classification**		**Date**
		Residential	**Commercial**	
Blanding	San Juan	4	4	2002
Carbon County	Carbon	4	4	2001
Emery County	Emery	4	4	2002
Ferron City	Emery	5	5	1998
Grand County	Grand	3	3	2001
Huntington	Emery	3	3	2001
Moab City	Grand	4	4	1997
Price City	Carbon	3	3	2001
San Juan County	San Juan County	4	4	2002

Community Ranking System
Communities that regulate development in floodplain are able to participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally backed flood insurance policies available for properties in the community. The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes. Class 1 requires the most credit points and gives the largest premium reduction. Class 10 receives no premium reduction. Refer to Table 5-4 for a list of the participating communities.

Table 5-4 Community Ranking System Scores for WFRC

Community Name	**Entry Date**	**Effective Date**	**Class**	**% Discount for SFHA***	**% Discount for Non-SFHA**
Moab City, Grand County	04/01/01	04/01/01	9	5	5

***** Special Flood Hazard Area

3. Fiscal Capability

Every county in the SEUALG region has very limited fiscal capability to implement hazard mitigation strategies. This is due to the four county planning areas having a small population and tax base. In Utah, almost 70 percent of the land area remains in federal control, with only about 21 percent privately owned. In the Southeastern region those percentages are typically much higher. Between federal and state ownership, counties in the southeast region are essentially "sharecroppers" of the land. The federal and state governments in turn, restore a small portion of these revenues to the local governments in the form of grants and subsidies.

Furthermore, the State of Utah spends more money than it takes in for three of the four counties (Carbon, 1.44; Emery, 1.51; and San Juan, 4.03) in the Southeast region. Only Grand County receives less in state funding than it sends to the state. In fact, San Juan County ranks as number three in the state for ratio of dollars spent to dollars received by the state (Carbon is ranked 15th and Emery 16th). In each case the majority of dollars are spent on K-12 education (See *Redistributing Utah's Resources: Burdens and Benefits Around the State*. Research Report Number 657, May 2003, Utah Foundation).

Given the above information it is highly unlikely that counties in the Southeastern region could afford to provide the local match, without state support, for the available hazard mitigation grant programs. Considering the current budget situation at both the State and local government level, combined with the apparent increased reliance on local accountability by the Federal government, this is a significant and growing concern for our region.

Under the Disaster Mitigation Act of 2000, FEMA has made special accommodations for "small and impoverished communities", who will be eligible for a 90% Federal share, 10% non-Federal cost split for projects funded through the Pre-Disaster Mitigation Grant Program. Unfortunately, according to the current Interim Final Rule for Section 322 of the Act, none of the counties in our region will qualify as a small and impoverished community. The definition is restricted to "communities of 3,000 or fewer individuals that is identified by the State as a rural community."

4. Political Willpower

Most area residents are quite knowledgeable about the potential hazards that faces their community and through the pre-disaster mitigation planning process; they have become more familiar with the principles of mitigation. It is strongly believed that such efforts within the community have created a greater sense of awareness among local residents, and that hazard mitigation is a concept that they are beginning to readily accept and support.

Because of this fact, coupled with the region's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

Part 6. Risk Assessment

A. Hazard Identification

The first step in risk assessment is identifying the hazards that could affect the Southeastern region. Hazard identification addresses the geographic extent and intensity / magnitude of a hazard as well as the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Planning Team
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Department of Emergency Services and Homeland Security
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in the table below have the possibility of affecting each county within the SEUALG region. The identification process for each county and participating jurisdictions utilized those natural hazards that consistently affected each county prior to and during the planning process based on history of occurrences, future probability, and risk (Table 6-1). Table 6-1-1 identifies those hazards on a county level for easy reference.

The Wasatch Front Regional Council with help from the SEUALG and local GIS officials, created maps that identified the location of critical facilities and the municipalities affected by each identified hazard. Initial data from this study was also used to determine those hazards that presented the greatest risk to each of the counties. The geographic extent is identified in the maps at the end of every county section. The hazard intensity/ magnitude and probability is also profiled in each county section.

Within each of the four counties, there are several jurisdictions. All of these jurisdictions contributed to the risk assessment analyses performed for each county when located within a hazard boundary. Within each county section refer to the "description and location of extent" paragraph detailing this risk assessment. Earthquake, Drought, and Severe Weather are considered regional hazards and have been profiled as such. Please refer to Part 4 Regional Data for more information.

Table 6-1 Hazard Identification

Hazard	How Identified	Why Identified
Mapped Hazards		
Earthquake	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers, USGS, UGS, Utah DESHS, and community members	• Utah is predicted, 1/5 chance, to experience a large earthquake within the next fifty years. • Utah experiences approximately 13 earthquakes a year with a magnitude over 3.0. • Can create fire, dam failure, flooding, hazardous materials incident, transportation, and communication breakdowns. • Southeastern Utah has recorded earthquakes in the past.

Landslide	• Input from City and County Emergency Operations Managers, USGS, UGS, NCDC, Utah DESHS, and community members	• Have caused damage in the past to residential and commercial infrastructure. • Can be life threatening. • Generally occur in known historical locations, therefore risks throughout much of Southeastern Utah. • Would like to increase community awareness.
Wildfire	• Review of County Emergency Operations Plans • Review of Community Wildfire Plans • Input from County Emergency Managers, Utah DESHS, Utah FFSL, Utah FS, NWS, FEMA, and local community members	• Serious threat to life and property. • Increasing threat due to urban sprawl in URWIN areas. • Secondary threat associated with flooding, drought, and earthquake. • Most of Utah is at risk including the Southeastern Utah counties. • Additional funding and resources offered by local and state agencies to reduce risk. • Would like to increase community awareness.
Problem Soils	• Review of County Emergency Operations Plans • Input from community members, Utah, DESHS, and UGS • Researched historical data	• Related to subsequent effects from earthquakes that happen in Southeastern Utah. • Have affected infrastructure and local economy in the past. • Southeastern Utah has a significant amount of problem soils.
Dam Failure	• Review of County Emergency Operations Plans • Input from community members, Utah DWS, Dam Safety Section, Utah DESHS • Review of inundation maps	• Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc. • Many reservoirs located in the four county region of Southeastern Utah. • Threat to downhill communities. • Would like to increase community awareness. • Would like to incorporate mitigation measures into existing plans to help serve local residents.
Unmapped Hazards		
Flood/ Flash Flood	• Review of past disaster declarations • Input from City and County Emergency Operations Managers, Utah DWS, UGS, Utah Army Corps of Engineers, Utah DESHS, and community members • Review of Flood Insurance Studies, Floodplain maps, and Flood Insurance Rate Maps	• Several previous incidents have caused severe damage and loss of life. • Many of the rivers and streams are located near neighborhoods. • Many neighborhoods are located on floodplains, alluvial fans. • Due to Utah's geology and climate cloudburst storms and heavy precipitation cause flash flooding throughout most of Southeastern Utah.

Drought	• Review of County Emergency Operations Plans • Input from community members, Utah DESHS, NWS, NCC, and NCDC	• Affects local economy and residents. • Affects water reservoirs' levels and therefore culinary, irrigation, and municipal water. • Currently in a drought period. • Secondary threat associated with wildfire. • Utah's is the nation's second driest state. • Can result in loss of farming resources and livestock.
Infestation	• Review of County Emergency Operations Plans • Input from community members, Utah FFSL, Utah State University Extension Service, Idaho Forest Health Protection Agency, Boise State Foresters, and Utah Dept. of Agriculture	• Consistently affects this region. • Declined forest health and agriculture losses. • Previous experiences have affected Southeastern Utah. • Affects local economy. • Destruction can be severe and is very costly to mitigate. • Need a better understanding of ways to mitigate and prepare. • Secondary threat of drought.
Severe Weather (Severe Storm, Avalanche, Lightning)	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers, Utah Avalanche, Forecast Center, Utah Department of Transportation, and community members, National Weather Service	• Damage to communities, homes, infrastructure, roads, ski areas, and people. • Can cause property damage and loss of life. • Affects local economy and vegetation. • Lightning is the number one cause of death in Utah. • Can be costly to recover from. • Affects the young and old more severely.

Table 6-1-1 County Hazard Identification

	Carbon County	Emery County	Grand County	San Juan County
Earthquake	X	X	X	X
Landslide	X	X	X	
Wildland Fire	X		X	X
Problem Soils	X		X	
Dam Failure	X	X		X
Flood/ Flash Flood	X	X	X	X
Drought	X	X	X	X
Infestation	X			X
Severe Weather	X	X	X	X

The hazard identification process was aided through the use of FEMA How to Guidance documents, FEMA 386-1,2,3,7 FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12, Disaster Mitigation Act of 2000, 44 CFR Parts 201 and 206, Interim Final Rule, and FEMA Region VIII Crosswalk. The risk assessment process also utilized assistance from local Wasatch Front region GIS departments using the best available data.

B. Hazard Profile

This section describes the causes and characteristics of each identified hazard including it's severity or magnitude (as it relates to the percentage of the jurisdiction that can be affected), probability, conditions that make the area prone to the hazard, a hazard history, and a map of the hazard's geographic location or extent. The hazards were profiled based on history of occurrence, local input, county emergency operations plan's, and county master or general plans, scientific reports, historical evidence, and hazard analysis plans. A risk assessment "Hazard Profile" table was created that highlights the above-mentioned materials in each of the county portions of the plan introducing each identified hazard.

In determining hazard magnitude a scale was used to identify the level of damage on a countywide basis from Catastrophic to Negligible (Table 6-2).

Table 6-2 Hazard Profile

	Jurisdiction Affected	**Risk**
Catastrophic	More than 50%	Extreme or High
Critical	25-50 %	Moderate
Limited	10-25%	Moderate
Negligible	Less than 10%	Low

The probability of a hazard event was determined through the amount of risk to the county. The probability or likelihood of an occurrence is categorized into four categories: Highly Likely, Likely, Possible, and Unlikely.

The geographical extent or location of the community that would be affected has been identified in the mapping portion of each county when plausible.

Hazard history has been identified and recorded and is located in Section F of each county section.

Maps were created using GIS software to identify the location and extent of each identified hazard area. Drought, Flood, Infestation, and Severe Weather maps were unable to be created due to the lack of data, or the nature and geographic extent of these hazards, therefore, hazard profiles will be in narrative form only.

The following Risk Assessment maps were created for each county:

- Earthquake Epicenters and Fault Zones
- Landslide
- Wildfire
- Problem Soil
- Dam/ Reservoir Sites

C. Vulnerability Analysis

The vulnerability analysis is based on asset identification and potential loss estimates for those jurisdictions located within identified hazard areas.

Asset Identification

The vulnerability analysis combines the data from each of the hazard profiles and merges it with community asset information to analyze and quantify potential damages from future hazard events. The asset inventory identifies buildings, roads, and critical facilities that can be damaged or affected by the hazard events. Critical facilities are of particular concern because of the essential products and/or services they provide to the general public. These critical facilities can also fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in this plan can include hospitals, police and fire stations, schools, communication facilities, utility companies, and water and wastewater treatment plants. In order to assess where and to what extent the identified hazards will affect the assets of each county, the locations of assets were identified and correlated with the mapped hazards using GIS software. Identified assets are discussed in detail within each county section. For a complete list of critical facilities for each county refer to Appendix C.

Potential Loss Estimates

Potential dollar losses were estimated using the same method indicated above, therefore estimates were completed for existing infrastructure only. When data permitted, structure, contents, and function of the identified vulnerable infrastructure were incorporated into the vulnerability assessments. Describing the vulnerability in terms of dollar losses provides the community and the state with a common framework from which to measure the effects of hazards on assets.

We were unable to analyze future planned development due to the lack of available data in GIS format. However, countywide development trends have been identified and are addressed within each county's chapter.

The core planning team and local planning team members estimated potential losses from the identified hazards by using the methodology explained in the FEMA document "Understanding Your Risks: Identifying Hazards and Estimating Losses", Utah DESHS historical data, and GIS data.

The information sources used to complete the vulnerability analysis and loss estimates include county GIS departments, county assessors offices, HAZUS MH data, the Utah Automated Geographic Reference Center (AGRC), and Census 2000 data. Parcel data, and Census 2000 data were used to identify household types and numbers as well as the number of residents within the identified boundary. This data was compiled into GIS layers that were used as overlays to identify critical facilities, municipalities, roads, and residents. Utah Department Of Transportation (DOT) provided the base map layer to aid in the risk assessment. The assets that have been identified are based on the best available data at the time of the compilation of this plan in GIS form.

Flood loss estimates were unable to be created due to the lack of digitized floodplain datasets. Future natural hazard mitigation planning would like to include flood losses in the future by using up to date flood maps. The Utah Department of Emergency Services and Homeland Security at this time recognizes the need for updated data and is underway to initiate that change.

Methodology

Geographic Information System (GIS) software was used as the basic analysis tool to complete the hazard analysis for the Southeastern Utah Association of Governments Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and Census 2000 demographic information. Statewide digital data was obtained from Utah Automated Geographic Reference Center (AGRC) for the following hazards: landslides, problem soils, quaternary faults, wildfire, dam locations, and epicenter locations. The vulnerability assessment for each county estimates the number of homes, businesses, infrastructure and population vulnerable to each hazard and assigns a replacement dollar value to

residential structures in each hazard area. The value of residential housing was calculated using estimated average residential housing values for each county. All the analysis takes place within the spatial context of GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

The methodology used to determined vulnerability to each hazard -- earthquakes, problem soils, landslides, and wildfire within the study area was almost identical. The number of households and population vulnerable to each hazard was determined using Block Data from the Census 2000 data. Parcel data was unavailable. The Block Data from the Census 2000 database was intersected with each of the mapped hazard layers in order to determine the number and location of residential housing units and the population at risk from each hazard. The methodology used assumes an even distribution of residential housing units and population across each census block. Point data from HAZUS MH was used to determine the number of businesses and the annual sales of each business in each hazard area.

In addition to the above methodology, earthquake was profiled using HAZUS MH, which is shorthand for Hazards United States. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses.

The number of acres of extreme, high, and moderate wildfire; acres of historically active landslides; acres within earthquake fault zones; and acres of problem soils were determined for each city and all unincorporated areas. Once the acre total was identified it was overlaid on the Census Block data to determine the total number of homes impacted. This figure was then multiplied by the average housing value as reported by the county Assessor's office to determine the total value of potential loss. The County Assessor's data used year 2000 average housing values.

County	**2000 Average Estimated Residential Sales Price**
Carbon	$78,637
Emery	$82,909
Grand	$123,751
San Juan	$123,751

In the case of wildfire and earthquake, the value of the land (20% of total) was subtracted from the totals reported in the vulnerability tables. Rationale for the 20% discount is that in the event of a wildfire or an earthquake land is usually left more useful than after a landslide. Also note that content values are not included in the potential loss analysis. Content values could raise the potential loss numbers for housing by approximately 50%.

The potential impact of natural hazards on transportation and utilities was determined in a similar method as described above. Roads and utilities were overlaid on the hazard areas and the impacted utility and road segments were inventoried. Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These costs include:

Item	**Cost per Mile**
Local Roads	2,000,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to linear infrastructure, point data from HAZUS MH and state GIS including critical facilities, dams, care facilities, schools, power generation facilities, and substations was analyzed to determine if the feature was within a hazard area.

Limited availability of digital data represented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, landslides, problem soils and wildfires in this plan. Additional limitations to the above described analysis method include:

- Assuming random distribution
- Limited data sets for water, gas, and electrical resulting in incomplete numbers for these features
- Lack of digital parcel data from the county assessors' offices
- No digital data for dam failure inundation, flood plains, or infestation
- Relied on state wide data not intended for manipulation at the scale it was used
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data
- Meta data was lacking on some of the used data sets

In terms of hazard mapping, this document contains simple maps created to provide a graphical illustration of hazard location. These maps are done at a scale, which allows them to fit on a standard letter sized page. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool to be used by interested persons within the Southeastern Utah Association of Governments and the jurisdictions the AOG serves. Information from these maps must not take the place of accurate field verified mapping from which ordinances need to be based off.

Effort to analyze hazards related to potential development areas was also addressed where applicable. Identifying hazards to potential development is very difficult. This study merely identifies areas, which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available, but this data does not necessarily indicate which areas will be developed and which will not.

D. Mitigation Goals, Objectives, Actions

Using the findings from the risk assessment and the capabilities assessment as a guide several mitigation actions were identified that would benefit each jurisdiction. Each action has been formalized and placed into this plan in each of the county mitigation sections. These actions were identified in the planning group meetings, which included input from the core planning team, local planning team, state and local agencies, county government, and city and county residents.

Within the Southeastern Association of Local Government's all four counties participated in the Mitigation Workbook set forth by the Utah Division of Emergency Services and Homeland Security. Each county chose a task leader to create a workgroup made up of local elected officials and community members to identify local mitigation strategies. Once the workgroup was setup they were given training and direction for completing the workbook. Mitigation strategies were pulled from existing plans and programs and those projects already identified were included in this plan. Other strategies were also included that met the STAPLEE process. Some of these strategy ideas were generated using a general mitigation strategies menu found in Appendix B. The completed workbook was then given to the Wasatch Front Regional Council for review and to incorporate into the plan.

Goals and objectives were developed in a working session between the above-mentioned figures with a period provided for comment and revision. Each of the jurisdictions identified mitigation actions based on the identified goals and objectives with particular emphasis on new and existing buildings and infrastructure. These actions are included in Section G of every county portion of this plan. The mitigation actions identify the responsible agency, the funding source, timeline, background, and their priority. Actions were selected using the information obtained from the capabilities assessment, which identified existing programs and shortfalls related to mitigation activities. The actions were prioritized based on the STAPLEE method identified in the FEMA How to Guides. Prioritization emphasized the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each of the actions were judged and ranked against these criteria and assigned the priority of High, Medium, or Low.

E. Hazard Description

Each of the natural hazards that could affect Utah, including the Southeast region, has been described below. These are general descriptions about each hazard to give an idea of what, why, when, and how the hazards occur.

1. Earthquake

According to Sandra Eldridge, (Utah Natural Hazards Handbook 4-15), an earthquake is the result of "…sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface"(5). The energy that is released is abrupt shaking, trembling or sudden motion in the earth and rocks that break along faults or zone of weakness along which the rocks slip. Seismic waves are then transmitted outward and also produce ground shaking or vibrations in the earth. The Richter scale measures the magnitude of earthquakes on a seismograph. An earthquake with a Richter magnitude 6 is 30 times more powerful than a Richter magnitude 5. A Richter magnitude 7 is 1000 times more powerful than a Richter magnitude 5. In order for humans to feel an earthquake is usually needs to be at least a magnitude 2.0. In order for significant damage to occur an earthquake needs to be at least a magnitude of 5.5 or greater. The amount of damage that occurs from an earthquake depends on soil type, rock type, ground-water depth, and topography. Other factors include the type of construction in an area and the population density. The Utah region records approximately 700 earthquakes a year, and an average of 13 of those are of magnitude 3.0 or greater. A magnitude 5.5 to 6.5 earthquake occurs in Utah every 7 years (4-5).

Locations and Activity: Faulting can be evident on the earth's surface or not evident at all, therefore earthquakes are believed to be able to occur anywhere in Utah (6-8). The earthquake history of WFRC is complicated by the fact that we have not had a large recorded earthquake during recorded historical time. The geographic area comprising WFRC last produced a major earthquake, approximately 1,350 years before present. Yet, when looking at the region, the potential for a large earthquake exists when one considers that "since 1850 at least 16 earthquakes (excluding aftershocks) of magnitude 6.0 or greater have occurred within the ISB" (Eldredge 6). The greatest earthquake hazard is considered to be in the areas surrounding the Wasatch, East Cache, East Bear Lake, Bear River, Hansel Valley, Northern Oquirrh, West Valley, and East Great Salt Lake fault zones. Other areas of significant hazard along the southern portion of the ISB include Hurricane, Paragonah, and Sevier faults. The other significant hazard areas in Central Utah are the Stansbury, Joes Valley, and Gunnison faults (7). On the Wasatch fault, the segments between Brigham City and Nephi the "composite recurrence interval for large surface-faulting earthquakes (magnitude 7.0 to 7.5) is 395 ± 60 years.

Average number of earthquakes occurring in Utah

Magnitude	Frequency
≥ 3.0	6 per year
≥ 4.0	1 per year
≥ 5.0	1 every 4 yrs
≥ 5.5	1 every 10 yrs
≥ 6.0	1 every 20 yrs
≥ 6.5	1 every 50 yrs
≥ 7.0	1 every 150 yrs

≥ = greater than or equal to

(Source: University of Utah Seismograph Stations)

Chart 1.1 Average number of earthquake occurring in Utah.

The most recent surface-faulting earthquake on the Wasatch fault occurred 400 years ago on the Nephi segment" (Eldredge 7). The two largest historical earthquakes to occur in Utah were the Richfield earthquake of 1901, with a magnitude of 6.5 and the Hansel Valley earthquake of 1934 with a magnitude of 6.6.

The Hansel Valley earthquake produced MM intensities of VIII in Salt Lake City, with numerous reports of broken windows, toppled chimneys, and structures twisted on their foundations. A clock mechanism weighing more than 2 tons fell from the main tower of the Salt Lake City County Building and "crashed through the building" The only death that occurred during the event was caused when the walls of an excavation collapsed on a public-works employee south of downtown Salt Lake City (Qtd. in Lund 20).

Utah's most damaging earthquake was of a smaller magnitude (5.7), which occurred near Richmond within Cache Valley during 1962. This earthquake damaged over 75 percent of the houses in Richmond, as well as roads and various other structures. The total damage in 1962 dollars was about one million dollars.

The Utah Seismograph Stations records about 700 earthquakes each year; only about 13 of these have a magnitude of 3.0 or larger.

"*Earthquakes in 1909, 1914, and 1943 produced MM intensities in Salt Lake City of up to VI, and earthquakes in 1910, 1949, and 1962 had MM intensities of VII in Salt Lake City. Damage produced by these events included broken windows, cracked walls, fallen plaster, toppled chimneys, and buildings shifted on their foundations. The 1949 earthquake also ruptured a water main causing loss of water to a portion of the city"* (Qtd. in Lund 20).

On average a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) occurs in Utah every 7 years. The history of seismic activity in Utah and along the Wasatch Front suggests that it is not a matter of "if" but when an earthquake will occur.

Secondary Hazards: Associated earthquake hazards include ground shaking, surface fault rupture and tectonic subsidence, soil liquefaction, flooding, snow avalanches, dam failure, fire, and slope failure.

Ground Shaking: Ground shaking is caused by the passage of seismic waves generated by an earthquake. Shaking can vary in intensity but is the greatest secondary hazard because it affects large areas and stimulates many of the other hazards associated with earthquakes. The waves move the earth's surface laterally and horizontally and vary in frequency and amplitude. High frequency, small amplitude waves cause more damage to short, stiff buildings. Low frequency, large amplitude waves have a greater effect on high-rise buildings. The intensity depends on geologic features such as bedrock and rock type, topography, and the location and magnitude of the earthquake. Other significant factors include ground water depth, basin shape, thickness of sediment, and the degree of sediment consolidation. Moderate to large earthquake events generally produce trembling for about 10 to 30 seconds. But aftershocks can occur erratically for weeks or even months after the main earthquake event (7-8).

Surface Fault Rupture and Tectonic Subsidence**:** Surface fault rupture or down dropping and tilting associated with tectonic subsidence can rupture the ground surface and in Utah the result is the formation of scarps or steep breaks in the slope. The Hansel Valley (1934) earthquake resulted in a surface displacement of approximately 1.6 feet. Surface faulting in the central segments of the Wasatch fault are expected to have the highest potential. Also earthquakes having a magnitude of 6.5 or greater could result in surface faulting of 16 to 20 foot high and 12 to 44 mile long break segments. Surface displacement generally occurs over a zone of hundreds of feet wide called the zone of deformation. Tectonic subsidence generally depends on the amount of surface fault displacement. The greatest amount will be at the fault and will gradually diminish out into the valley (8-10).

Soil Liquefaction**:** Liquefaction occurs when there is a sudden large decrease in shear strength of sandy soils caused by the collapse of the soils structure, in which the soil loses its bearing capacity, and also by a temporary increase in pore-water pressure, or water saturation during earthquake ground shaking. Liquefaction is common in areas of shallow ground water and sandy or silty sediments. Two conditions must be met in order for soils to liquefy; (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy (Lips). The result is soils that will flow even on the gentlest of slopes. Lateral spreading is a type of failure that results in surficial soil layers breaking up and moving, up to 3 feet or more, independently over the liquefied layer. On slopes more than 5 percent, flow failures can move miles up to 10s of miles per hour. On slopes less than 0.5 percent the bearing capacity will lessen and can cause buildings to settle or tip. No matter the slope percent ground cracking and differential settlement will occur. Liquefaction can also cause foundation materials to liquefy and fail and/or cause sand boils. Sand boils are deposits of sandy sediment ejected to the surface during an earthquake along fissures. Liquefaction can occur during earthquakes of magnitude 5.0 or greater (10-11).

Slope Failure**:** Ground shaking can cause rock falls and landslides in mountainous or canyon areas. Rock falls are the most common slope failure and can occur up to 50 miles away from a 6.0 magnitude earthquake. Landslides occur along benches in wet unconsolidated materials. During a 6.0 magnitude earthquake, landslides may occur within 25 miles of the source (11).

Flooding: “Flooding can happen due to tectonic subsidence and tilting, dam failure, seiches (waves generated in standing bodies of water) in lakes and reservoirs, surface-water diversion or disruption, and increased ground-water discharge”, According to the Natural Hazards Handbook 11.

Snow Avalanches: Avalanches could be triggered because of the associated ground movement. The most vulnerable areas include those that have steep terrain, high precipitation, high earthquake potential, and high population density. An example of this area in Utah would be the Wasatch Front (11-12).

Sensitive Clays: Sensitive clays are a soil type that losses strength when disturbed and result in liquefaction or collapse. The resulting type of ground failure is similar to liquefaction (12).

Subsidence: A settling or sinking of the earth’s crust in loose granular materials such as and gravel that do not contain clay. Western Utah is subject to this type of ground settlement (12).

Figures 6-1-1, 6-1-2, and 6-1-3 identify earthquakes with a Richter magnitude of 3.0 or higher and where in the County they are located between 1962 and 1993, courtesy of Kory Iman.

Figure 6-1-1

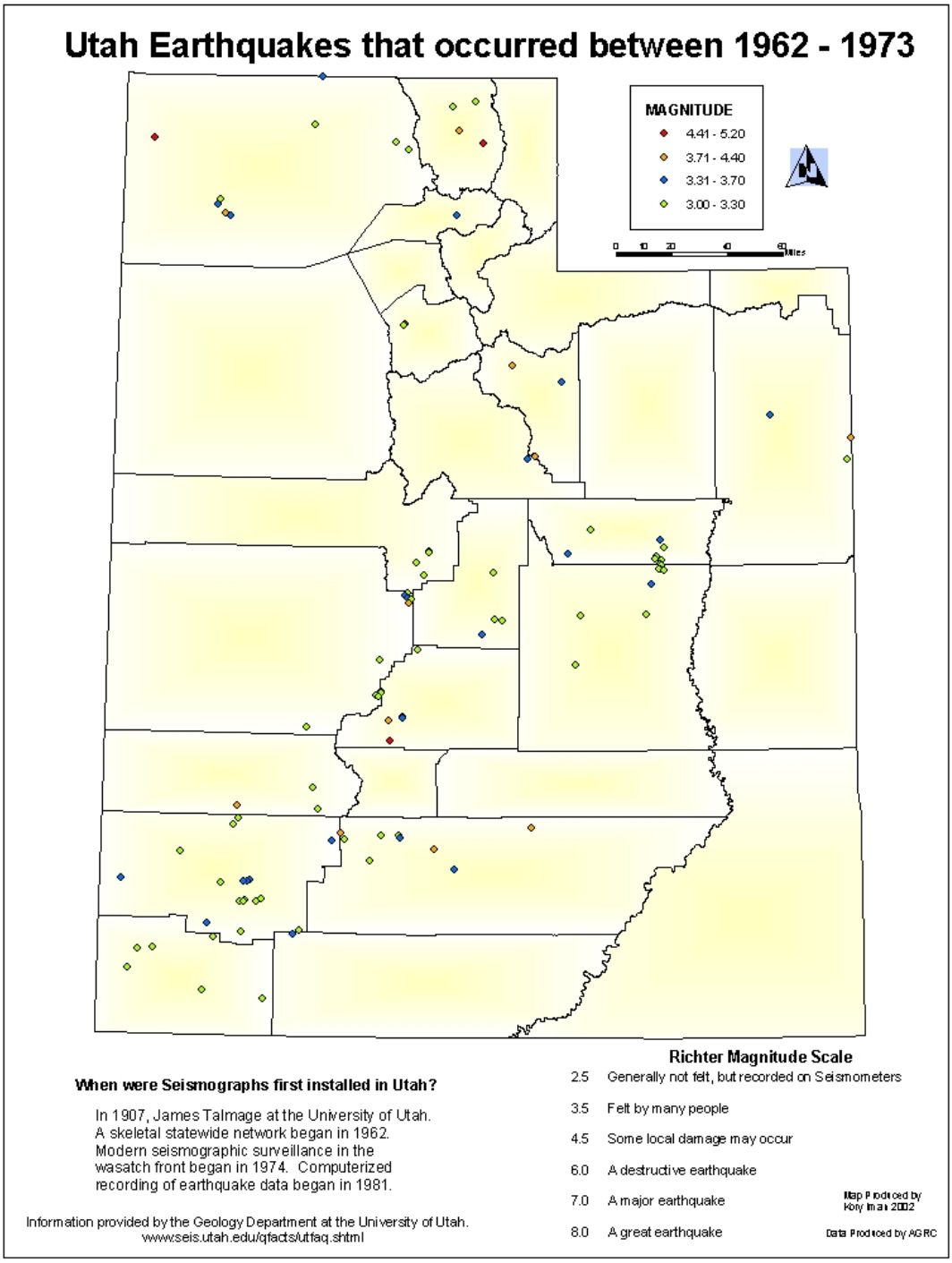

Utah Earthquakes that occurred between 1962 - 1973
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
Miles
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfacts/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake
Map Produced by
Kory Imai 2002
Data Produced by AGRC

Figure 6-1-2

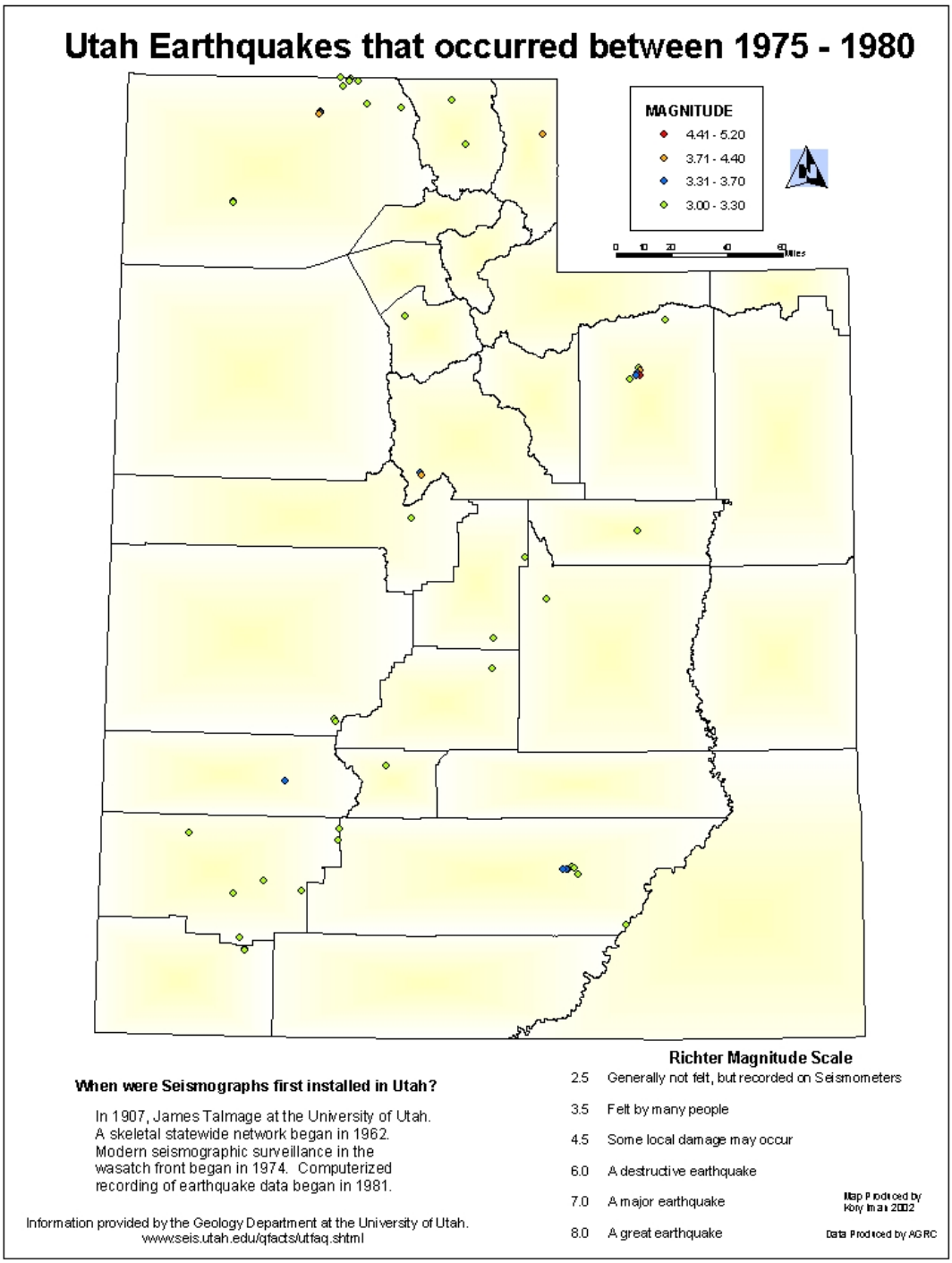
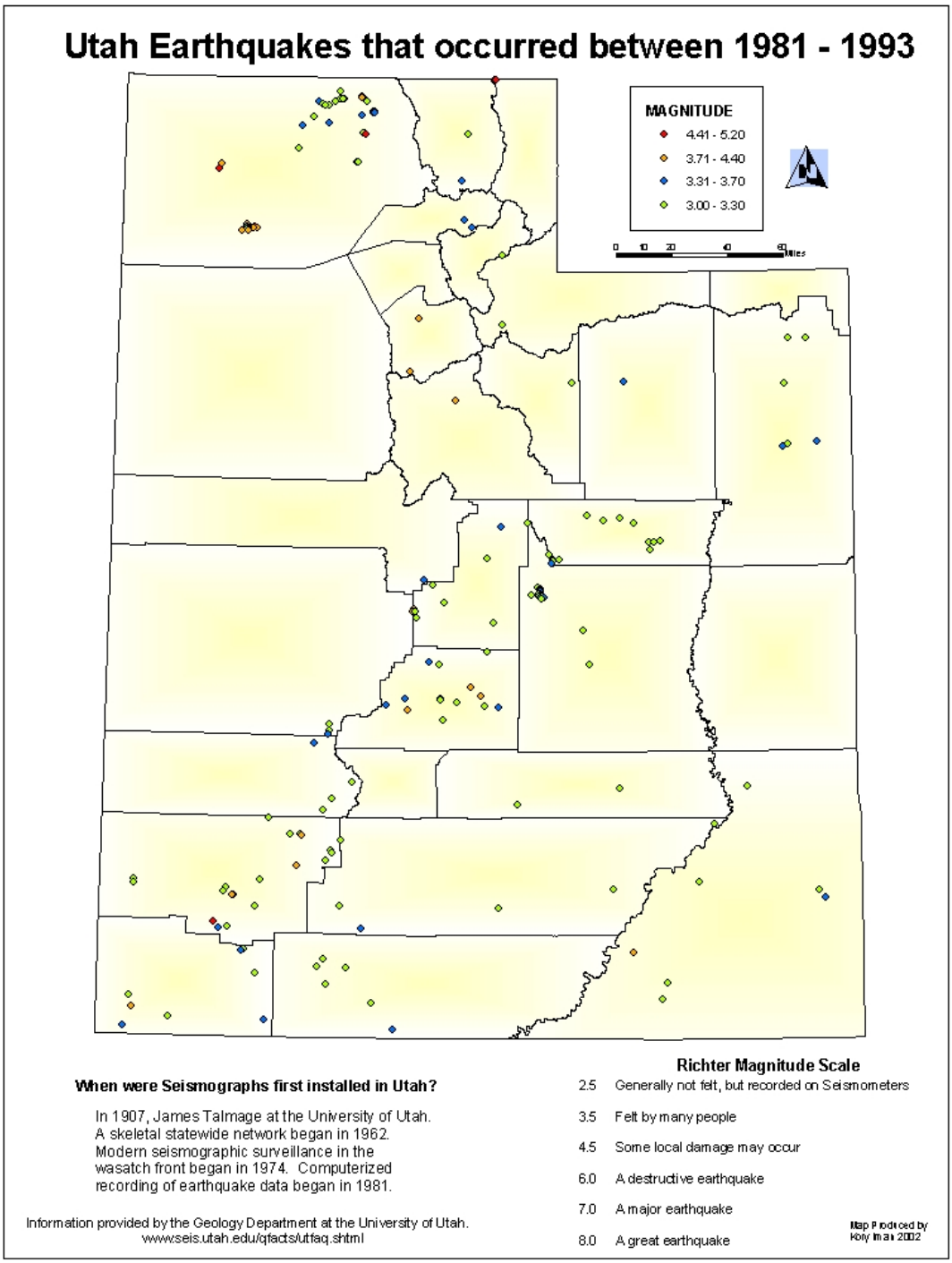

Utah Earthquakes that occurred between 1975 - 1980
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
0 10 20 40 60 Miles
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfacts/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake
Map Produced by
Kory Imai 2002
Data Produced by AGRC

Figure 6-1-3


Utah Earthquakes that occurred between 1981 - 1993
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.31 - 3.70
3.00 - 3.30
0 10 20 40 60 Miles
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
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Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake

2. Flood

It is important to note that flooding is a natural event for rivers and streams. Flood is determined to be the overflow of water onto land that is normally dry. Floods are related to an excess of snowmelt, rainfall, or failure of natural or engineered impoundments onto the banks and adjacent floodplains. Floodplains are lowland areas near river, lakes, reservoirs, oceans, and low terrain urban areas that are subject to recurring floods. Flooding occurs when the peak discharge, or rate of flow in cubic feet per second, is larger than the channel of the river or the storm sewer capacity in a city. The peak discharge for a stream is associated with a probability of occurrence. The probability of occurrence can be stated in terms of recurrence intervals or return periods. For example, a probability of occurrence of 10 percent would be a flood expected to occur once in 10 years or 10 times in a 100 years. Flooding damage includes saturation of land and property, erosion from water, deposition of mud and debris, and the fast flowing waters from the flood itself. Most injuries and deaths occur from the fast moving floodwaters and most of the property damage results from the inundation by sediment-filled water. Flash flood conditions result from intense rainfall over a short period of time (Utah Natural Hazards Handbook 42-45).

Snowmelt floods occur from the rapid snowmelt in the mountains. These floods generally happen in April, May and June. Warm air masses with mostly sunny skies melt the mountain watershed snowpack. The large accumulations of water generally last several days and the magnitude depends on the amount of snowpack and the warm weather. Snowmelt flood risk is reduced when the snowpack is below normal and/or the weather changes from winter to spring and summer gradually without an abrupt warming trend (43).

Rainfall floods result from large amounts of precipitation. Short duration local storms such as cloudburst or thunderstorms with a high intensity rainfall as well as the general storm that last several days with a less intense rainfall can produce a flooding event (43).

Areas prone to flooding, according to the Utah Natural Hazards Handbook, include lake and reservoir shorelines, which may flood when the flow of water into the lakes or reservoirs is greater than the outflow capacity. The Great Salt Lake and Sevier Lake are known as terminal lakes, which mean they do not have an outlet. These types of lakes are subject to considerable variations in water levels because the only outflow is by evaporation. Successive wet or dry periods that last several years result in a large change in size in terminal lakes. Development near this type of lake during a dry period is risky and certain to get flooded during wet periods (44).

River and creek floodplain areas range from narrow zones to extensive lowlands extending great distances from a natural drainage area. Construction in floodplains is also dangerous because of the high flood risk.

Urban areas are also prone to flooding because of the decrease in vegetation of the natural watershed. Houses, driveways, parking lots, buildings, and streets are all replacing the vegetative cover that is so important in lessening the potential for flood. This type of development prevents water infiltration into the soil and greatly increases the runoff. In some areas undersized piping and channels are used which may cause flooding. Manmade drainage ways can also play a role in flooding, trash and debris can obstruct passageways (44).

3. Landslide

Utah ranked third in the nation in terms of largest total landslide damage cost and cost per person between 1973 and 1983. Utah's landslide hazard rating is "severe" which is the highest level of five hazard classes given by the Geological Survey. The three main contributing factors to slope failure include areas with moderate to steep slopes, conducive geology, and high precipitation. The main elements that cause slope failure include precipitation events, topography and vegetation (Utah Natural Hazards Handbook 16-22).

Landslide distribution in Utah is associated with topography and physiographic provinces. The two physiographic regions that are conducive to landslides in Utah are the Middle Rocky Mountains province and the High Plateaus subdivision of the Colorado Plateau physiographic province.

Landslides are also known as slope failure and are classified according to the type of movement and the material involved. The five types of movement include falls, topples, slides, lateral spreads, and flows. The types of materials include rocks, debris (course-grained soil), and earth (fine-grained soil). Slope failure types are identified as rock falls, rock topples, rock slides, debris flows, debris topples, debris slides, slumps, and earth flows (17-18).

Rock Falls and Rock Topples occur when loosened blocks or boulders from an area of bedrock move down slope. Rock falls and topples generally occur along steep canyons, cliffs, and steep road cuts. Rock fall damage usually affects roads, railroad tracks, and utilities.

Debris Slides and Debris Flows generally occur in mountainous areas and involve the relatively rapid, viscous flow of course-grained soil, rock, and other surficial materials. Debris flows generally occur in mountainous areas and are considered a flow rather than a slide because of the high water content coupled with the debris. Debris flows are typically more dangerous because of the high speeds under which they form and travel. Debris flows generally remain in stream channels but can flow out from canyon mouths for a considerable distance. Debris flows and slides can damage anything in their path including buildings, roads, railroad tracks, life lines/utilities, and reservoirs.

Slumps are common along road embankments and river terraces. They slip or slide along a curved failure plane away from the upper part of a slope leaving a scarp (a relatively steeper slope separating two more gentle slopes). Slumps generally do not move very far from the source area.

Earth Flows are slumps with the addition of water that slump away from the top or upper part of a slope, leaving a scarp. These can range in size from very small to flows involving hundreds of tons of material and result in a bulging toe that can block streams and cause flooding, and damage buildings or other structures.

Causes of landslides are the result of hillside instability. Slope makeup, slope gradient, and slope weight all play a role. Other important factors of slope instability include rock type and structure, topography, water content, vegetative cover, and slope aspect. Debris flows, for example, occur when these elements are modified by natural processes or by human created processes.

Natural processes that can induce slope failure include ground shaking, wind and water weathering and erosion.

Human created processes involve lawn watering and irrigation. Excess water is the leading cause of landslides because water adds weight to the strength of the material and raises the pore pressure leading to a loss of shear strength. Water can also change the consistency of the slope material reducing cohesion leading to an unstable mixture. Rock types containing clay, mudstone, shale, or weakly cemented units, which, are strongly affected by weathering and erosion are particularly prone to landsliding because of the expansive and lubricating properties. Other processes include the removal or addition of slope materials during construction. Vegetation is very important in the stabilization of slopes because it prevents rainfall from impacting the soil directly and helps protect from erosion by retaining water and decreasing surface

runoff. The roots systems serve as slope-stabilizing elements by binding the soil together or binding the soil to the bedrock. Increase in slope gradient such as placing heavy loads at the top of a slope and /or the removal of material at the toe of a slope all affect the equilibrium and result in slope failure because of slope instability.

4. Wildfire

The Urban Rural Wildland Interface (URWIN) area, or I-Zone, is where residential areas meet wildland areas. It is known as the interface zone and presents a serious fire threat to people and property. The urban aspect includes homes, schools, storage areas, recreational facilities, transmission lines, and commercial buildings. Wildland refers to unincorporated areas including hills, benches, plateaus, and forests. Homes are built on the benches adjacent to wildland areas. Wildfires remove vegetation, which results in slope failure, erosion, water runoff and depletion of wildlife resources. The three conditions that affect fire behavior are topography, vegetation and weather (Utah Natural Hazards Handbook 23-28).

Topography includes such factors as slope, aspect, and elevation. Fires spread faster upslope because the fuels are closer to the flames on the upslope. The heat from a fire moves uphill and dries fuels in front of the fire allowing for easier ignition. The aspect of slope dictates moisture content. In other words, the sun dries out fuels on south and west facing slopes more than on north and east facing slopes. Elevation and weather are interrelated because, generally, higher elevations result in cooler temperatures and a higher relative humidity. Elevation also determines the types of vegetation present (24).

Vegetation plays a major role in the speed of a fire. Light grasses burn rapidly and heavy dense fuels burn slowly but with a greater intensity. The five major fuel types in Utah's vegetation include grass/sagebrush, pinion-juniper, mountain bush, hardwoods, and softwoods. The grass/sagebrush area poses a serious threat because people under-estimate the danger of wildfires in this area. These fires burn across thousands of acres rapidly and pose a serious threat to not only property but also life. Pinion-juniper fuel does not normally burn much, except when conditions are hot, dry, and windy. When a fire does happen here it will burn intensely and spread rapidly. Mountain brush is commonly found in Utah's foothills and if moderate to extreme fire conditions are present this type of fuel will burn hot and fast. Hardwood-forest and softwood (deciduous) fuel types are generally less risky (24).

Size, continuity and compactness all affect the fuel's rate of spread. Large fuels do not burn as readily as smaller fuels and need more heat to ignite. Small fuels on the other hand ignite easier, and a fire will spread more rapidly through them. Continuity is described by how fuel is arranged horizontally. Fuels that are broken up burn unevenly and usually slower than uniform fuels. Compactness is how fuel is arranged vertically. Tall, deep fuels have more oxygen available so they burn more rapidly. Less oxygen is available to compact fuels such as leaf litter and stacked logs therefore they burn slower (24).

Weather, is made up of a few different factors namely temperature, humidity, precipitation, and wind. Weather affects the ease with which a fuel ignites, the intensity at which it burns, and how easy the control may be. High temperatures increase fire danger because they heat fuels and reduce water content, which increases flammability. Humidity influences fuel ignition and how intensely fuel burns. A decrease in relative humidity causes the fuel to become drier and will ignite easier and burn more intensely. Wind can increase burning in the direction that it is moving. Wind carries heat from a fire into unburned fuels drying them out and causing them to ignite easier. The wind may also blow burning embers into unburned areas ahead of the main fires starting spot fires (25).

Fire protection in these areas is difficult because the tactics used for wildland-fire suppression cannot be used for structure protection and suppression. The energy that is emitted from a wildland-fire is very dangerous to firefighters and homeowners and makes protection of homes almost impossible. One third of all firefighter deaths occur fighting wildfires. Many believe that URWIN areas increase the risks to firefighters significantly. Legally federal wildland protection agencies seldom have the responsibility to protect structures, and the legal responsibility for protecting structures on non-federal wildlands varies widely among state forestry agencies (26).

5. Dam Failure

Dams serve various functions and are built by different agencies and entities. Such agencies and entities include The Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, cities, counties, and even the private sector. Dams are built for uses such as hydroelectric power generation, flood control, recreation, water storage for irrigation, as well as municipal and industrial uses. Because of Utah's dry summers, it is critical that the winter snowfall is stored for uses all year round. 84% of Utah's stored water is behind federal dams, 650 non-federal dams hold more than 1.2 million acre-feet of water. Dam placement is important and needs to be in an area where they can collect and distribute the greatest amount of water. Dam sites with strong impermeable bedrock are the best in terms of strength. Other materials can be used to construct a dam such as earthen fill, concrete, roller compacted concrete, and rocks and mine tailings. Other dams are created by the enlargement or addition of existing lakes (Utah Natural Hazards Handbook 47-48).

"Rainy Day failures occur when floodwaters overstress the dam, spillway, and outlet capacities. The floodwater flows over the top of the dam and eventually erodes the structure from the top down. At this point the floodwater meets with the floodwaters from the rainstorm and a very destructive, powerful flood is created" (47).

Sunny Day failures are the most dangerous because they happen without any warning. Downstream residents or inhabitants have no time to prepare or even evacuate the area; the results are generally very catastrophic. Sunny day failures occur from seepage or erosion inside the dam. This erosion removes fine materials creating a large void that can cause the dam to collapse, or overtop and wash a way. Earthquake ground shaking or liquefaction can also create structure problems. Ground shaking will cause the dam to start piping, slumping, settling, or experience a slope failure similar to a landslide. The dam would than fail internally or overtop and wash away. Other sunny day failures occur when vegetation or rodents get into a dam and leave holes or tunnels that can lead to failure. Not all dam failures are catastrophic; sometimes a dam can fail and be drained and repaired without a damaging flow of floodwaters (47).

"Hazard ratings are determined by downstream uses, size, height, volume and incremental risk/damage assessments. The hazard ratings are: Low- insignificant property loss; Moderate- significant property loss; High- possible loss of life" (48). Over two hundred of Utah dams are rated as high-hazard dams.

6. Drought

According to the Drought Hazard Mitigation Plan, drought originates from a shortage of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. “Drought could be considered relative to some long-term average condition of balance between precipitation and evapo-transpiration in a particular area”. Drought is also related to the timing and effectiveness of the rains. Drought is a normal, recurrent feature of weather and climate but is a particular concern to all affected because of its devastating outcome. It occurs in almost all climatic zones with varying characteristics. “Drought is a temporary aberration and differs from aridity since aridity is restricted to low rainfall regions and is a permanent feature of climate”. Drought is a dry progression through the winter, spring, and summer months that could end in a year or last for many years. The number of dry years correlates with those affected, usually a one to two year drought affects only agriculture, while a three-year drought typically results in impacts on culinary water in the local areas and communities (13-15).

Conceptual definitions of drought help people understand the idea of a drought.

Operational definitions define the process of drought. This is usually done by comparing the current situation to the historical average, often based on a 30-year period of record. It is hard to develop a singular operational definition of drought because of the striking differences throughout the world (Defining Drought).

Meteorological drought is defined by the degree of dryness in comparison to an average amount and the duration of the dry period. Meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region (13-15).

Hydrological drought refers to the precipitation decline in the surface and subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale (13-15).

Agricultural drought occurs when there is not enough water available for a crop to grow. This drought links various characteristics of meteorological or hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, and reduced ground water or reservoir levels (13-15).

Socioeconomic drought occurs when the physical water shortage begins to affect people (16-20).

When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface and subsurface water are usually the last to be affected. Ground water users are often the last to be affected by drought during its onset but may be the last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates (18-19).

Measuring Drought:

Palmer Drought Severity Index (PDSI): Wayne Palmer developed the PDSI in 1965. The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions used by government agencies and states to trigger drought relief programs. The PDSI provides a measurement of moisture conditions that were “standardized” so that comparisons using the index could be made between locations and between months. This is the oldest index for measuring drought and is less well suited for mountainous land or areas of frequent climatic extremes and does not include man-made changes. The PDSI is calculated based on precipitation and temperature data as well as local available water content of the soil. This scale is given as

monthly values and is the most effective in determining long-term drought. The index ranges from –4 to 4 with negative values denoting dry spells and positive values indicating wet spells. The values 0 to -.5 equal normal, -0.5 to –1.0 equal incipient drought, -1.0 to –2.0 equal mild drought, -2.0 to –3.0 equal moderate drought, -3.0 to –4.0 equal severe drought, greater than –4.0 equals extreme drought. The wet spells use the same adjectives in the positive values (What is Drought).

Surface Water Supply Index (SWSI): Shafer and Defman developed the SWSI in 1982. This index uses the same basic classifications as the Palmer Drought Index and is designed to complement the Palmer in the western states. The SWSI is more of an indicator of surface water conditions and described as "mountain water dependent", in which mountain snowpack is a major component; calculated by river basin, based on snowpack, stream flow, precipitation, and reservoir storage. The objective of the SWSI was to incorporate both hydrological and climatological features into a single standardized index value. The pros and cons of the SWSI is that the index is unique to each basin. The SWSI is centered on 0 and has a range between –4.2 (extremely dry) and 4.2 (abundant supply). The index is calculated by combining pre-runoff reservoir storage with forecasts of spring and summer stream flow that is based on hydrologic variables (What is Drought).

Standardized Precipitation Index (SPI): T.B. McKee, N.J. Doesken, and J. Kleist of the Colorado State University, Colorado Climate Center formulated the SPI in 1993. The Standardized Precipitation Index was designed to quantify the precipitation deficit for multiple time scales; basically, the SPI is an index based on the probability of precipitation for any time scale. It assigns a single numeric value to the precipitation that can be compared across regions with different climates. The SPI is calculated by taking the difference of the precipitation from the mean for a particular time scale and dividing by the standard deviation. The SPI is normalized and so the wetter and drier climates can be represented in the same way. The SPI can provide early warning of drought and help assess drought severity yet the values based on preliminary data may change. The SPI values indicate an extremely wet period value at 2.0+, very wet equals 1.5 to 1.99, moderately wet is 1.0 to 1.49, -.99 to .99 is near normal, -1.0 to –1.49 moderately dry, -1.5 to –1.99 is severely dry, -2 and less is extremely dry. The time scales were originally calculated for 3-, 6-, 12-, 24-, and 48- months (What is Drought).

After review of 33 gaging stations, the drought analysis in Utah indicated that a localized drought has occurred on at least one stream every year since 1924. The duration of drought lasts longer in basins where runoff is mainly from snowmelt. The frequency of occurrence is greater for areas in the Wasatch Range than in the Wasatch Plateau, the mountain of southwestern Utah, or the Uintah Mountain range. Because Utah relies on surface water supplies, about 81% of the population relies on off stream water use and 35% of the population relies on surface water supplies, drought severely affects the people and industry of the whole state.

7. Infestation

Infestation has plagued this region since the early 1800's and continues to be a problem. Infestation is known as a parasite that over-populates in numbers or quantities large enough to be destructive, threatening, or obnoxious. Past infestation events have been devastating enough for presidential disaster declarations because of the destruction to food supplies that affect wildlife, livestock, and agricultural lands including alfalfa, wheat, and barley. Crickets, katydids, grasshoppers, and worms tend to be the most damaging and affect the rural areas the most. With the recent drought in the area the predators decrease. The drought also affects the food supplies and so the insects begin to search over a wider area when in search of food.

8. Severe Weather

Avalanche: According to Sandra Eldredge, Utah Geological Survey "a snow avalanche is the rapid down-slope movement of snow, ice, and debris. Snow avalanches occur in the mountains of Utah as the result of snow accumulation and unstable snowpack conditions." Ground shaking, sound, or a person treading in an avalanche area can trigger a slide that can cover a wide area or can be concentrated to a smaller more or narrow path. An avalanche consists of a starting zone, a track, and a runout zone. The starting zone is where the ice or snow breaks loose and starts to slide; this zone can be triggered by human and/ or natural activities. Human induced avalanches can result from snowmobilers, backcountry skiers, or other outdoor recreationalists triggering the avalanche because of ground shaking. The two main natural factors that affect avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Other factors that contribute to the stability of the snowpack include the amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. The Track is the grade or channel down which an avalanche travels. The runout zone is where an avalanche stops and deposits the snow. For large avalanches, the runout zone can include a powder-or windblast zone that extends far beyond the area of snow deposition. In Utah, avalanches are the number one natural hazards that kill more people and ironically are triggered by the victim. Each winter an average of four people die in Utah due to avalanche activity (Utah Natural Hazards Handbook 50-53).

Weather and terrain conditions affect avalanche conditions. The weather controls the durations and the extent of an avalanche while terrain is the element that determines where, why, and how an avalanche occurred. In Utah, the months of January through April pose the greatest avalanche potential. Weather related aspects that affect the snowpack stability include rate of accumulation, amount of snowfall, moisture content, wind speed and direction, and snow crystal type. Wind can deposit snow 10 times faster than snow falling from a storm without accompanying wind. This affects avalanche potential because the underlying weak layer of snow cannot adjust to the new load. Rain and the melting of snow can almost instantly cause an avalanche because of the added weight 50-51).

Terrain includes such variables as slope, aspect, elevation, roughness and angle. The slope is important in understanding where an avalanche will occur. Slopes greater than 45 degrees are too steep because the snow continually sluffs off, however slopes greater than 20 degrees can produce avalanches. Optimum slope degree is between 30 to 45 degrees, which is also the optimum angle for backcountry skiers. This slope angle is where approximately 99.9 percent of avalanches occur. The slope aspect and elevation affect the snow depth, temperature, and moisture characteristics of the snowpack. Slope aspect, such as north facing or shady slopes usually produce more avalanches and more persistent avalanche hazards occur during mid winter months. In the spring, south facing slopes produce more wet avalanches from the strong sun (Utah Avalanche Center).

Slope shape and roughness correlate with snowpack stability. Roughness identifies boulders, shrubs, and trees that can help slow, or reduce avalanche speed and impact. A bowl shaped slope is more prone to an avalanche than a ridge or cliff.

Dry avalanche is when a cohesive slab of snow that fractures as a unit slides on top of weaker snow and breaks apart as it slides. Dry slab avalanches occur usually because too much additional weight has been

added too quickly, which overloads the buried weak layer, even the weight of a person can add a tremendous stress to a buried weak layer. Dry snow avalanches usually travel between 60-80 miles per hour within 5 seconds of the fracture and are the deadliest form of snow avalanche (Utah Avalanche Center).

Wet Snow avalanches occur for the opposite reason of dry avalanches; percolating water dissolves the bonds between the snow grains on the pre-existing snow, which decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour (Utah Avalanche Center).

Avalanches can result in loss of life as well as economic losses. What are at risk are some communities, individual structures, roads, ski areas, snowmobilers, backcountry skiers, snowshoers, snowboarders, and climbers. Avalanches can reach speeds up to 200 miles per hour and release enough force to wipe out everything in its path. One of the major consequences of snow avalanches is the burial of structures, roads, vehicles, and people in the runout zone where tens of feet of debris and snow can be deposited (51).

Severe Storm: Winter storms gain their energy from the collisions of two air masses. In North America a winter storm is usually generated when a cold air mass from dry Canadian air moves south and interacts with a northward moving warm moist air mass from the Gulf of Mexico. The position where a warm and a cold air mass meet is called a front. If cold air is advancing and pushing away the warm air the front is known as a cold front. If the warm air is advancing, it rides up over the cold air mass and the front is known as a warm front. A winter storm will typically begin under what is known as a stationary front. A stationary front is when neither air mass is advancing. The atmosphere will try to even out the pressure difference by generating an area of lower pressure; this creates wind that blows from high pressure towards a low-pressure area. As the air travels toward the center of the low-pressure area it is pushed up into the colder regions of the upper atmosphere because it has nowhere else to go. This causes the water vapor to condense as snow in the northern areas because of the colder temperatures. In the south, if the temperatures are warm enough the water vapor will fall as heavy rain in thunderstorms. Because of the easterlies in Northern America the winter storm moves quickly over the area and generally does not last longer than a day in one area. However, in Utah because of the Great Salt Lake “lake-effect” snowstorms can last for many days. This is because of the amount of moisture from an unfrozen body of water. When a strong cold wind blows over a larger area of water, the air can attain a substantial amount of moisture; this moisture turns into heavy snow when it reaches land causing a lake effect snowstorm (All About Winter Storms).

Strong winds often accompany a winter storm creating blizzard conditions; dangerous wind chill, severe drifting and can knock down trees, power lines, and utility poles (Severe Weather Safety).

Extreme Cold: Prolonged exposure to the cold can cause frostbite or hypothermia and can become life threatening (Severe Weather Safety).

Ice Accumulations can bring down electrical wires, telephone poles and lines, trees, and communication towers. Ice can also cause extreme hazards to motorists and pedestrians (Severe Weather Safety).

Heavy Snow can stop a region by stranding commuters, stopping the flow of supplies, disrupting emergency and medical services, close infrastructure and services (Severe Weather Safety).

Severe Thunderstorm usually last around 30 minutes and are typically only 15 miles in diameter. But they all produce lightning. They can also lead to flash flooding from heavy rainfall, strong winds, hail and tornadoes may also accompany a thunderstorm (Severe Weather Safety).

Extreme Heat: Heat-related illnesses affect people, this happens when their bodies are unable to compensate and properly cool themselves. Usually a body will sweat to cool itself, however under some conditions, sweating isn’t enough and a person’s body temperature will rise that can cause damage to the brain or other vital organs. This can happen when the humidity is high, sweat will not evaporate as quickly, preventing the body from releasing heat quickly; other conditions include age generally the elderly and young, obesity, fever, dehydration, heart disease, mental illness, poor circulation, sunburn, and prescription

drug use and alcohol use (Extreme Heat). Extreme heat can manifest in several ways including sunburn, heat exhaustion, heat stroke, and heat cramps (Severe Weather Safety).

Waterspouts are weak tornadoes that form over warm water and in Utah they can occur with cold late fall or with late winter storms (Tornadoes).

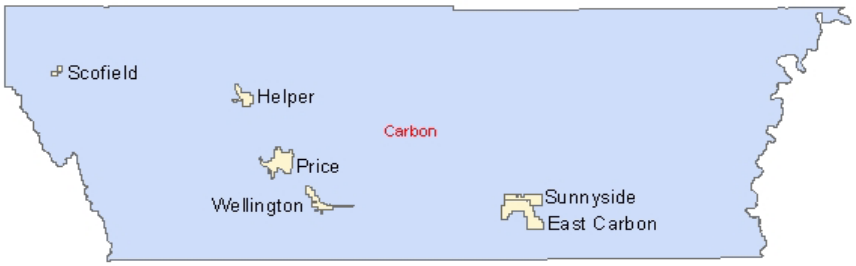
Tornado: Expressed as a violently rotating column of air extending from a thunderstorm to the ground. A tornado is often on the edge of the updraft or next to the air that's coming down from the thunderstorm. The tornado's vortex is a low-pressure area and as air rushes into the vortex, its pressure lowers and cools the air. This cooler air condenses into water vapor in the funnel cloud, known as the vortex, and doesn't touch the ground. The swirling winds of the tornado pick up dust, dirt, and debris from the ground, which turns the funnel cloud darker. Some tornadoes can have wind speeds up to 250 miles per hour or more with a damage zone of 50 miles long and 1 mile wide. But most tornados have winds less than 112 miles per hour, are less than 100 feet wide, and generally do not last longer than 10 minutes. They generally move along the ground 20-50 miles per hour. While a tornado can happen anytime, for the northern parts of the state tornadoes happen more frequently during the summer (Tornadoes). A change in wind direction and an increase in wind speed along with increasing height create an invisible, horizontal spinning effect in the lower atmosphere form a tornado while the rising air within the thunderstorm updraft tilts the rotating air vertically resulting in what we call a tornado. The area of rotation is generally 2-6 miles wide and extends through much of the storm (Tornadoes).

Scale: Tornadoes are classified by wind damage using the Fujita Scale that was accepted for use by the National Weather Service in 1973. The scale uses numbers from 0 through 5 with the ratings based on the amount and type of wind damage (Tornado Safety).

Fujita Scale
F-0: Winds up to 72 mph, Light damage, down tree branches, chimney damage
F-1: Winds 73-112 mph, Moderate damage, mobile home damage
F-2: Winds 113-157 mph, Considerable damage, mobile home demolished, trees uprooted
F-3: Winds 158-206 mph, severe damage, roofs and walls torn down, trains overturned, cars thrown
F-4: Winds 207-260 mph, Devastating damage, well-constructed walls leveled
F-5: Winds over 261 mph, incredible damage, homes lifted off foundation and carried, autos thrown as far as 100.

Part 7. Carbon County

Carbon County is a large county in terms of land area and is made up of six municipalities: East Carbon City, City of Helper, Price City, Scofield Town, Sunnyside City, and Wellington City. Carbon is located in the mid-eastern portion of the State.



A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rate of Change, and Population and Development Trends is important in understanding the impacts that a natural hazard would have on a local community. Population numbers also identify the constancy of a community by determining the degree of change a community (Table 7-1).

Table 7-1 Carbon County Population

	Carbon County	East Carbon	Helper	Price	Scofield	Sunnyside	Wellington	Balance of Carbon	Southeast
1980 Census Population	22,179								54,124
1990 Census Population	20,228	1,270	2,148	8,712	43	339	1,632	6,084	49,801
2000 Census Population	20,422	1,393	2,025	8,402	28	404	1,666	6,504	54,180
2005 Population Projections	20,562								54,559
2010 Population Projections	21,801								57,699
2015 Population Projections	23,769								62,754
2020 Population Projections	25,236								66,489
2030 Population Projections	25,848								67,867
1990-2000 AARC	.01%	0.9%	-0.6%	-0.4%	-4.2%	1.8%	0.2%	0.7%	
2000-2030 AARC	0.79%								0.75%

1990-2000 Percent Change	1.0%								
Rank by 2000 Population	13								
Rank by Percent Change	29								
Rank by AARC	29								
Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.									

B. Economy

The principle towns in Carbon County include Price, Helper, Wellington, East Carbon and Sunnyside. The County's economy relies on coal mining, transportation/railroad, energy, government, services, trade, and tourism. Coal mining has long played vital role in the county's economic and social development. Utah Power and Light built a large electric generating plant in the county. Ninety-eight percent of the power for the company comes from coal-burning thermal plants (Carbon County). The College of Eastern Utah located in Price also plays a significant role in the County's cultural diversity and economic development.

In 2002, the Carbon County unemployment rate was 5.6 (just above the state's 5.1 percent average), non-farm jobs rose 3.4 percent in the first quarter and 6.5 percent in the second quarter, and the mining industry rebounded with around 180 jobs. The service sector (trade, transportation, information, recreation, lodging, and food services) expanded during the first two quarters of 2002 along with fabricated metal manufacturing, construction jobs, health care and social assistance, and goods-production employment. On the downside was the trucking and rail transportation businesses and local government jobs, namely education. The 2002 outlook continues to see an upward trend, but relies heavily on the sustainability of mining jobs (Carbon County Trends). The 2000 estimated average house value is $78,637 (Annual Statistical).

C. Transportation and Commuting Patterns

The major transportation routes within Carbon County are Highways 6, 10, 123, and 191. The principle north-south corridors through the county are Highways 6 and 191. State Highway 10, between Price and Emery, is the major highway for the populated section of the county, connecting Price to I-70 to the south. Highway 123 runs from highway 6 east through the towns of East Carbon City and Sunnyside (Traffic Volume Map).

D. Land Use and Development Trends

Seventy-six percent of the property in Carbon County is owned and managed by the federal government, 8.7% is owned by the State, and 13.7% is privately owned (Consolidated Plan). These land ownership patterns are similar to many of Utah's rural counties. Because the Federal government administers the majority of the land within Carbon County they play a large part in mitigation efforts identified in subsequent sections of this plan. In many cases city development is surrounded by federal land boundaries.

Land development trends for the last 100 years have been principally influenced by the volatile mining industry. Over the last twenty-five years the county has experienced slow and steady development growth mainly in Price, Helper, Wellington, and East Carbon. As available lots were developed within municipalities, growth spread to small and medium sized lots along county roads and/or unincorporated portions of the county. Agricultural growth has also increased with the purchase of "mini-farms" from one-

half to twenty-acres. Suburban development in the larger communities has increased the demand for more community services and infrastructure.

Price City, considered a regional hub city, hosts the county seat and retains the majority of the region's businesses as well as a junior college. Price City is considering annexing surrounding residential and commercial developments.

Carbon County's second largest city, Helper City, is experiencing a financial depression due to closures of the bigger mines (Castle Gate and Willow Creek), and a consolidation of the railroad. The city is currently struggling to restore its historic downtown district and to rejuvenate its infrastructure.

Wellington is the third largest city within Carbon County. Wellington's economy is based on agriculture and a few small businesses and has always struggled with growth. Wellington functions as a bedroom community of Price City and the surrounding areas.

In 1981 the county adopted development codes and building ordinances. In March 2003 these codes and ordinances were revised.

Over the last ten years Carbon County's population growth has been below 1% overall. This trend includes seasons of both local and countywide negative growth. As a result, overall development has been minimal. Building Permits issued from 1998-2002 are as follows.

- Residential permits consist of a large variety of construction activity on residential premises including (but not limited to) remodels, additions, gas meter, electrical upgrade, re-roof, garage, single-family dwellings, manufactured homes, and mobile homes in parks.
- Dwelling permits include single-family dwellings, manufactured homes (new and used), and mobile homes in parks.
- Commercial permits include all construction activity on commercial property.
- Industrial permits include mining, gas wells, etc.

GORDON CREEK & CARBONVILLE & WESTWOOD

310	Residential
139	Dwelling
15	Commercial
10	Industrial

SPRING GLEN & KENILWORTH

164	Residential
24	Dwelling
3	Commercial
4	Industrial

SOUTH PRICE & MILLER CREEK & DRUNKARDS WASH & HIAWATHA & RIDGE RD

314	Residential
124	Dwelling
33	Commercial
25	Industrial

COAL CREEK & CLARKS VALLEY & NINE MILE

22	Residential
12	Dwelling
1	Commercial
11	Industrial

SCOFIELD MOUNTAIN AREA & CLEAR CREEK & BEAVER CREEK

146	Residential
54	Dwelling
2	Commercial
0	Industrial

SCOFIELD TOWN

46	Residential
3	Dwelling
1	Commercial
0	Industrial

HELPER & SPRING CANYON

197	Residential
9	Dwelling
9	Commercial
0	Industrial

EAST PRICE

4	Residential
5	Dwelling
9	Commercial
4	Industrial

WELLINGTON

193	Residential
66	Dwelling
5	Commercial
1	Industrial

SUNNYSIDE & WHITEMORE CANYON & BRUIN

42	Residential
6	Dwelling
1	Commercial
1	Industrial

Employment

Five hundred and seven people entered the Carbon county workforce last year. This is an increase of 5.3% over the previous year. However, the overall unemployment rate increased from 6.96% to 8.34%, or a 1.37% total rate increase. This means that only 66% of the new entries found gainful employment, assuming that last year's workforce retained their employment status.

Residential

Most residential growth in Carbon County occurs in the Circle K and Westwood areas just west and outside of Price City boundaries. The largest growth in the county occurs in summer homes in and around Scofield Town. Real estate sales are higher this year than last by 281.4%, but most sales are of existing stock rather than new construction.

Commercial

Most commercial development occurs in and around Price city.

Industrial

Most heavy industrial development has occurred south of Price along Highway 10 and on Ridge road.

Natural Resource Production
Carbon County mining revenues are down 24.0% from last year -- from $11.6 million to $8.8 million. Development of gas wells and high-pressure gas lines in and around the Drunkards Wash area has slowed down recently. Wholesale gas sales are down by 12.6% from last year. Bill Barrett Corp. is contemplating a major development in the Northeastern part of the county around Nine-Mile canyon that may be three times larger in volume than previous county fields.

Roads and Infrastructure
UDOT is currently in the process of widening U.S. 6 from Price to Wellington from two lanes to four. Crews are currently relocating utility lines, which should be completed in November 2004. UDOT is also doing a rotomill, overlay and chip seal project on U.S. 6 from Price Canyon Mile Post 202 to 238; this project was expected to be complete by September of 2003.

Water
Price city and Helper have their own water treatment and distribution but PRIWD handles wastewater. Sunnyside and East Carbon cities jointly own water service through Grassy Trail.

Power
Utah Power supplies electrical power to all of Carbon County.

Carbon County's Future:
Carbon County has specified in the community plan that they will not spot zone, and will avoid practices not consistent with the community plan. Industrial development will be compatible with the limited water supply. Carbon County is also looking at rezoning the areas that are not appropriately zoned to ensure that industry types will remain consistent with their locations. Carbon County will continue to allow for various types of residential development and will keep these areas away from industrial zones and high-volume traffic corridors.

Carbon County will preserve open lands and assist farmers to keep these lands in agricultural production. Preservation can take place through the formation of Agriculture Protection Areas, zoning, and by easing the demand for those lands. The county will also preserve some areas of the mountains and hillsides for no development. Areas that provide critical wildlife winter range and critical watershed will be excluded from development. The county will also preserve the quality of its communities and rural areas, and develop an outdoor advertising sign ordinance.

The county will also protect and enhance those areas that have potential for outdoor activities. The Price River corridor will be developed and enhanced with trails. Preservation of access to the trails systems and planning of residential areas near parks and trails will be encouraged.

As cities and towns have incorporated and grown in the county, incompatible land uses have risen along boundaries. Coordination between municipalities for future development plans will reduce future incompatibility.

E. Risk Assessment

The risk assessment process found Carbon County to be vulnerable to the following hazards: Dam Failure, Flood, Wildland Fire, Landslide, Problem Soil, and Infestation. Carbon County is also vulnerable to drought, severe weather and to a lesser degree - earthquake; these hazards are all covered in a regional annex as Carbon County's condition affects the entire region. Vulnerability maps (found at the end of this section), were compiled for the hazards of dam failure, wildfire, landslide, problem soils, and earthquake. A GIS based risk assessment was completed where appropriate. Refer to Appendix C for a complete list of the critical facilities.

1. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H Dam locations are mainly in the southeastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

Description of Location and Extent

Twenty dams are located in Carbon County, but only one dam is considered a high hazard. A high hazard is defined as a possibility of life being lost due to dam failure. Two dams are listed, as having a moderate hazard rating, meaning there is a significant likelihood of downstream property loss if the dam were to fail. The remaining seventeen dams have a low hazard rating; meaning if they were to fail there would be insignificant property loss (Table 7-4). All dams, regardless of rating should be monitored. It should be noted, dam safety hazard classifications are in the event of dam failure and are based upon the consequences of dam failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Table 7-4 Dam Hazard Rating

Dam Name	Hazard Rating
1) Scofield Reservoir	High
2) Grassy Trail Reservoir	High
3) Sunnyside Co-Generation Reservoir	Moderate
4) Price Storm Water DB	Moderate
5) Anderson East	Low
6) South	Low
7) US Steel Corp Tailing Up	Low
8) Sunnyside Cogeneration Dragert	Low
9) US Steel Corp Storage	Low
10) US Steel Corp Tailings	Low
11) Mud Springs Reservoir	Low
12) Olsen	Low
13) Powell	Low
14) Millerton	Low
15) Abbott	Low
16) Castle Valley SP SVC DST- Elmo	Low
17) Desert Lake- Desert Lake Dike	Low
18) Rowley Brothers	Low
19) Desert Lake –Wash Lake	Low
20) Desert Lake –Old Desert Lake	Low
21) Desert Lake –Fawn Lake	Low

In the following narrative, downstream towns have been identified that could be potentially affected if any of the identified reservoirs were to breach. However, potential dollar losses were unable to be evaluated for dam failure due to the lack of dam inundation maps that would be needed to conduct such a study.

East Carbon and Sunnyside Cities

The Grassy Trails Reservoir was built in 1952 and is jointly owned by East Carbon and Sunnyside Cities. A possible dam breach would affect both East Carbon and Sunnyside, which are 7 miles from the reservoir. This reservoir is considered to have a high hazard threat and the need for mitigation is imminent. The reservoir storage at the spillway crest is 916 acre-feet and the storage at the dam crest is 1,156 acre-feet. Maximum dam breach flow would be 16,000 cubic feet per second.

The Sunnyside Dam has a moderate hazard rating. It was built in 1992 and is owned by Sunnyside Cogeneration Associates. The reservoir storage at the open channel spillway is 123 acre-feet. The first downstream town is East Carbon City, which is only 0.5 miles away.

Helper City, Spring Glen, Carbonville, Price City, and Wellington City

The Scofield Dam is 10 miles northeast of the town of Scofield. It was constructed in 1943-1946 and has a 73,600 acre-feet capacity. If it were to fail, it would exhibit a natural breech failure. The drainage area is 161 square miles, the storm duration could last 80 hours, and the peak inflow is 41,000 cubic feet per second. This dam does not have a hazard rating at this time but if it were to breach many areas near the Price River would suffer severe damage from the water and from the lack of the water, including parts of Helper, Spring Glen, Carbonville, Price, and Wellington. Most of the populated areas of the entire county depend heavily on this large water supply.

Price City

The Price Stormwater Dam, owned by Price Municipal Corporation, is planned and/or under construction at the time of the writing of this plan. The reservoir storage at spillway crest will be 900 acre-feet. The first downstream town is Price located just 0.1 miles away. At this time the dam has not been rated.

Vulnerability Assessment

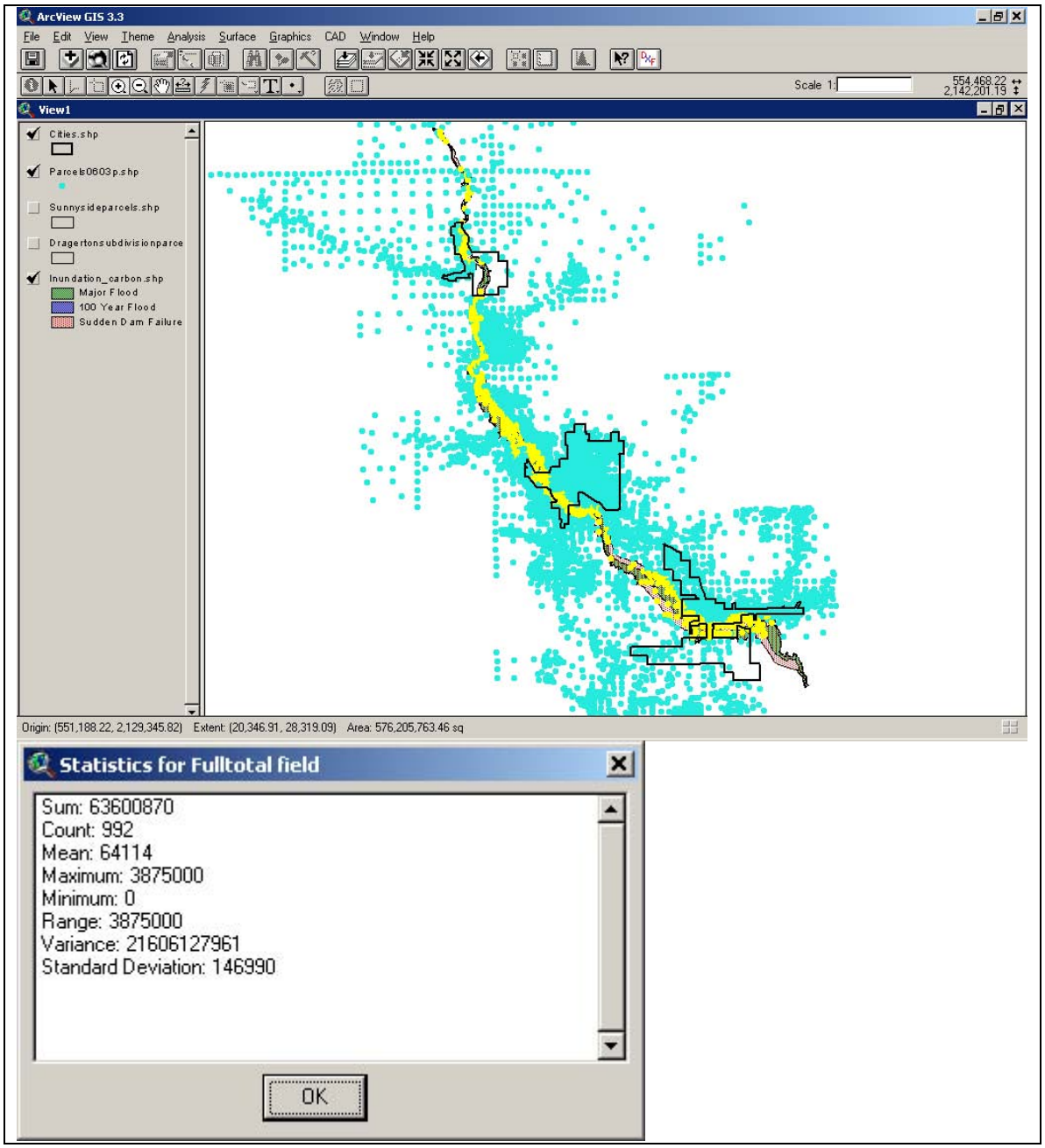
The risk assessment values for dam failure were difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. The municipalities, roads, critical facilities, and GIS layers were superimposed over the dam identification layers. This analysis reveals the geographic extent of the dams and the critical facilities within the hazard areas. This analysis could not identify potential dollar loss estimates using the available data.

The Carbon County GIS Department overlaid county assessor data, and parcel data from Census 2000 and 2001 with county dam inundation maps.

Figure 7-1, the process used to figure the statistics shown was by selecting the parcels that intersect with the inundation zone. Out of 1498 records 177 of these have either 0 or null value. There are approximately 100 parcels in Helper City that are missing (Figure 7-1).

Figure 7-2, the process used to figure the statistics shown was by selecting the parcels that intersect with the inundation zone. Out of 172 records 50 of these have either 0 or null value. Some parcel information was not available (Figure 7-2).

Figure 7-1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View1
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Parcels0603p.shp
Sunnysideparcels.shp
Dragertonsubdivisionparce
Inundation_carbon.shp
Major Flood
100 Year Flood
Sudden Dam Failure
Origin: (551,188.22, 2,129,345.82) Extent: (20,346.91, 28,319.09) Area: 576,205,763.46 sq
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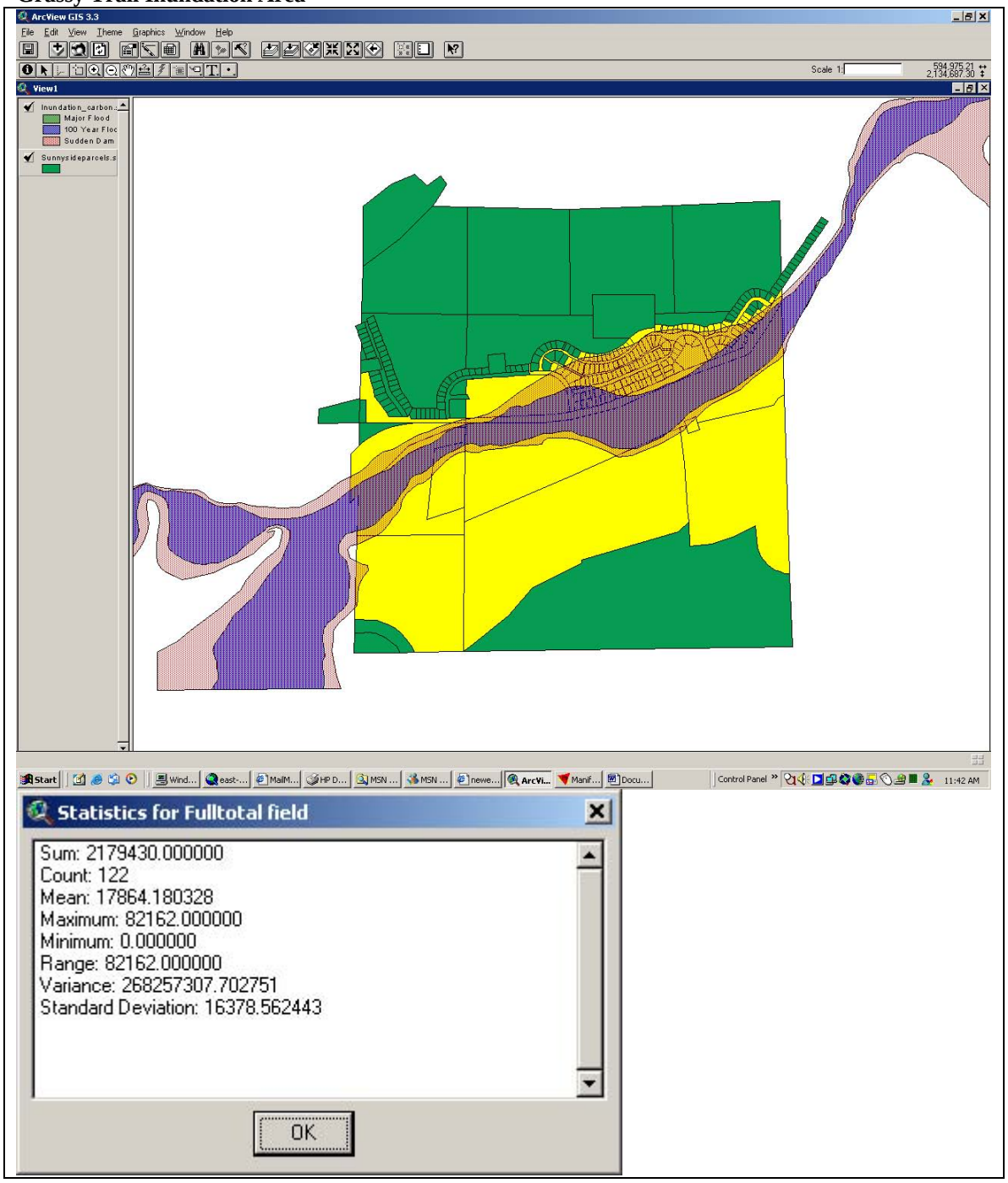
Sum: 63600870
Count: 992
Mean: 64114
Maximum: 3875000
Minimum: 0
Range: 3875000
Variance: 21606127961
Standard Deviation: 146990
OK

Figure 7-2

Grassy Trail Inundation Area



2. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	See map in Section H		
Seasonal Pattern or Conditions	Spring, cloudburst storms and heavy snowfall runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study, Hazard Analysis Plans, GIS data		

Description of Location and Extent

The local planning team members, including the County GIS department, were able to identify and map flood prone areas within the county. The core planning team utilized this research to conduct the risk assessments. The Army Corps of Engineers compiled a Flood Hazard Identification Study in 2003 that addressed unmapped communities within Southeastern Utah (Appendix E).

The entire county can experience flooding near the low-lying areas. The Price River and its tributaries, Cardinal Wash, Meads Wash, Spring Glen Wash, Spring Canyon Wash, Soldier Creek, Coal Creek, Hayes Wash, Deadman Creek, Drunkard Wash, Pinnacle Canyon Wash, Gordon Creek, Garley Canyon Wash, Consumers Wash, and Willow Creek all have the possibility to overflow. The Price River above the confluences of the Cardinal, Meads, Spring Glen, and Spring Canyon Washes, as well as Gordon Creek all tend to flood. The Price River is the main drainage system that flows southwest through Carbon. Overflow generally occurs during summer and fall cloudburst storms.

The following canals also pose a threat to Carbon County: Carbon, Price-Wellington, and Spring Glen. The Carbon Canal is an earthen canal that could potentially affect the west side of Price, Westwood, and Robertson subdivisions. The Price-Wellington earthen canal could threaten the north half of Price and Wellington. The earthen Spring Glen Canal could pose a threat to Spring Glen. The Price River floodplain between Price City and Helper City has the highest degree of development. The recurrence interval is a long-term average period between floods of a specific magnitude. However, rare floods could occur at short interval recurrence periods (review the Hazard History portion at the end of this section to identify past occurrences).

Vulnerability Analysis

Due to the lack of digitized floodplain maps potential dollar loss estimates were unable to be completed during the making of this plan.

3. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

The Division of Emergency Services and Homeland Security augmented a statewide wildfire database to represent wildfire vulnerability into five categories: Extreme, High, Medium, Low, and Very Low. These ratings cover all of Carbon County and are based on the type and density of vegetation in each area. Additional factors influencing wildland fires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Vulnerability Analysis

Loss estimates were made by identifying the wildland fire areas of extreme, high, and moderate within the county and then overlaying the infrastructure and the housing GIS databases to identify vulnerable areas. The following table includes the population, number of commercial, and number of residential structures inside extreme, high, and moderate wildfire risk areas within the county (Table 7-5).

Table 7-5 Structures and Population in Wildfire Area

Use Type	Extreme Risk	High Risk	Moderate Risk
Commercial Units / Annual Sales	16 / $10.9 Million	77 / $102 Million	60 / $150 Million
Residential Units / *Est. Replacement Cost	638/$50,170,406	954/$75,019,698	592/$46,553,104
Population	1347	2048	1491

*Replacement cost does not include contents, which would increase the values list by approximately 50%.

Wildfire Risk with Municipal Boundaries

Table 7-6 Wildfire Risk Area contains the number of acres in each wildfire risk area within the municipal boundaries of the following cities in Carbon County.

Table 7-6 Wildfire Risk Area

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Helper	305	188	12
Price	56	637	286
East Carbon/Sunnyside	843	2210	1171
Wellington	0	0	0

Table 7.7 Infrastructure affected by Wildfire

Item	Length (Miles)	Replacement Cost
Local Roads	41.57	$83,149,600
State Highways	46.31	$111,760,738
US Highways	8.18	$19,740,499
US Interstates	0.25	$900,000
Power Lines	143.93	$6,948,940
Gas Lines	0.00	$0

Table 7.8 Wildfire Hazard History

Date	Fire Name	Cause	Size
9/11/88	Bear Fire	Lightning	300 - 999 Acres
7/25/96	East Carbon	Lightning	1000 - 4999 Acres

4. Landslide

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

The map "Carbon County Landslide Hazard" shows the locations of potentially active landslides, and identifies historical landslides and their locations. Landslides are generally located in well-defined, localized areas, but when they occur is usually unpredictable. The impact of a landslide can be countywide.

Several areas in the county pose landslide risks. The largest landslide threat in the county is along the Book Cliff Mountain range where landslides have historically taken place. Specific areas include the Cave Hollow subdivision, which has development adjacent to steep slopes, and the areas of 100 East St. from 500 North to 800 North in Price. This area could be affected because the backyards of these homes are along the base of Wood Hill. Price Canyon has the water treatment facility that could be damaged in a landslide or slope failure event. The Wasatch Plateau has also experienced several landslides. A major landslide event took place north and west of the Town of Thistle in Utah County, but its impact severely affected Carbon County's economy. In 1983, the Thistle landslide destroyed the major highway and railroad connecting Price City with the Wasatch Front. Residents were unable to conduct business effectively in and out of Price City and freight costs increased dramatically.

Vulnerability Assessment

Tables 7-9 and 7-10 identify the infrastructure within landslide areas. In order to accurately capture landslide risks in these areas a more detailed assessment using parcel data rather than Census Block data is required.

Table 7-9 Inventory of Properties in Landslide Risk Areas

Use Type	Number	Estimated Value
Commercial Units	0	0
Residential Units	97	$7,627,789
Population	127	N/A
Total Estimated Loss $7,627,789		

Table 7-10 Infrastructure affected by Landslide

Item	Length (Miles)	Replacement Cost
Local Roads	1.01	$2,020,000
State Highways	0.00	$0
US Highways	0.00	$0
US Interstates	0.00	$0
Power Lines	1.46	$70,489
Gas Lines	0.00	$0

5. Problem Soil

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	See map in Section H.		
Seasonal Pattern or Conditions	Dependant on geology of county.		
Duration	Constant problem		
Analysis Used	Reviewed information and maps provided by County soil classification books, UGS, DESHS, AGRC, and local input.		

Description of Location and Extent

Carbon County has ongoing problem soil issues. Problem soils pose challenges to construction, utility trenching, and agriculture. The county contains large quantities of compacted mancos shale, as well as soils with high alkali content. Problem soil occurrences are high within the whole county (Refer to the map titled "Carbon County Problem Soils" at the end of this section to identify the location and/or geographic extent).

Vulnerability Assessment

Using the problem soils and major roadways map from DESHS, developed for the State of Utah and Census 2000 block data, the two maps were overlaid to indicate where households and roadways exist in relation to problem soil areas. The results from the analysis are presented in Tables 7-11, 7-12 and 7-13. The map "Carbon County Problem Soils " shows the areas of Problem Soils within Carbon County. The assessed values are considered to be high due to the fact that problem soils were taken into account during construction of most structures.

Table 7-11 Problem Soil Areas and Households within Municipal Boundaries

City Name	Acres within City Boundaries	Households in Problem soil area	Assessed Value
East Carbon/Sunnyside	1730	295	$23,197,915
Helper	857	890	$69,986,930
Price	1450	1961	$154,207,157
Wellington	698	788	$61,965,956

Table 7-12 Businesses in Carbon County located on Problem Soil Areas

City Name	Number	Annual Sales
Helper	76	$35,600,000
Price	287	$445,500,000
Sunnyside	10	$7,100,000
Wellington	36	$67,800,000

Table 7-13 Roadways in Carbon County located on Problem Soil Areas

Roadway	Miles	Estimated Replacement Cost
200 West	0.32	$639,489
4500 N Kenilworth Rd.	0.14	$281,561
Bryner Canyon	1.07	$2,147,590
Carbon Ave	4.15	$8,291,669
Front St.	0.35	$706,928
Highway 10	4.57	$9,132,011
Highway 6	2.31	$4,623,593
Ivy Street	0.16	$319,240
		$0
		$0
		$0
		$0
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		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
		$0
Kenilworth Rd	3.14	$6,284,346
Main Street	3.75	$7,492,319
Mill Street	0.14	$271,514
Spring Glen Rd	1.48	$2,968,355
State Highway 290	1.62	$3,239,574
State Route 10	3.56	$7,122,959
State Route 122	9.43	$18,865,779
State Route 123	11.65	$23,296,467
State Route 124	6.02	$12,041,025

State Route 139	0.70	$1,390,961
State Route 264	5.84	$11,681,174
State Route 55	0.98	$1,959,904
State Route 96	13.22	$26,439,169
Total	**119.65**	**$149,195,626**

6. Infestation

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Agricultural lands, Forested areas, areas of extreme drought, countywide.		
Seasonal Pattern or Conditions	Summer months, related to drought.		
Duration	Months to years		
Analysis Used	Reviewed information provided by UGS, DESHS, AGRC, Idaho's Forest Health Protections agency, Utah Forestry Fire and State Lands, Utah Forest Service, Utah State University Extension Service, and local input.		

Description of Location and Extent

In the past, Carbon County has been infested with numerous destructive insect species. Surveyors from Boise, Idaho's Forest Health Protection did a study based on infestation in Utah's forests. With help from the Forest Health Coordinator from Utah FFSL the following information was made available. Carbon County has 1,000 acres currently (May 2003) infested with grasshoppers. This infestation is due to Utah's drought, which started in 1999. Because of the amount of forested lands within the county, infestation risk potential is countywide. Drought weakens tree species rendering them more susceptible to disease; as the drought continues the probability of infestation also continues. Infestation affects all segments of the economy, particularly agriculture. Infestation once in place can last several months, even years.

In 1998, 4% or approximately 99,000 acres of Carbon County's total of 985,294 acres was surveyed. Of the 39,500 acres surveyed it was determined that the Douglas Fir Beetle affected 15 acres, the Spruce Beetle affected 119 acres.

In 1999, 10% or 98,529 acres of the county's total acres were surveyed, the Douglas Fir Beetle affected 65 of the surveyed acres, the Spruce Beetle affected 102 acres, and the Sub-Alpine Fir Complex affected 30 acres.

In 2000, 14% of Carbon County's total acreage was surveyed. The Mountain Pine Beetle affected 42 acres of ponderosa, 299 acres of Douglas Fir, and 184 acres of Spruce. The Fir Engraver Beetle infested 40 acres of Sub Alpine Fir Complex; and Aspen Discoloration affected 30 acres.

In 2001, 16% of Carbon County's acres were surveyed. The Mountain Pine Beetle Ponderosa affected 47 acres, the Douglas Fir Beetle affected 486 acres, the Spruce Beetle affected 1,238 acres, the Fir Engraver Beetle affected 39 acres, the Sub Alpine Fir Complex affected 2,356 acres, and Aspen Discoloration affected 246 acres.

In 2002, 26% of Carbon County's total acres were surveyed and the Mountain Pine Beetle Ponderosa affected 88 acres, the Douglas Fir Beetle affected 742 acres, the Spruce Beetle 539 acres, the Fir Engraver Beetle infested 75 acres, and the Sub Alpine Fir Complex affected 141 acres.

Vulnerability Assessment

Potential loss estimates were unable to be completed during the making of this plan due to the lack of digitized datasets related to infestation. Future studies and maps need to be completed to fully understand this hazard.

F. Hazard History

Identifying past hazard events is key in predicting where future events are likely to occur. The following available relevant information such as date, location, area impacted, and damage costs are identified in the table below (Table 7-14). Due to the frequency and geographic extent of problem soil, and some severe weather events past events have not been recorded and are therefore not identified in the table below.

Table 7-14 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Drought	1930-1936	Countywide	Municipal and agricultural water supplies.	Resulted in the construction of reservoirs, development of groundwater resources, and improved land management.
Drought	1953-1965	Countywide	Agriculture	10-25 year recurrence interval period.
Earthquake	August 2, 1968	Hiawatha		Richter magnitude 3.5
Earthquake	November 17, 1968	Wattis		Richter magnitude 4.6
Earthquake	June 11, 1971	Near Scofield		Richter magnitude 3.2
Earthquake	April 14, 1972	South of Sunnyside		Richter magnitude 3.6
Earthquake	August 10, 1973	West of Sunnyside		Richter magnitude 3.0
Drought	1974-1978	Countywide	Agriculture	10-25 year recurrence interval period.
Earthquake	1985-1986	County	Minor structure damage, no deaths.	
Flash Flood	August 6, 1901	West of Scofield	Winter Quarters. 2 deaths and property damage.	
Flood	1911		Structural damage.	
Flood	September 18, 1919	Helper City. Lost Creek	Price River flooded the city of Price to the canyon mouth above the city of Helper.	Cloudburst storm. Greatest recorded flood in county history with a discharge greater than 12,000 cfs. 200-year event.
Flash Flood	August 16, 1928	Nine Mile Canyon, West of Price City	1 death, property damage.	
Flash Flood	July 29, 1937	Price City	1 death, 3 injuries, property damage.	
Flood	September 12, 1939	Wellington City	Infrastructure damage	
Flood	September 13, 1940	Price/Helper	Homes, farmlands, and streams flooded. Roads blocked. Soldier Canyon closed due to sliding. Helper accumulated $10,000 in damage.	Heavy Cloudburst
Flood	August 5, 1942	Helper City. Price River.	Damage to homes, roads, rail-lines, mines,	

			and bridges. $75,000 damage.	
Flood/ Debris Flow	August 5, 1947	Sunnyside City	1 death, property damages.	
Flash Flood	August 5, 1948	Sunnyside City	1 death, property damages.	
Flood	July 17, 1953	Price City. Willow Creek Canyon	Property and road damage.	
Flood	July 5, 1961	Price City	Property and road damage.	
Flood	July 28, 1968	Spring Glen/ Kenilworth	Property and road damage.	Spring Glen water line and main street damage.
Flood	September 13, 1970	Price/ Helper. Price River and Willow Creek.	Property damage, agricultural losses, railroad lines blocked, $10,000 in damage in Helper City	
Flood	1983	Countywide-Presidential Declaration	Thistle landslide created severe economic loss of $7 million. Road, property, water, culvert, and sewer line damage.	Price River.
Flood/ Mud and Debris Flow	May 13, 1984	Clear Creek	1 death, property damage.	
Earthquake	August 14, 1988	Epicenter at San Rafael Swell, Emery County.	Impacted almost all of Carbon County.	Richter magnitude 5.3
Flood	1996	Wellington City. Center Street and Main Street.		Cloudburst storm. Flooded sewer mains and basements. $100,000+
Drought	1999-present	Countywide	Agriculture and Industry.	
Flood	2002	Wellington City. Main Street and 800 East to 1600 East.		Cloudburst storm
Severe Weather: Wildfire	2002	Price Canyon	3 miles north of Price Canyon	
Severe Weather: Infestation	May, 2003	County	1,000+ acres	Grasshoppers. Related to drought.

G. Mitigation Goals, Objectives, and Actions

Mitigation Strategies Workbook
Carbon County

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Solider Summit, Scofield, Colton, Spring Glen, Kenilworth, Carbonville, Wattis, Hiawatha, Helper, Price, Wellington, East Carbon, Sunnyside, and Clear Creek

WILDLAND FIRES

Countywide Problem Identification
Wildfire can significantly impact identified areas and communities in Carbon County.

Goal 1 – Priority HIGH

Objective 1 - Decrease fuel potential in areas if western Carbon County
Action: Remove dead and diseased trees
Time Frame: Ongoing
Funding: Private
Estimated Cost: Sale of trees will generate income
Staff:
Background:

Goal 2 – Priority HIGH

Objective 1 - Maintain adequate fire breaks between wildfire zones and residences in East Carbon County
Action 1: Secure up-to-date property mapping
Time Frame: Ongoing
Funding: None
Estimated Cost: Unknown
Staff: City staff to include; County Assessor, Recorder, and GIS Specialists
Background:

Action 2: Build roads between fire interface zone and residential areas
Time Frame: 6 months
Funding: City funds
Estimated Cost: Unknown
Staff: City staff and public works staff
Background:

Countywide Problem Identification
Urban contiguous fire impact lives and property in the county.

Goal 1 – Priority MEDIUM

Objective 1 - Prevent fire hazards within city limits
Action 1: Review building codes
Time Frame: Immediately
Funding: None
Estimated Cost: Minimal
Staff: Local

Background:

Action 2: Install parapets on building tops
Time Frame: Extended
Funding: Private
Estimated Cost: Unknown - Variable
Staff: Contract
Background:

DAM FAILURE

Countywide Problem Identification
National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.

Goal 1 – Priority HIGH

Objective 1 - Lives and property from dam failure inundation risk. Prevent or mitigate damage and loss of life from Scofield Dam failure.
Action 1: Install Remote Warning System building codes
Time Frame: Immediately
Funding: None
Estimated Cost: Minimal
Staff: Local
Background:

Action 2: Maintain periodic testing of dam
Time Frame: Immediate
Funding: State, Federal and Local
Estimated Cost: Unknown
Staff: Federal
Background:

Action 3: Build new bridge to bypass Scofield Dam Road
Time Frame: Undetermined
F**unding:** State, Federal and Local
Estimated Cost: $10,000,000
Staff: State and Local
Background:

Action 4: Construct series of dams on Lower Fish Creek
Time Frame: Ongoing/Extended
Funding: Unknown
Estimated Cost: $5,000,000 each
Staff: Contractor
Background:

Action 5: Construct water holding reservoir in Price Canyon
Time Frame: Begin now with proposals, could take several years
Funding: Unknown
Estimated Cost: $Millions
Staff: Contractor

Background:

Objective 2- Prevent or mitigate damage and loss of life from Grassy Trails Dam failure
Action 1: Install Remote Warning System
Time Frame: One year
Funding: Unknown
Estimated Cost: $30,000
Staff: Contracted
Background:

Action 2: Build riprap dike to redirect flow from Grassy Trails Dam failure
Time Frame: 3 years
Funding: County
Estimated Cost: $100,000
Staff: County employees
Background:

Objective 3 - Protect lives and property from Grassy Trail Dam failure.
Action 1: Obtain funding for engineering, equipment and long-term system maintenance
Time Frame: Unknown
Funding: Unknown
Estimated Cost: Unknown
Staff: City Administrative Staff
Background:

Action 2: Install sensors at dam site and monitor devices at City Offices
Time Frame: 6 months
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Private engineering firm will work with East Carbon and Sunnyside administrations
Background:

Action 3: Monitor dam
Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: City Administrative Staff
Background:

Objective 4 - Minimize safety risk and property damage to Sunnyside City from dam failure
Action 1: Construct riprap dike on the east side of Highway 13 from northern Sunnyside City boundary to Sunnyside Park
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Private construction firm to work with City
Background:

Action 2: Excavate wash
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Private construction firm to work with City
Background:

FLOODING

Countywide Problem Identification
Flooding continues to be of concern in the County and cities and towns within the County. The County experience flooding during spring snow melt and summer thunderstorm season.

Goal 1 – Priority HIGH

Objective 1 - Minimize safety risk and property damage to Carbon County residents due to flooding by establishing, upgrading and maintain structural control measures.

Action 1: Build catch pond on Meads Way
Time Frame: Underway
Funding: City and Federal
Estimated Cost: $100,000
Staff: City staff
Background:

Action 2: Build catch pond on Cardinal Wash
Time Frame: 2 years
Funding: State, County, and City
Estimated Cost: $75,000
Staff: County
Background:

Action 3: Build catch pond on Grassy Trails
Time Frame: 2 years
Funding: State, Federal, County, and City
Estimated Cost: $30,000
Staff: County and City
Background:

Action 4: Excavate wash
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Private construction firm to work with City
Background:

Action 5: Increase culvert size on Cardinal Wash at Highway 50-6
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: $500,000
Staff: UDOT
Background:

Action 6: Excavate wash
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Private construction firm to work with City
Background:

Action 7: Enlarge culvert and Pine Street and Edgehill Drive in Sunnyside City
Time Frame: 1 year
Funding: Federal Grant

Estimated Cost: Unknown
Staff: Private construction firm to work with City
Background:

Problem Identification
Reduce economic loss due to flooding

Goal 2 – Priority HIGH

Objective 1 - Promote flood insurance throughout the County
Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County and City Floodplain Administrators, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

DROUGHT

Countywide Problem Identification
Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority MEDIUM

Objective 1 - Minimize the loss of life, damage to property and disruption in commerce and governmental services caused by drought through proactive water conservation measures
Action 1: Promote water recycling utilizing secondary water sources
Time Frame: Underway
Funding: State, Federal, And Local
Estimated Cost: Unknown
Staff: City(s)
Background:

Objective 2 - Create new water storage facilities
Action 1: Construct new dam in Garley Canyon
Time Frame: 5 years
Funding: Federal, State, And Local
Estimated Cost: $100,000,000
Staff: Contractor
Background:

Action 2: Construct dam in Willow Creek Canyon
Time Frame: 5 years
Funding: Federal, State, And Local
Estimated Cost: $100,000,000
Staff: Contractor
Background:

Objective 3 - Find new water sources
Action 1: Research the possibility of "cloud seeding"
Time Frame: Immediately
Funding: County
Estimated Cost: $100,000
Staff: Contractor
Background:

Goal 2 – Priority MEDIUM

Objective 1 - Secure adequate water for culinary and agricultural needs of East Carbon and Sunnyside through structural measures

Action 1: Design and build silt control coffers at water inlets at Grassy Trail Reservoir to prevent buildup.
Time Frame: 1 year
Funding: Federal Grant
Estimated Cost: Unknown
Staff: Contractor, private engineering firms to work with cities
Background:

Action 2: Obtain funding to Build Range Creek water delivery tunnel
Time Frame: Unknown
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background:

Action 3: Tunnel from Range Creek dam site to drop off point
Time Frame: 2 years
Funding: Federal Grant
Estimated Cost: $100,000
Staff: Contractor, private engineering firms to work with cities
Background:

Action 4: Obtain funding to build Range Creek Dam
Time Frame: Unknown
Funding: Unknown
Estimated Cost: Unknown
Staff: City Staff
Background:

Action 5: Construct Range Creek Dam
Time Frame: 5 years
F**unding:** Federal Grant
Estimated Cost: $100,000
Staff: Contractor, private engineering firms to work with cities
Background:

LANDSLIDE

Countywide Problem Identification
There is a potential risk to structures located in areas identified Federal and state agencies and depicted in GIS as landslide risk areas.

Goal 1 – Priority LOW

Objective 1 - Minimize loss of life, damage to property and disruption in residents, commerce and government services caused by landslides through structural measures.

Action 1: Build retaining fences and momentum absorbers along highways
Time Frame: 5 years
Funding: Federal, State, And Local
Estimated Cost: $1,000,000
Staff: UDOT

Background:

Action 2: Dislodge large rocks along highways
Time Frame: Immediate
Funding: Federal, State, And Local
E**stimated Cost:** $100,000
Staff: UDOT
Background:

Action 3: Build retaining walls on residents identified at risk
Time Frame: 5 years
Funding: Individual
Estimated Cost: Variable
Staff: Unknown
Background:

Action 4: Develop pathways to capture falling rocks adjacent to residences
Time Frame: 5 years
Funding: Federal, State, And Local
Estimated Cost: $100,000
Staff: City and County
Background:

PROBLEM SOILS

Countywide Problem Identification
Problem soils are a risk to property and life due to its volatility

Goal 1 – Priority LOW

Objective 1 - Protect roadways
Action 1: Increase width of slope adjacent to roadways
Time Frame: Extended
Funding: Federal, State, And Local
Estimated Cost: Unknown
Staff: State, County, and City
Background:

Action 2: Educate homeowners about problem soil risk
Time Frame: 2 years
Funding: Local
Estimated Cost: $3,000
Staff Local
Background:

Action 3: Monitor and control water on alkali soils
Time Frame: Ongoing
Funding: Local
Estimated Cost: $3,000
Staff: Local
Background:

INFESTATION

Countywide Problem Identification
Infestation of noxious insects and bird species can impact the health, safety and welfare of County and its residents.

Goal 1 – Priority LOW

Objective 1 - Control insects and birds
Action 1: Insecticide spray
Time Frame: Ongoing
Funding: Local
Estimated Cost: $100,000
Staff: Local
Background:

Action 2: Remove dead and diseased trees
Time Frame: Extended
Funding: Private
Estimated Cost: Trees will be harvested by commercial enterprise.
Staff: Private
Background:

Action 3: Pigeon removal
Time Frame: Undetermined
Funding: Federal, State, And Local
Estimated Cost: $15,000
Staff: Local
Background:

SEVERE WEATHER

Countywide Problem Identification
Snowstorms, summer thunderstorms, hail, and high winds over eastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Priority MEDIUM

Objective 1 - Protect County from adverse affects of severe weather
Action 1: County participates in the Storm Ready program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Action 2: Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the

search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Carbon County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOC's to ensure they are grounded lightning, to include buildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Proposed alternate Command Centers (Public Works, Public Utilities), Sheriff's Dispatch, Command Vehicle(s) and associated equipment need to be protected from severe weather events including lightning.

HAZARDOUS MATEIALS

Countywide Problem Identification
Highway 6 is one of the main arteries going east and west in the State. In most places this is a two-lane highway that experiences numerous accidents and hazardous material incidents.

Goal 1 – Priority Medium

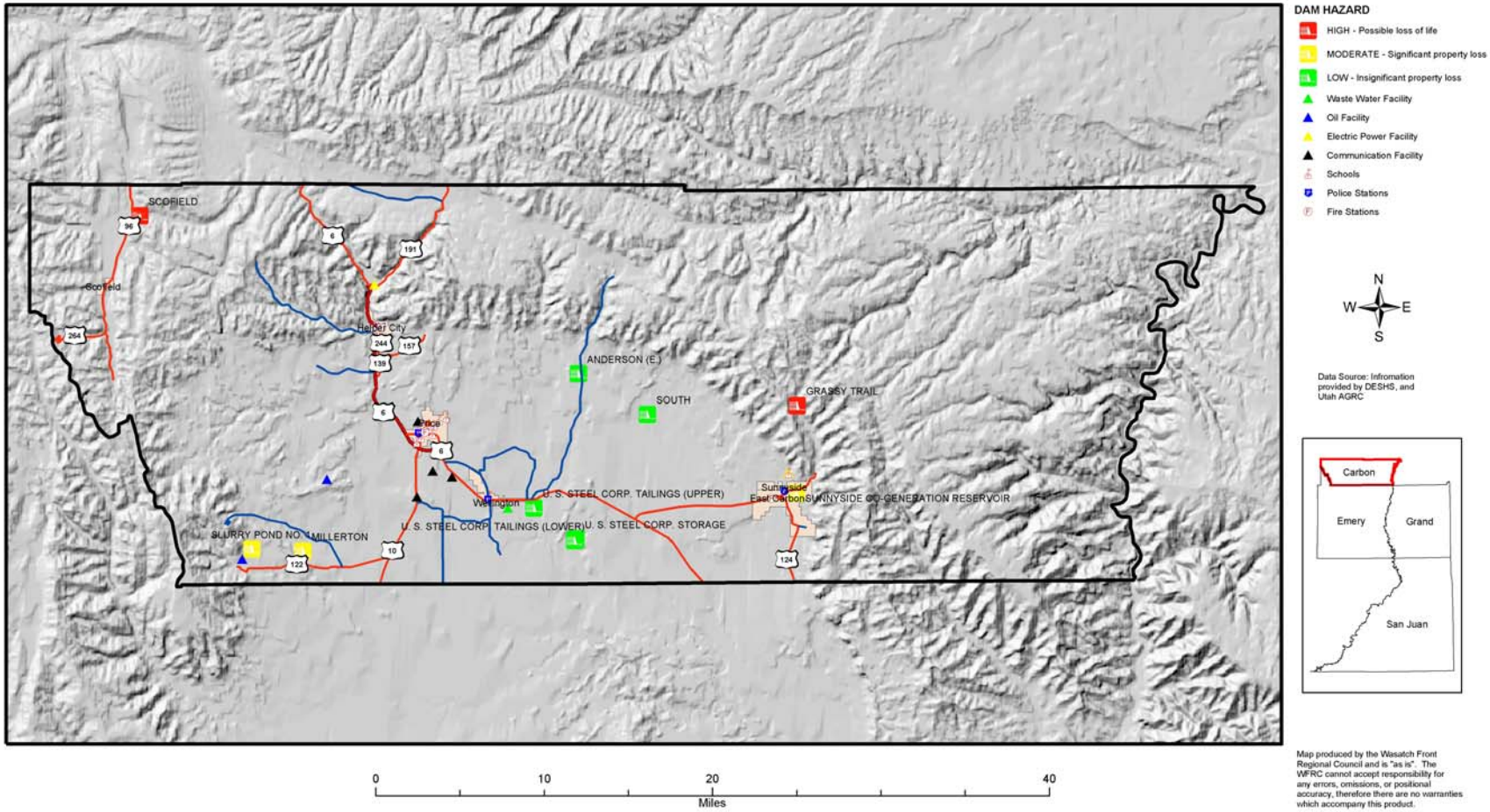
Objective 1 - Protect lives and property from hazardous materials spills.
Action 1: Work with County LEPC to help identify hazardous materials traffic on Highway 6
Time frame: Ongoing
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management/LEPC, State HMI
Jurisdictions: Countywide
Background:

H. Maps

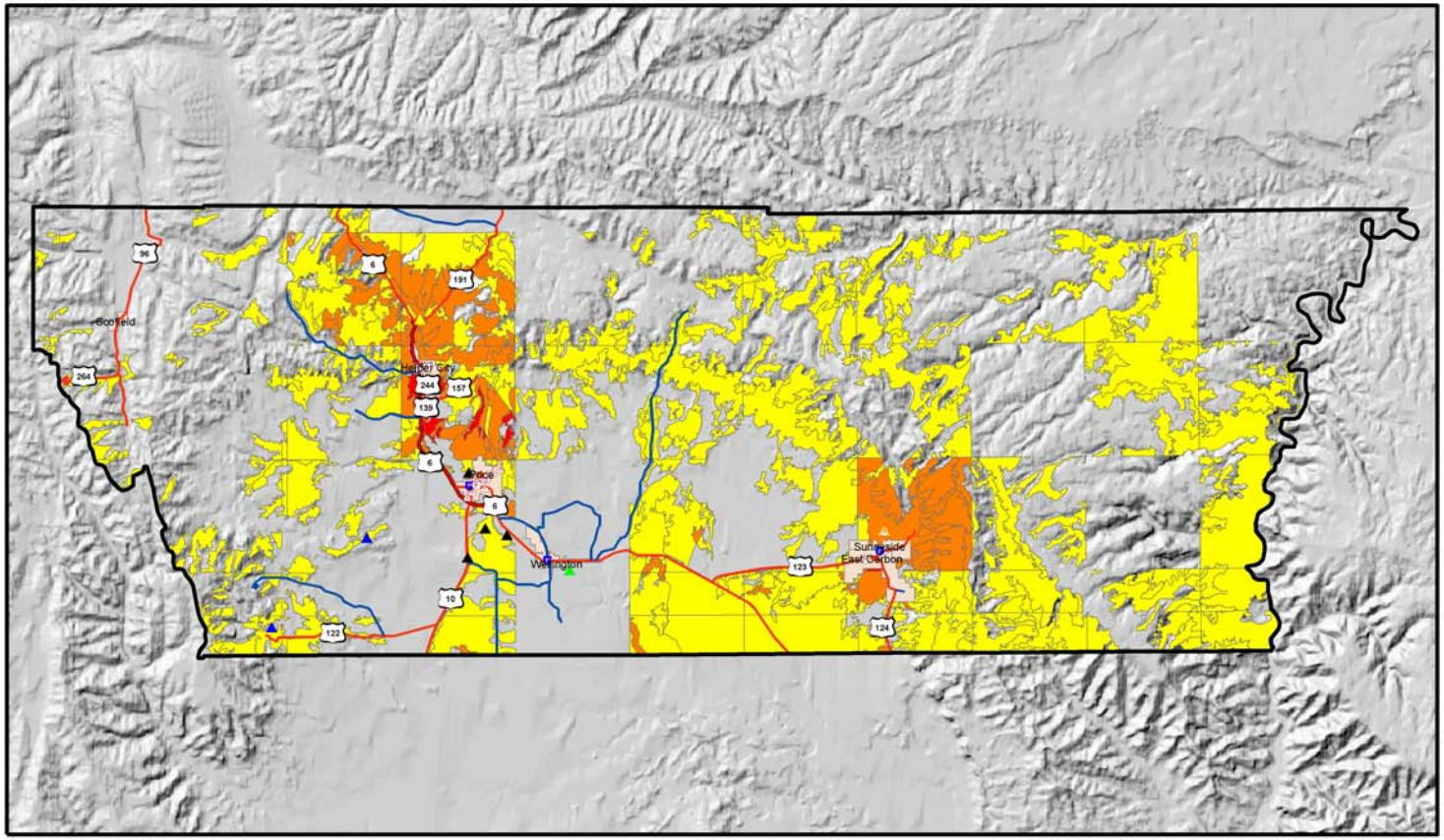
All of the following maps have been created for the purposes related to PDM using the best available data. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; As such, there are no warranties, which accompany the maps.

Map 7.1.1 Dam Hazard
Map 7.3.1 Wildfire Risk
Map 7.4.1 Landslide Hazard
Map 7.5.1 Problem Soils
Map 7.9.1 Earthquake Hazard

Carbon County Dam Hazard



Carbon County Wildfire Risk

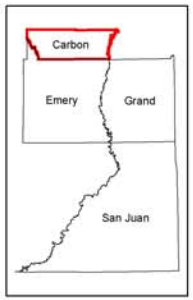


Wildfire Risk

- Extreme
- High
- Medium
- Waste Water Facility
- Oil Facility
- Electric Power Facility
- Communication Facility
- Schools
- Police Stations
- Fire Stations

N
W E
S

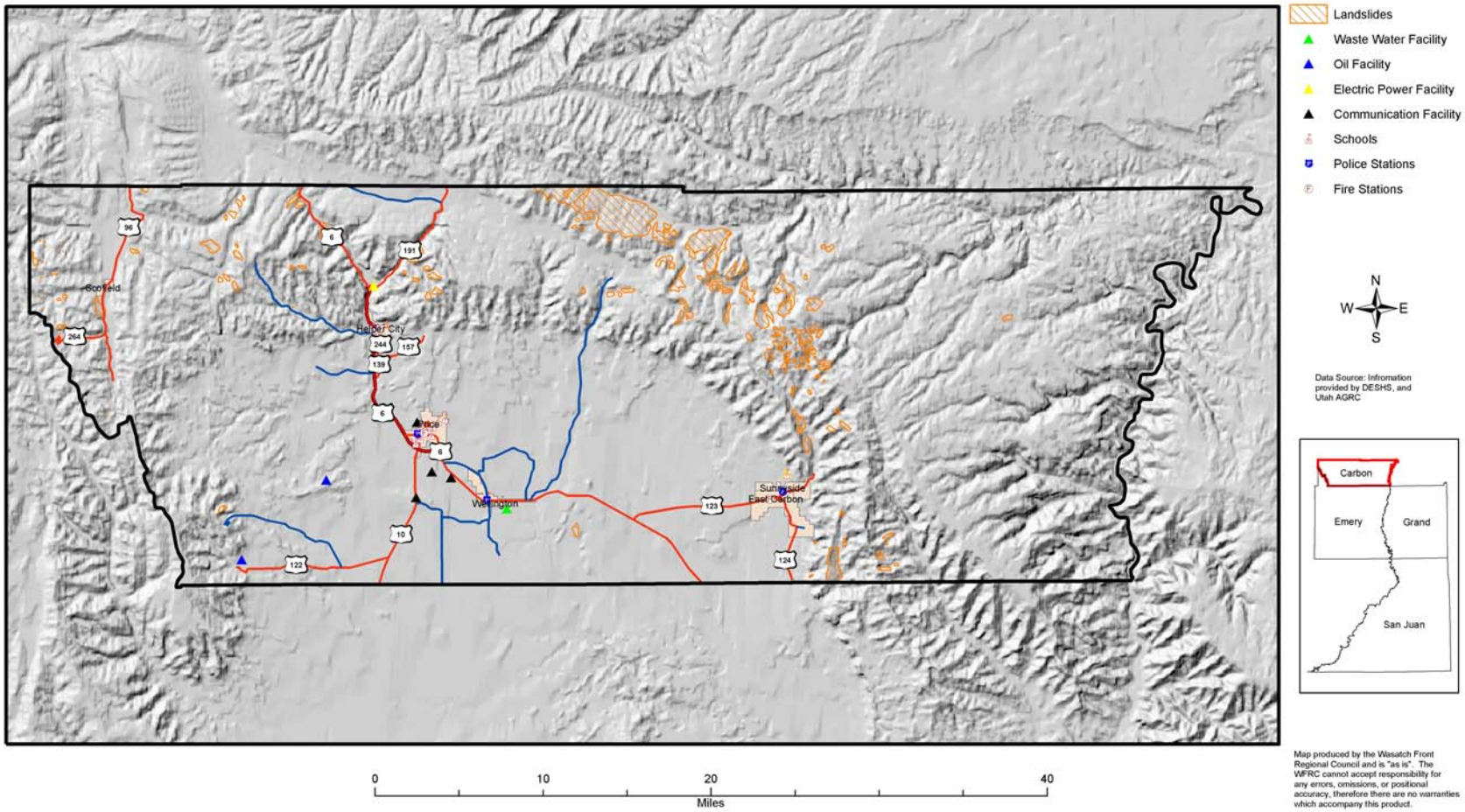
Data Source: Infromation provided by DESHS, and Utah AGRC



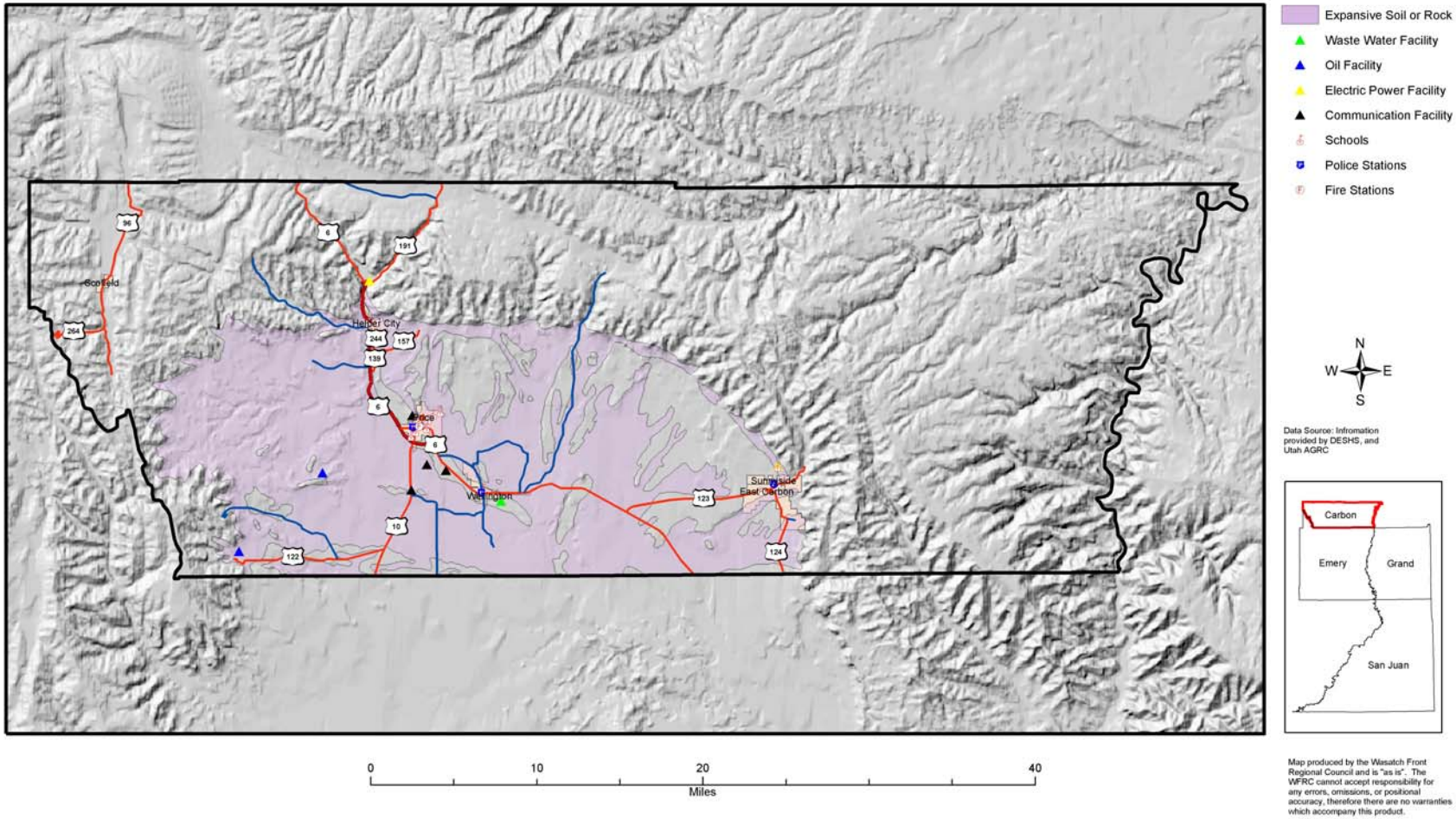
0 10 20 40
Miles

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Carbon County Landslide Hazard

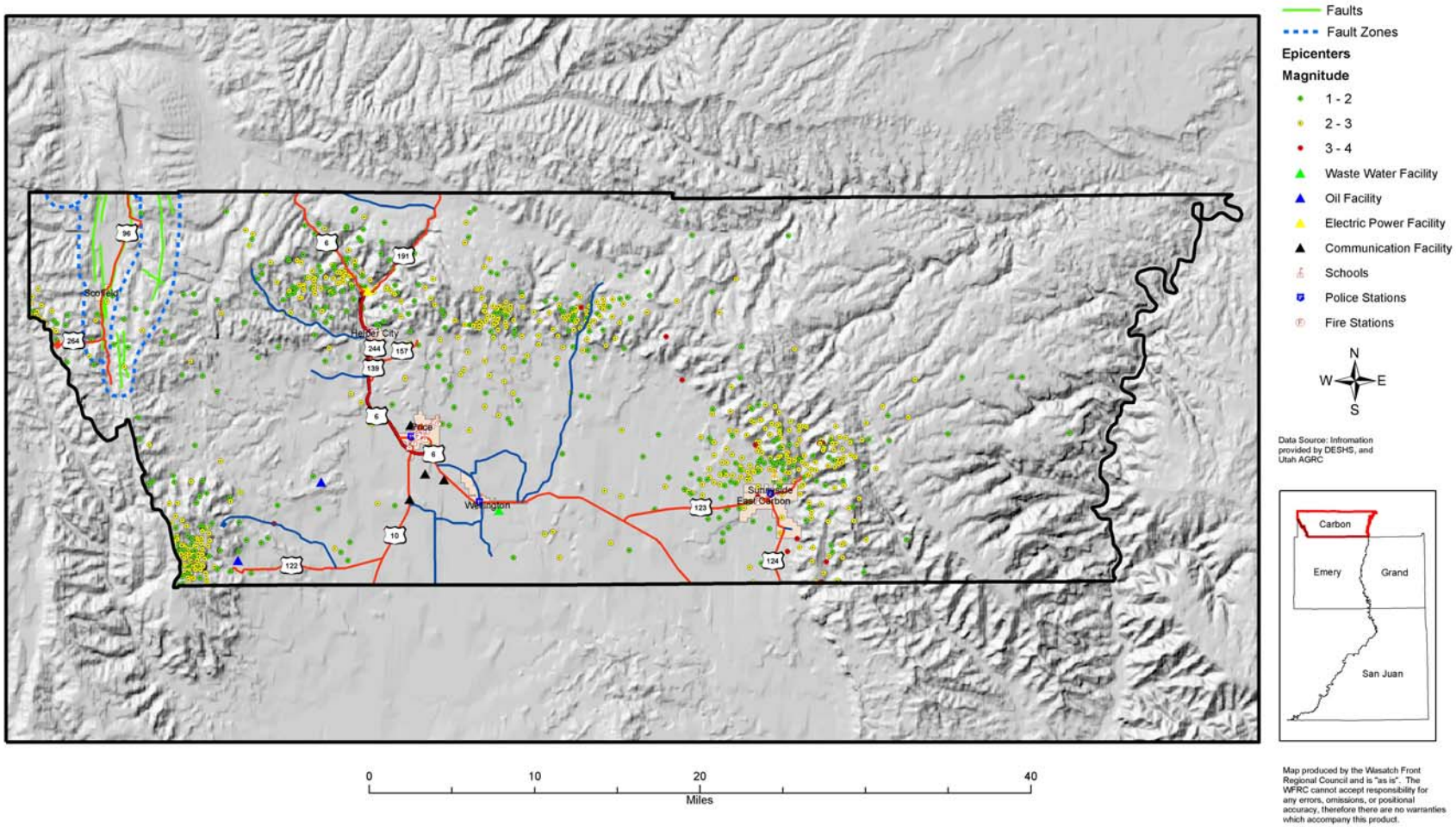


Carbon County Problem Soils



Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Carbon County Earthquake Hazard



Part 8. Emery County

Emery County includes nine municipalities: Castle Dale City, Clawson Town, Cleveland Town, Elmo Town, Emery Town, Ferron City, Green River City, Huntington City, and Orangeville City. Emery is located in the southeastern portion of the state.

A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rate of Change, and Population and Development Trends is important in understanding the impacts that a natural hazard may have on a local community (Table 8-1). Population numbers also identify the constancy of a community's population inflow and outflow data.

Table 8-1 Emery County Population

	Emery County	Castle Dale city	Clawson town	Cleveland town	Elmo town	Emery town	Ferron city	Green River city	Huntington city	Orangeville city	Balance of Emery County	Southeast Region
1980 Census Population	11,451											54,124
1990 Census Population	10,332	1,704	151	498	267	300	1,606	881	1,875	1,459	1,591	49,801
2000 Census Population	10,860	1,657	153	508	368	308	1,623	973	2,131	1,398	1,741	
2005 Population Projections	10,667											
2010 Population Projections	11,103											
2015 Population Projections	11,906											
2020 Population	12,455											

Projections												
2030 Population Projections	12,438											
1990-2000 % AARC	0.5 %	-0.3%	0.1%	0.2%	3.3%	0.3%	0.1%	1.0%	1.3%	-0.4%	0.9%	
2000-2030 % AARC	0.45%											0.75%
1990-2000 Percent Change	5.1%											
Rank by 2000 Population	19											
Rank by Percent Change	28											
Rank by AARC	28											

Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.

B. Economy

Emery County's economy struggled in 2002 with non-farm employment falling during the first two quarters; non-farm jobs dropped 4.0 percent in the first quarter and 1.5 percent in the second. The coal mining industry also lost jobs, as did utilities. Construction positions gave the economy a slight boost and manufacturing jobs were basically unchanged. Trucking, information, and local government employment, as well as retail and wholesale trade all saw a slight decline, while federal land management jobs increased. Emery County's economy will likely continue to struggle into 2003 with the national recession and uncertainty over energy prices while the construction and telecommunications growth will continue to provide a buffer to overall job losses (Emery County Trends). The 2000 estimated average house value is $82,909 (Annual Statistical).

C. Transportation and Commuting Patterns

The principle east-west corridor through Emery County is Interstate Highway 70. United States Highways 191 and 6 are main highways for both north-south traffic between Salt Lake City and southeastern Utah, and east-west traffic between Salt Lake City and Denver, Colorado. Along State Highway 10, between Price and Emery, lay the majority of the population of Emery County. Highway 10 is located on the east bench of the Wasatch Range. The Burlington Northern Santa Fe (BNSF) Railroad runs roughly parallel to US highway 6 and 191 from Green River through Price City (Hazard Analysis, Emery).

D. Land Use and Development Trends

Emery County is Utah's seventh largest county in terms of land area. Emery County encompasses 4,445 square miles of land of which 83% is federally owned, 10% is state owned, and 7% is privately owned.

The housing market has changed little in the last five years; the primary change has been an improvement in housing availability. From the fourth quarter of 2000 through the third quarter of 2001, housing costs increased by less than 2% district wide, with Grand County costs driving the increase. During this same period the average home cost in the Carbon and Emery County area sold for $86,376. In Grand and San Juan the average cost of a home through the third quarter of 2001 was $123,827.

Commercial housing development within the district continues to be practically non-existent. Lots are generally sold one at a time to a family that builds and then lives in the home. There is not a demand for the housing development that is seen in the faster growing urban corridor of the state. Also, development of larger multi-family projects is practically non-existent.

E. Risk Assessment

The risk assessment identified the following hazards in Emery County: Drought, Dam Failure, Flood, Earthquake, Severe Weather, and Landslide. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to maps and Part 6 for an explanation of the risk assessment process. According to this data there are a total of 21 identified critical facilities within Emery County, for the complete list refer to Appendix C.

Representatives from each Emery County jurisdiction contributed to the risk assessment analyses of each hazard within the identified hazard boundary (Section E). Drought, Earthquake, and Severe Weather are regional hazards and have been profiled as such (Part 4 Regional Data).

1. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H Dam locations are mainly in the Mid- to northwestern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

Description of Location and Extent

Hazard ratings are determined by downstream uses, size, height, volume and incremental risk/damage assessments. The hazard ratings are: Low-insignificant property loss; Moderate- significant property loss; High- possible loss of life. It should be noted, dam safety hazard classifications are in the event of dam failure and are based upon the consequences of dam failure, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Table 8.4 Emery County Dam Risk

Dam Name	Hazard	Acre-Feet Storage Capacity
1. BOR Huntington North	High	5,420
2. BOR Joes Valley	High	62,500
3. Cleveland	High	5,340
4. Miller Flat	High	5,560
5. Millsite	High	18,000
6. Utah Power and Light- Electric Lake	High	31,500
7. Castle Valley - Emery Town LWR	Moderate	N/A
8. Castle Valley - Emery Town UPR	Moderate	N/A
9. Castle Valley SP SVC DST- Orangeville	Moderate	N/A
10. Duck Fork	Moderate	N/A
11. Ferron Debris Basin No. 4	Moderate	N/A
12. Ferron Debris Basin No. 5	Moderate	N/A
13. Nielson (John)	Moderate	N/A
14. Potters Pond No. 1	Moderate	N/A
15. Potters Pond No. 2	Moderate	N/A
16. Utah Power and Light- Huntington	Moderate	N/A
17. Utah Power and Light- Huntington Set.	Moderate	N/A
18. Wilberg #1 (Northern)	Moderate	N/A
19. Wilberg #2 (Old Dam)	Moderate	N/A
20. Wilberg #3 (New Dam)	Moderate	N/A
21. Wrigley Springs	Moderate	N/A

* N/A – Not Applicable, none known at this time.

Castle Dale and Orangeville
The Joe's Valley Reservoir was inspected by the Bureau of Reclamation in July of 1990 and was classified to be a high downstream hazard to Orangeville and Castle Dale due partly to the faults that run directly under the reservoir contained by the dam.

Castle Valley Special Service District-Orangeville dam has a moderate hazard rating. It was built in 1983 and is owned by the Castle Valley Special Service District. It has 23 acre-feet reservoir storage at spillway crest and a maximum dam breach flow of 2,000 cfs in a 0.1 square mile drainage basin area. The first downstream town is Orangeville, located just 1 mile away. Castle Dale is just downstream and adjacent to Orangeville to the southeast

Ferron
The Millsite Reservoir was built in 1971 and modified in 1998. This reservoir has a high hazard rating and is owned by the Ferron Canal and Reservoir Company. The reservoir storage at spillway crest is 18,000 acre-feet and the storage at the dam crest is 20,000 acre-feet. The maximum discharge is 5450 cfs and the maximum dam breach flow would be 258,000 cfs. The first downstream town is Ferron located 3 miles away.

The Ferron Debris Basin No. 4 has a moderate hazard rating. This dam was built in 1970 and owned by Ferron Canal and Reservoir & Company. The reservoir storage at spillway crest is 44 acre-feet and the reservoir storage at dam crest is 61 acre-feet. The maximum dam breach flow is 7,000 cfs in a 1 square mile drainage basin area. The first downstream town, Ferron, is only 2 miles away.

The Ferron Debris Basin No. 5 has a moderate hazard rating. The dam's owner is Ferron Canal and Reservoir & Company and the dam was completed in 1970. The reservoir storage at spillway crest is 65 acre-feet with a 207 acre-feet storage area at the dam crest. Maximum dam breach flow would be 10,000 cfs in a 2 square mile drainage basin area. The spillway maximum discharge is 2080 cfs. The downstream town of Ferron is only 1 mile away.

Huntington
Cleveland Reservoir was built in 1909 and modified in 1985. The dam has a high hazard rating and the owner is Huntington-Cleveland Irrigation Company. The reservoir storage at spillway crest is 5340 acre-feet and the storage at dam crest is 6020 acre-feet. The spillway maximum discharge is 2446 cfs and the maximum dam breach flow would be 74,000 cfs in a 9 square mile drainage basin area. The first downstream town is Huntington, 25 miles away.

The Miller Flat Reservoir was built in 1948 and modified in 1985. The dam has a high hazard rating and the owner is Huntington-Cleveland Irrigation Company. The reservoir storage at spillway crest is 5560 acre-feet and the storage at dam crest is 6393 acre-feet. The spillway maximum discharge is 2000 cfs and the maximum dam breach flow would be 99,000 cfs in a 9 square mile drainage basin area. The first downstream town is Huntington, 24 miles away.

The Utah Power and Light- Electric Lake was built in 1974 and has a high hazard rating. The reservoir storage at spillway crest is 31,500 acre-feet and the storage at dam crest is 35,500 acre-feet. The spillway maximum discharge is 2,300 cfs and the maximum dam breach flow would be 175,000 cfs in a 30 square mile drainage basin area. The first downstream town is Huntington, 24 miles away.

Vulnerability Assessment
We were able to overlay municipalities, roads, and critical facilities atop dam identification layers provided by DESHS using GIS to identify the location of the water reservoirs. Refer to the map titled "Emery County Dam Hazard" for the location of the reservoirs listed in Table 8.4 below. In the following narrative downstream towns have been identified that could be potentially affected if a dam were to breach. However, we were unable to evaluate potential dam failure dollar losses due to lack of credible dam inundation map data. The Utah Dam Safety Section is currently working on updating and digitizing dam failure inundation areas for all of the states high hazard dams. It is expected that future revisions of this plan will include these maps.

2. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H, mainly the major rivers of the Green River and the San Rafael.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study, Hazard Analysis Plans, GIS data		

Description of Location and Extent

Areas, outside the countywide threat that could be affected if there were heavy snowmelt and/or dam failure include farmland along the east bench of the Wasatch Plateau. The towns of Castle Dale, Cleveland, Emery, Ferron, Huntington, Orangeville, and Green River are the most susceptible. Canal systems, such as the earthen Clipper, Western and the Mammoth canals could threaten Orangeville. The Joes Valley Canal, also known as the Cottonwood Creek- Huntington Canal (a 5-mile membrane and 12 mile earthen canal) could affect Orangeville, Huntington, and Castle Dale.

Vulnerability Assessment

We were unable to assess vulnerability in terms of potential losses due to the lack of digital floodplain maps. Because we recognize the need to understand flood vulnerability and to have digitized flood maps, this process of obtaining GIS-compatible data has been included as one or our mitigation actions.

A rudimentary Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003, addressing areas previously (and sometimes erroneously) identified as *"No Special Flood Hazard"* as well as unmapped jurisdictions in Emery County (Appendix E).

3. Landslide

Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

Recorded landslides have taken place primarily in the northern portion of the county within Black Butte, Red Plateau, Buckhorn Flat, and Cleveland Lloyd Dinosaur Quarry. Other areas include the northern most tip of the county as well as in the lower western portion near the Coal Cliffs and Molen Reef. Landslides generally occur in well-defined, localized areas, but are not always identifiable and can have countywide impacts.

In 1983, a major landslide event took place in the Town of Thistle outside of Emery County, but severely impacted the county economy. The Thistle slide destroyed the major highway and railroad connecting Eastern Utah with the Wasatch Front. To date the Thistle Landslide has been the most expensive landslide in the United States.

Vulnerability Assessment

The hazard analysis indicates that there are no business or critical facilities in Emery County that are located within the high landslide risk area. Refer to Table 8-5 for the infrastructure damage related to landslides.

Table 8-5 Infrastructure in Landslide Area

Item	Length (Miles)	Replacement Cost
Local Roads	3.80	$7,600,000
State Highways	0.00	$0
US Highways	0.00	$0
US Interstates	0.25	$900,000
Power Lines	0.26	$12,553
Gas Lines	0.00	$0

*There are no known residences, businesses or population located in landslide risk areas in Emery County.

F. Hazard History

Within the mitigation planning process it is important to remember that knowledge of the past is the key to planning for the future. Identifying past hazard events is key in predicting potential location of future hazards. Included in Table 8-6 are hazard events with as much relevant information as was available including date, location, area impacted, and damage costs.

Table 8-6 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Hail	9/29/1951	Emery County	Highway 10 flooded	Heaviest hailstorm recorded in US.
Cloudburst	08/26/1952	Castle Dale	Buckhorn Wash	1 death
Flood	07/19/1957	Castle Dale	Buckhorn Flat Road	Considerable road damage
Flood	08/08/1957	Castle Dale/ Orangeville City		Flood damage to homes, crops, and streets
Tornado	05/04/1961	Emery City		3k in property damage
Cloudburst	08/25/1961	Moore	Emery Canal, Muddy Creek	Farmland and canal damage
Hail	09/08/1961	Emery City		1” magnitude
Flash Flood	09/21/1962	Woodside	Saleratus Wash	Destroyed section of Highway 6 and railroad track
Flood	08/ 1-2/1964	Orangeville City	Cottonwood Creek	Farmland, canal, and road damage $17,500
Flood	07/25/1965	Emery	Ivie Creek	Farmland, bridge, and irrigations facilities damage
Tornado	05/09/1966	Emery City		
Earthquake	04/03/1967	Emery County	Northwest of Huntington	Richter magnitude 3.4
Flood	05/25/1967	Orangeville City	Clipper Canal	Highway 59 flooded, home and canal damage
Cloudburst	07/17/1967	Green River		Farmland, bridge, and crop damage
Flash Flood	07/23/1967	Ferron City	South Straight Hollow and Dutch Flat Wash	Canal, road, and construction project damage
Cloudburst	08/8-9/1967	Ferron City	Dutch Flat Canal	Ferron watershed project and road damage
Tornado	11/02/1967	Emery City		F2, 25k in property damage
Thunderstorm	07/30/1968	Ferron City	Molen Steeps Wash, Dry Wash	City culinary water system, roads, irrigation flumes damaged and destroyed
Cloudburst	08/01/1968	Ferron City	North Canal	Farmland, road, business damage
Storm	09/09/1969	Huntington City	Huntington Canyon	Damage irrigation systems and crops,

				about $20,000.
Earthquake	08/20/1971	Emery County	North of Green River	Richter magnitude 3.1
Earthquake	04/17/1972	Emery County	San Rafael Swell	Richter magnitude 3.1
Earthquake	11/15/1972	Emery County	Near Emery	Richter magnitude 3.1
Thunderstorm/Wind	03/31/1978	Emery City		50kts.
Thunderstorm/Wind	07/21/1984	Emery City		55kts.
Hail	08/30/1986	Emery City		1.00 inch
Earthquake	8/18/1988	San Rafael Swell	Buckhorn	Richter magnitude 5.3
Earthquake	1988	Fish Lake		Richter magnitude 6.0
Hail	09/21/1988	Emery City		1.00 inch
Hail	09/21/1988	Emery City		0.75 inch
Earthquake	01/29/1989	South Wasatch Plateau	Between Salina and Freemont Junction	Richter magnitude 5.4
Tornado	07/26/1991	Emery City		F0
Tornado	07/26/1991	Emery City		F0
Heavy Snow	01/11/1993	Emery County		1 injury, 1k in property damage
Heavy Snow	01/29/1993	Emery County-not specific		
Heavy Snow	02/01/1993	Emery County-not specific		
Heavy Snow	02/08/1993	Emery County-not specific		
Heavy Snow	02/16/1993	Emery County-not specific		
Lightning	02/04/1994	Orangeville City		1 injury
Heavy Snow	02/04/1994	Emery County-not specific		
Drought/Heat	06/01/1994	Countywide		
Flash Flood	06/19/1994	Capital Reef		
Flash Flood	06/19/1994	Orangeville City		
Flash Flood	08/11/1995	Ferron City		
Flash Flood	08/23/1995	Huntington City		
Heavy Snow	02/25/1996	Emery County-not specific		1death, 1injury, 10k in property damage
High Wind	03/28/1996	Emery County-not specific		51kts. 17k in property damage
High Wind	12/16/1996	Emery County-not specific		96kts. 6 injury, 100k in property damage
Blizzard	01/11/1997	Emery County-not specific		3 death, 50 injury, 40m in property damage
Hail	06/14/1997	Ferron City		0.75 inch
Flash Flood	07/28/1997	Emery City		40k in property damage
Thunderstorm/Wind	08/12/1997	Green River		61kts. 1 injury, 10k in property damage
Flood	09/13/1997	Ferron City		
Thunderstorm/Wind	09/19/1997	Green River		61kts. 8k in property damage
Heavy Rain	07/28/1998	Green River		45k in property damage, 2k in crop damage
Flash Flood	08/21/1998	Green River		2k in property damage,

				1k in crop damage
Hail	09/29/1998	Ferron		0.75 inch, 1k in crop damage
Winter Storm	10/15/1998	Emery County-not specific		100k in property damage
Winter Storm	11/08/1998	Emery County-not specific		10 injury, 500k in property damage
Winter Storm	12/19/1998	Emery County-not specific		10 injury, 100k in property damage
Extreme Cold	12/21/1998	Emery County-not specific		20 k in property damage
Heavy Snow	04/04/1999	Emery County-not specific		
High Wind	04/15/2002	Emery County		75 kts. 10 injury, 2m in property damage, 100k in crop loss

G. Mitigation Goals, Objectives, Actions

Mitigation Strategies Workbook
Emery County

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Huntington, Elmo, Cleveland, Lawrence, Orangeville, Castle Dale, Clawson, Ferron, Emery, Molen, Moore, and Green River.

DAM FAILURE

Countywide Problem Identification
Orangeville and Castle Dale are directly downstream from Joe's Valley Dam and the communities of Cleveland, Emery, Ferron, Green River and Huntington can also be directly impacted from dam failure. Current dam inundation maps may not reflect risk. County should have central location for maps and review on a regular basis

Goal 1: Priority Medium

Objective 1 – Obtain and evaluate inundation maps for all major dams in the County

Action: Obtain funding for engineering in the evaluation of current dam inundation maps
Time Frame: Next five years
Funding: State and Federal grants, dam safety programs
Estimated Cost: Dependent on extend of evaluation
Staff: Contractors, BOR and State Dam Safety
Background: Evaluation of current dam inundation maps is essential for warning and notification systems

Objective 2 – Maintain Communication/Warning Systems for dam failure

Action 1: Evaluate existing warning systems for dam failure
Time Frame: Next two years
Funding: County and State – grants
Estimated Cost: Unknown, probably minimal
Staff: BOR, Dam Engineers, County Emergency Management
Background: Evaluation of current communication and warning systems can be viewed as a base line for future warning and communication needs

Action 2: Install additional warning systems where needed
Time Frame: Next five years
Funding: Unknown
Estimated Cost: Unknown
Staff: County, BOR, State Dam Safety
Background: Development and funding of existing warning systems to include: sirens, reverse 911, satellite phones, and "call down tree"

Action 3: Establish evacuation routes for dam failure
Time Frame: 2 years
Funding: None
Estimated Cost: Minimal
Staff: County Sheriff, City Police, and County Emergency Management
Background: Identified evacuation routes will assist in response to dam failure and help educate public on evacuation measures

Objective 3 – Develop public information on dam failure to include evacuation routes and sheltering plans

Action 1: Identify and maintain access and egress routes throughout the County (SR10/UDOT)
Time Frame: Immediate
Funding: None
Estimated Cost: Minimal
Staff: County Sheriff, City Police, County Emergency Management, School District County Road Dept. and Public Works
Background: Include a map of identified routes for evaluation purposes on County website and in City and County public buildings

Action 2: Establish agreements for emergency shelters
Time Frame: Immediate
Funding: None
Estimated Cost: Minimal
Staff: County Emergency Management, Red Cross, and School District
Background: Pre identifying shelters will assist in evacuation process

DROUGHT

Countywide Problem Identification
Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources and water storage

Goal 1: Priority High

Objective 1: Excessive water used for landscaping

Action: Develop and enforce policies to limit the amount of area that can be used as water requiring landscape.
Time Frame: Ongoing
Funding: Minimal
Estimated Cost: To be determined
Staff: County and Special Service Districts or Water Districts
Background: Emery County has had several years of drought and has at time been unable to supply water to residents on the Manila side of the county.

Objective 2 - Develop more water storage tanks in several areas in the county.

Action: Conduct feasibility study.
Time Frame: 5 years
Funding: Grants
Estimated Cost: Unknown
Staff: Unknown
Background: Water storage is always an issue in times of drought. The ability to adequate store water lessens the impact in areas of the county.

Countywide Problem Identification
Earthen irrigation systems throughout the county.

Goal 2- Priority MEDIUM

Objective 1 - Upgrading irrigation systems.

Action 1: Improve canal in order to have better efficiency of water.
Time Frame: Unknown (depends on funding)

Funding: State and Federal grants and loans.
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, etc. Irrigation Company
Background: Several years of drought and a need for water conservation.

Action 2: Install field sprinkler systems (pressurized, secondary lines)
Time Frame: Ongoing
Funding: Private
Estimated Cost: Unknown
Staff: Private with assistance from Federal agencies
Background: Better usage of agricultural water.

Countywide Problem Identification
Lack of public awareness of efficient water usage.

Goal 3 - Priority HIGH

Objective 1 - Education

Action: Use several ways in educating the public on efficient water usage.
Time Frame: Ongoing
Funding: State, Federal grants, city and county funds, irrigation companies.
Estimated Cost: Minimal
Staff: LEPC, County, Cities and Towns.
Background: Create programs to make the public aware. Use newsletters and the newspapers.

EARTHQUAKE

Countywide Problem Identification
Emery County is the site of at least two active faults. Both are located on the western border of the county in Joe's valley and are named the Joe's Valley Fault. Joe's Valley appears to be highly vulnerable to such an event and an earthquake-induced failure of the dam would put Orangeville and Castle Dale in jeopardy. An updated analysis is needed to evaluate earthquake faults and subsequent risk of damage to buildings and infrastructure in the county.

Goal 1: Priority Medium

Objective 1 - Have a study done to determine seismic resistance of structures within the county I.E. Elementary school, high schools, public buildings, and highways.

Action: Structural and non-structural earthquake hazard assessment.
Time Frame: 3 to 4 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background: Contact DESHS earthquake program specialist. Several seismographic tests have been done within the county most likely for oil.

Countywide Problem Identification
Residents uneducated about earthquakes.

Goal 2: Priority Medium

Objective 1 - Public Awareness

Action: Conduct pubic awareness campaign. Enhance earthquake instructions in school.

Time Frame: Ongoing
Funding: Federal and state grants, local sources.
Estimated Cost: Minimal
Staff: LEPC, volunteers and school administration.
Background: Contact DESHS earthquake program specialist.

Countywide Problem Identification
Requiring building code(s) and zoning ordinance enforcement

Goal 3- Priority MEDIUM

Objective 1 – Verify Building Codes and Zoning Ordinances are updated

Action: Check with Planning and Zoning on building codes.
Time Frame: Ongoing
Funding: Local sources.
Estimated Cost: Minimal
Staff: County, Cities and Town Building Officials and Planning and Zoning Dept.
Background: Ensure building codes are being implemented.

FLOOD

Countywide Problem Identification
There is not enough current flood information on flood areas in Emery County to identify the problem at this time.

Goal 1: Priority Medium

Objective 1 - Identify additional flood prone areas in county

Action: Evaluate need for additional County flood mapping of potential flood hazard areas.
Time Frame: Unknown
Funding: FEMA
Estimated Cost: Undetermined
Staff: State and FEMA personnel.
Background: Contact DESHS flood map specialist.

Action: Participate in the FEMA Flood Map Modernization Program
Time Frame: Ongoing
Funding: FEMA
Estimated Cost: Some cost share may be required.
Staff: County Emergency Management and State Floodplain Office
Background: Emery County has areas that should be reevaluated for flood hazards. Town of Cleveland and City of Green River have indicated their current flood map does not reflect the flood hazard and boundaries are inconsistent.

Countywide Problem Identification
Unstable canals are a flood threat

Objective 1 - To reduce the threat of flood from canal failures in the county

Action: Technical analysis on the irrigation canals
Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown.
Staff: Private, County Engineer

Background: Private canals and irrigation systems have proven to breach or fail flood.

Countywide Problem Identification
Participation in the NFIP allows citizens to mitigate flood damage through purchasing of flood insurance. Residents are not aware flood insurance is available. Communities are not aware of flood damage prevention ordinance that are in place for development in floodplains.

Goal – Priority - MEDIUM

Objective 1 - Promote purchase of flood insurance
Action: Obtain outreach materials on flood insurance
Time Frame: Immediately
Funding: None
Estimated Cost: Printing of FEMA documents
Staff: County and City Floodplain Administrators, County Emergency Management
Background: Flood insurance is an effective mitigation measure.

Objective 2 - Educate local Floodplain Administrators on floodplain compliance.
Action: Make training available on flood compliance and NFIP
Time Frame: 1 year
Funding: None
Estimated Cost: None
Staff: County and City Floodplain Administrators, Building Officials, Planning and Zone, State Floodplain Manager
Background: Contact State Floodplain Manager and arrange training.

SEVERE WEATHER

Countywide Problem Identification
Winter storms, summer thunderstorms, flash floods hail, and high winds over eastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 1 – Priority HIGH

Objective 1 - protect County from adverse affects of severe weather

Action 1: County participates in the Storm Ready program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Action 2: Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the

search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Emery County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOC's to ensure they are grounded lightning, to include buildings with towers
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.

LANDSLIDE
Countywide Problem Identification
There is a potential risk to structures located in areas identified Federal and state agencies and depicted in GIS as landslide risk areas.

Goal 1: Priority Low

Objective 1- Minimize loss of life, damage to property and disruption in residents, commerce and government services caused by landslides through structural measures.

Action 1: Build retaining fences and momentum absorbers along highways prone to landslide and rockfalls, Highway 29, Highway 10.
Time Frame: 5 years
Funding: Federal, State, Local
Estimated Cost: $1,000,000
Staff: UDOT, County Road Dept.
Background: Steep slopes and freeze thaw conditions create hazardous conditions

Action 2: Dislodge large rocks along highways
Time Frame: Immediate
Funding: Federal, State, Local
Estimated Cost: $100,000
Staff: UDOT, County Road Dept.
Background: Steep slopes and freeze thaw conditions create hazardous conditions

Action 3: Build retaining walls on residents identified at risk
Time Frame: 5 years
Funding: Individual
Estimated Cost: Variable
Staff: Unknown
Background: Protect homes in areas at risk.

Action 4: Develop pathways to capture falling rocks adjacent to residences
Time Frame: 5 years
Funding: Federal, State, and Local
Estimated Cost: $100,000
Staff: Cities, towns, and county
Background: Identify areas in residential areas that could accommodate pathways

PROBLEM SOILS

Countywide Problem Identification
Problem soils are a risk to property and life due to its volatility

Goal 1: Priority Low

Objective 1 - Protect roadways

Action 1: Increase width of slope adjacent to roadways
Time Frame: Extended
Funding: Federal, State, and Local
Estimated Cost: Unknown
Staff: State, county, and city
Background: Allows for buffer zone

Action 2: Educate homeowners about problem soil risk
Time Frame: 2 years
Funding: Local
Estimated Cost: $3,000
Staff: Local
Background: County Building Official should have information available to citizens

Action 3: Identify, monitor and control water on alkali soils
Time Frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Local
Background: Identifying areas of concern will help with planning.

INFESTATION

Countywide Problem Identification
Infestation of noxious insects and can impact the health, safety and welfare of County and its residents.

Goal 1: Priority Low

Objective 1 - Control insects

Action 1: Insecticide spray
Time Frame: Ongoing
Funding: Local, State and Federal
Estimated Cost: Unknown
Staff: Local and Federal
Background: Insect abatement districts and federal insect control should be coordinated

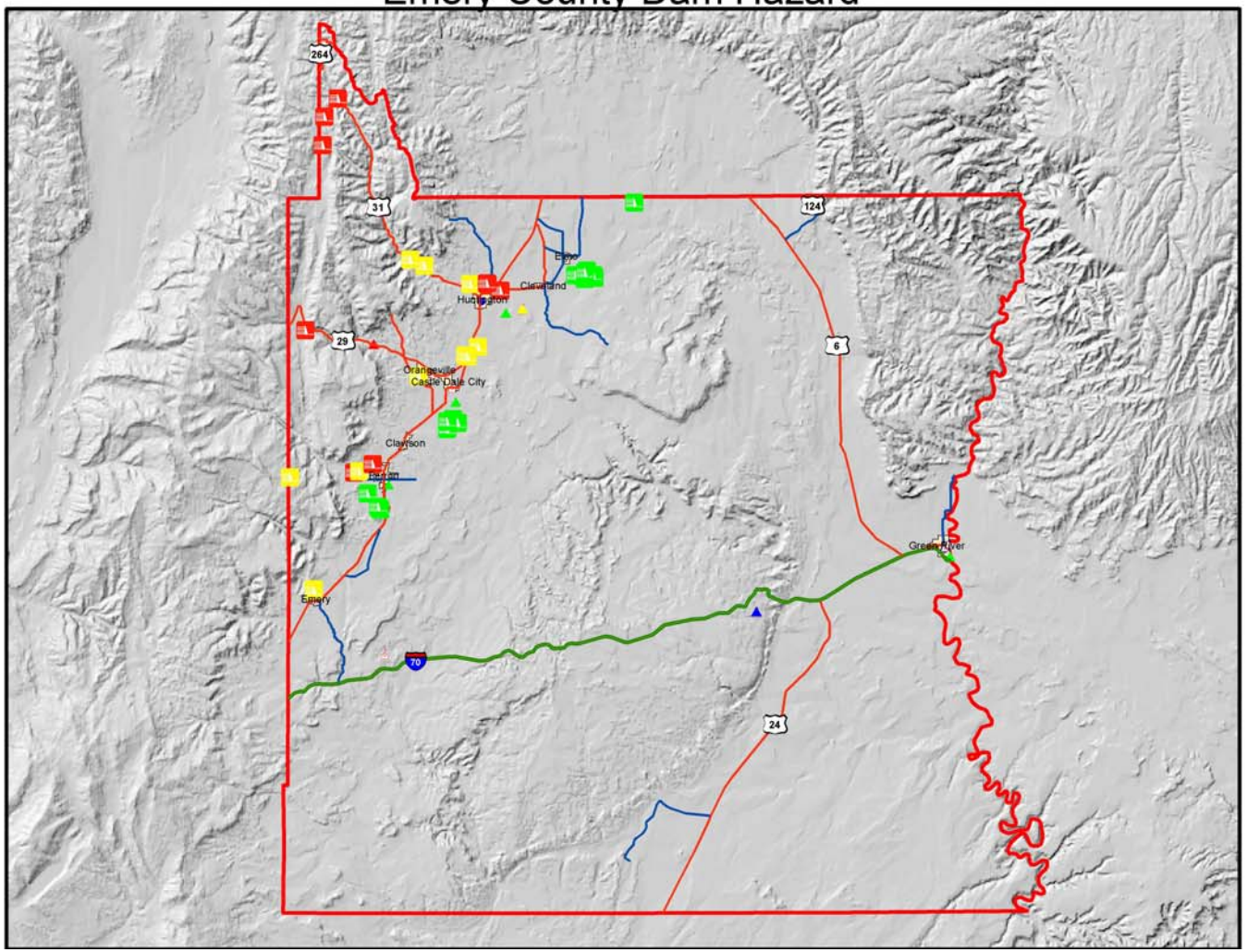
Action 2: Remove dead and diseased trees
Time Frame: Extended
Funding: Private
Estimated Cost: Trees will be harvested by commercial enterprise.
Staff: Private
Background: This could be a part of the fire management program and limited spread of infestation

H. Mapping

All of the following maps have been created for the purpose of Pre-Disaster Mitigation using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore no warranties are made respecting their accuracy.

Map 8.1.1 Dam Hazard
Map 8.3.1 Landslide Hazard
Map 8.1 Earthquake Hazard
Map 8.2 Problem Soils

Emery County Dam Hazard



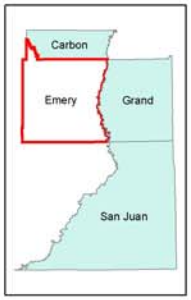
DAM HAZARD

- HIGH - Possible loss of life
- MODERATE - Significant property loss
- LOW - Insignificant property loss
- Potable Water Facility
- Oil Facility
- Electric Power Facility
- Schools
- Waste Water Facility
- Fire Stations
- Police Stations

N
W E
S

0 5 10 20
Miles

Southeastern Association of Local Governments



Data Source: Information provided by DESHA, and Utah AGRC

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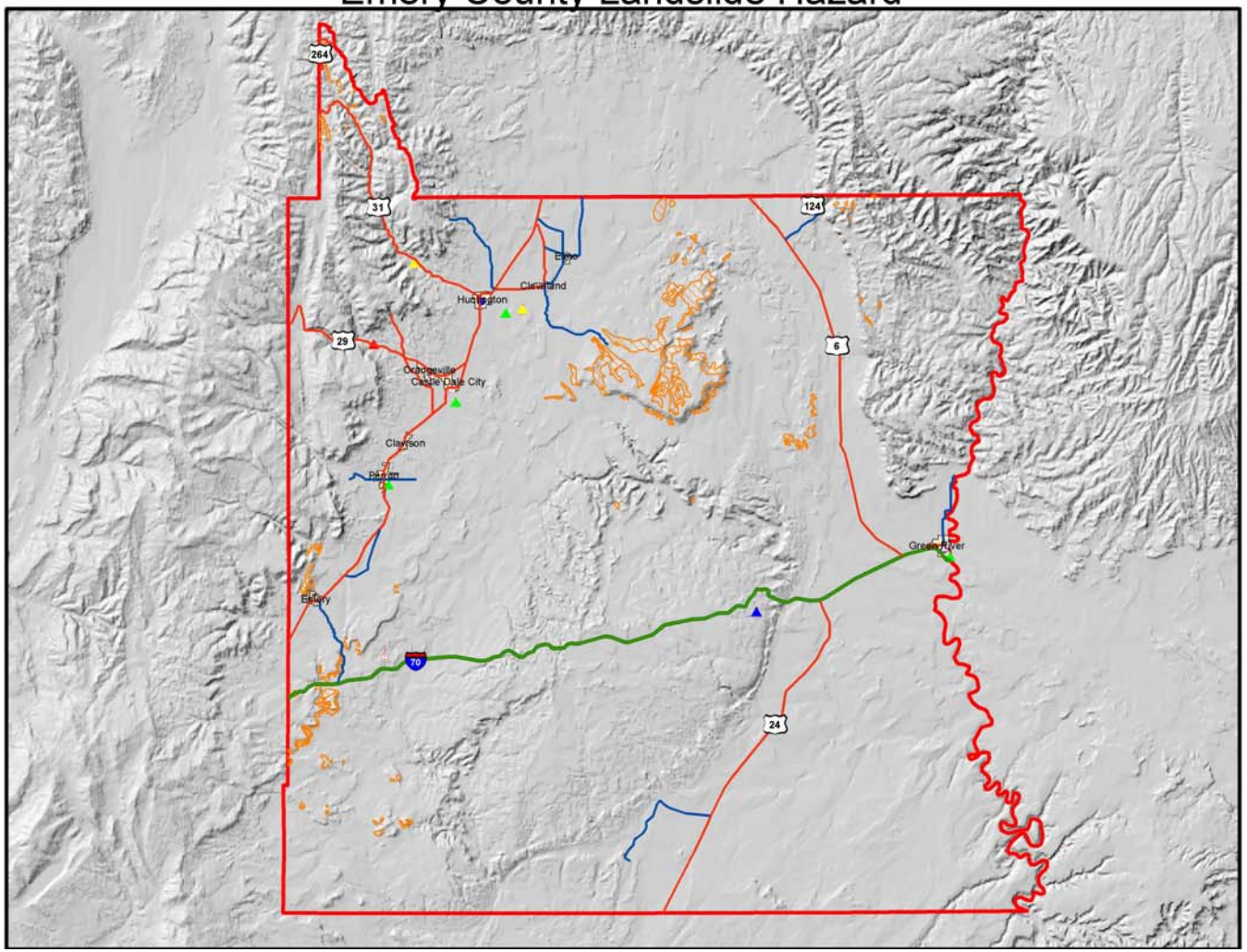
Emery County Landslide Hazard

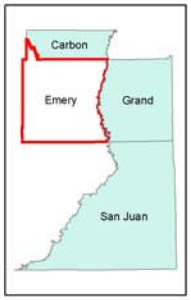


Landslides
Potable Water Facility
Oil Facility
Electric Power Facility
Schools
Waste Water Facility
Fire Stations
Police Stations

N
W E
S

0 5 10 20
Miles

Southeastern Association of Local Governments



Data Source: Infromation provided by DESHA, and Utah AGRC

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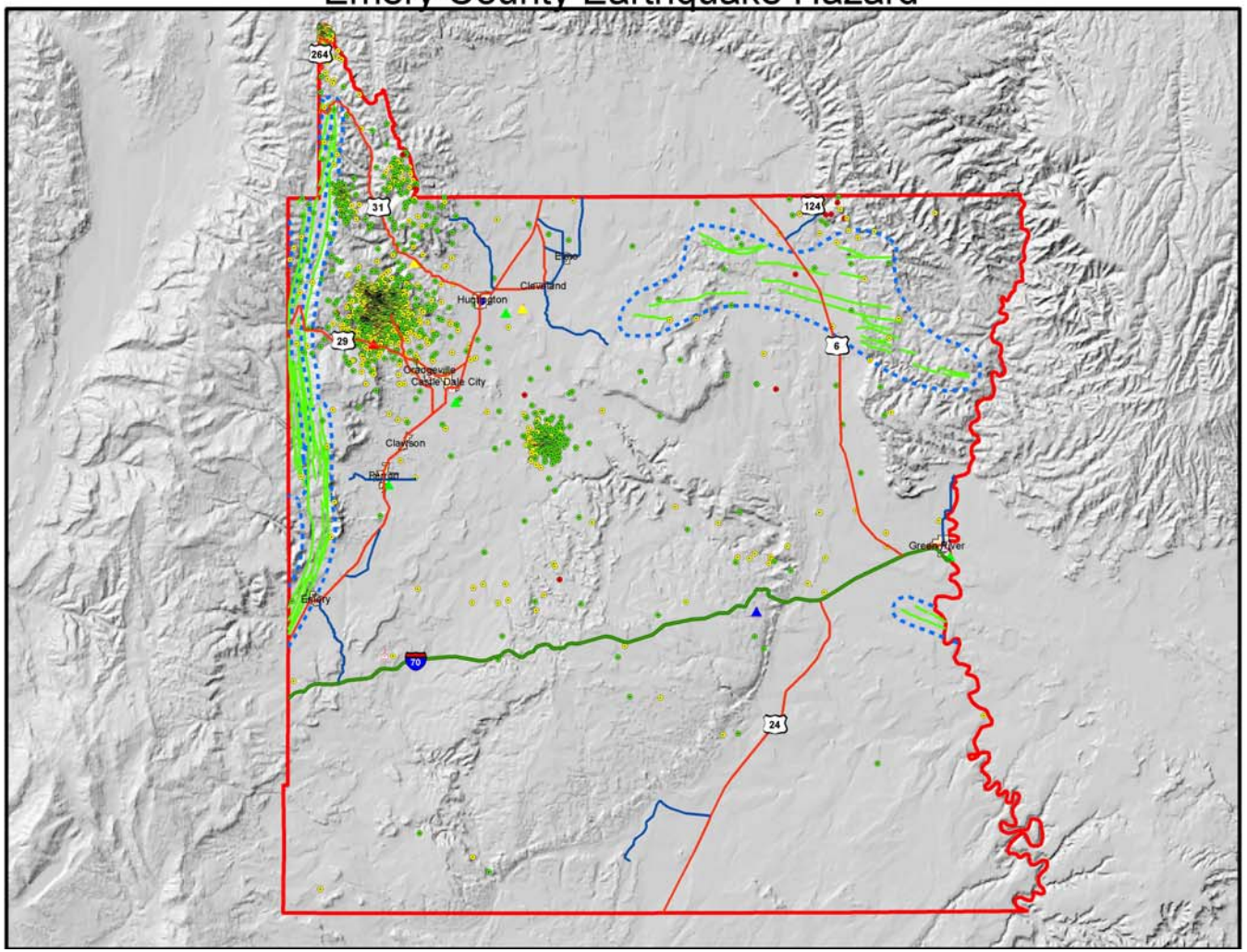
Emery County Earthquake Hazard



Faults
Fault Zones
Epicenters
1 - 2
2 - 3
3 - 4
Potable Water Facility
Oil Facility
Electric Power Facility
Schools
Waste Water Facility
Fire Stations
Police Stations

N
W E
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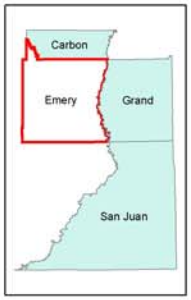
0 5 10 20
Miles

Southeastern Association of Local Governments



Data Source: Infromation provided by DESHA, and Utah AGRC

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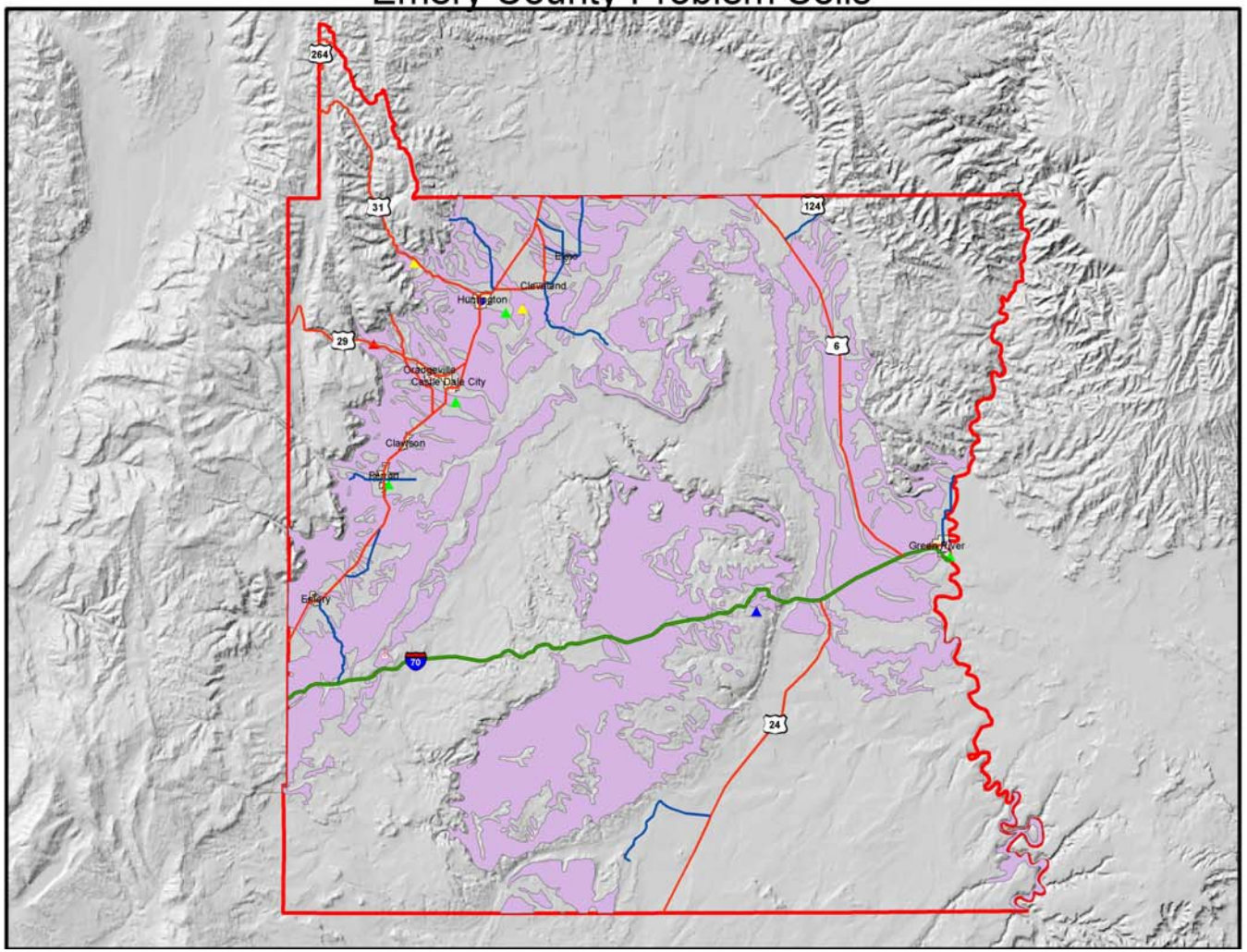
Emery County Problem Soils

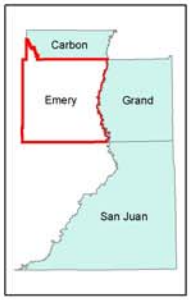


Expansive Soil or Rock
Potable Water Facility
Oil Facility
Electric Power Facility
Schools
Waste Water Facility
Fire Stations
Police Stations

N
W E
S

0 5 10 20
Miles

Southeastern Association of Local Governments



Data Source: Infromation provided by DESHA, and Utah AGRC

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Part 9. Grand County

Grand County is made up of two jurisdictions: Castle Valley and Moab City. The county is located in the southeastern portion of the state on the Utah Colorado border.

A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rate of Change, and Population and Development Trends is important in understanding the impacts that a natural hazard would have on a local community. Population numbers also identify the constancy of a community by determining the degree of change a community (Table 9-1).

Table 9-1 Grand County Population

	Grand County	Castle Valley	Moab City	Balance of Grand County	Southeast Region
1980 Census Population	8,241				54,124
1990 Census Population	6,620	211	3,971	2,438	49,801
2000 Census Population	8,485	349	4,779	3,357	54,180
2005 Population Projections	8,596				54,559
2010 Population Projections	8,969				57,699
2015 Population Projections	9,638				62,754
2020 Population Projections	10,102				66,489
2030 Population Projections	10,122				67,867
1990-2000 AARC	2.5	5.2	1.9	3.3	
2000-2030 AARC	0.59%				0.75%
1990-2000 Percent Change	28.2%				
Rank by 2000 Population	20				

Rank by Percent Change	12				
Rank by AARC	12				
Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.					

B. Economy

Presently, Grand County is working to diversify its economy by targeting light manufacturing, tourism and recreation, the fine arts, educational programs, television and motion picture production, agricultural, and through the development of natural resources. Grand County's economy is slowly expanding and moving forward. The unemployment rate for Grand County as of October 2002 was 6.4 percent, a 0.6-point drop from the 7 percent in October 2001. Non-farm jobs, construction, and manufacturing have all had a slight employment gain. The economy here is resilient and will continue to grow as the nation's economy improves (Grand County Trends). The 2000 estimated average house value is $123,751 (Annual Statistical).

C. Transportation and Commuting Patterns

The principle transportation routes through Grand County are Interstate 70 and U.S. Highway 191. The principle east-west corridor through Grand County is Interstate 70 (I-70). I-70 travels through the center of the county to the Colorado border. U.S. Highway 191 is the north-south corridor heading south from Crescent Junction off I-70, through the town of Moab, into San Juan County (Traffic Volume Map).

D. Land Use and Development Trends

Grand County uranium mining began in the early 1950's and as a result, the population jumped to nearly 10,000 in three years. Potash and salt mining, as well as milling operations were another source of economic prosperity in Grand County. Since the 1990's the local economy has been driven primarily by tourism. Over 1 million visitors enjoy mountain biking, river rafting, rock climbing, hiking, and four wheeling each year (Grand County History). Most land is owned and maintained by federal and state agencies, including the Bureau of Land Management (BLM), the Forest Service (FS), the National Park Service (NPS), and the Utah Divisions Of Forestry, Fire and State Lands (FFSL).

Moab City is the largest city within the county and offers a variety of residential and commercial real estate. There are an estimated 3,712 family housing units within Moab and Spanish Valley combined. These housing units include single family, mobile homes, and apartment homes. Because of the quiet streets and larger sized lots subdivisions and housing complexes in the area are very attractive for area newcomers. The median value of a home is $120,000.

E. Risk Assessment

The risk assessment process revealed the following risks: Drought, Flood, Wildfire, Severe Weather, Landslide, Earthquake, and Problem Soil. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part 6 for an explanation of the risk assessment process. According to GIS data there are a total of 17 identified critical facilities within Grand County (Appendix C).

Grand County and each jurisdiction contributed to the risk assessment analyses performed for the county when located within an identified hazard boundary (see Section E). Drought, Earthquake, and Severe Weather are regional hazards and have been profiled as such (Part 4 Regional Data).

1. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	See map in Section H, mainly near the major rivers of the Colorado and Green and their respective tributaries.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study, Hazard Analysis Plans, GIS data, Moab City Project Impact Application, Moab Hazard Mitigation Plan, and have worked with local residents of the community.		

Description of Location and Extent

The local planning team members including the county GIS department were unable to map flood prone areas within the county and complete a risk assessment due to the lack of digitized data. The Army Corps of Engineers compiled a rudimentary Flood Hazard Identification Study in 2003. This study can be found in Appendix E. The Army Corps' study identified the smaller unmapped tributaries of Castle Creek and its tributaries as threats in Castle Valley.

The City of Moab recorded 29 of 36 total flood events. Because of its location with streams and rivers, Moab has a very high flood threat. Moab City is the county seat and the largest community in the county and has been designated as a Project Impact Community. As a result, a Moab City Storm Water Management Plan was created and flood control issues were identified and put into place for Pack Creek, Mill Creek, and the Colorado River. Over half of the community is in a floodplain. Moab is subject to flash flooding mainly from the frequent thunderstorms and cloudbursts that occur in the steep slickrock canyons. Local roads, infrastructure, and residences are all subject to repeat flooding at Walker Canyon, Stewart Canyon, the Kelling Property, and Williams Way.

Vulnerability Assessment

Mill Creek floodplain flooding events were calculated for 13, 67, 125, and 370 -year events relaying the number of structures lost and approximate dollar losses for each flood event (Table 9-4).

Table 9-4 Mill Creek Floodplain Damage Estimates

Year	Approximate Dollar Loss	Number of Structures (residential and commercial)
370	71,709	848
125	68,577	772
67	50,218	486
13	22,396	86

<u>Dam Failure Flooding</u>

Ken's Lake is actually located in San Juan County, however the risk is region-wide. Ken's Lake Reservoir is considered to have a high hazard threat. The dam was built in 1981 and is owned by the Grand County Water Conservancy District. The reservoir storage at spillway crest is 2,820 acre-feet and the reservoir storage at dam crest is 3,360 acre-feet. The spillway type is open channel and the maximum dam breach flow is 64,000 cfs with a 3 square mile drainage basin area. The first downstream town is Moab, 6 miles away.

2. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

The Division of Emergency Services assigned five hazard categories to the wildfire risk data provided in the statewide fire risk assessment-- Extreme, High, Medium, Low, and Very Low. These ratings cover all of Grand County and are based on the type and density of vegetation in each area. Factors influencing wildland fire behavior such as weather conditions, wind speed and direction are not considered in this risk assessment. Refer to Table 9-9 for the recorded history of wildfires in the county.

Vulnerability Assessment

Loss estimates were completed by identifying the wildland fire areas of extreme, high, and moderate within the county then overlaying the municipalities in a GIS database that identifies the vulnerable areas. The following table includes the population and number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county (Table 9-5).

Table 9-5 Structures and Population in Wildfire Area

Use Type	Extreme Risk	High Risk	Moderate Risk
Commercial Units	0	36	20
Residential Units	0	417	242
Population	0	828	368

Potential Wildfire Loss Estimates

Table 9-6 details the annual sales of the businesses inside each wildfire risk area, and the assessed value of residential property in each wildfire risk area. Residential loss estimates do not include contents; including the value of contents would increase the values listed by 50%. No businesses are located in Grand County in Extreme wildfire risk areas. All businesses located in High and Medium Wildfire Risk areas except one are in the City of Moab or Castle Valley. The Thompson's Springs Fire Department is the only Critical Facility in Grand County located in a wildfire risk area.

Table 9-6 Inventory of Properties Located in Wildfire Risk Areas in Grand County

Businesses Number/Annual Sales	**Residential Units** Number/Replacement Cost	**Population**
56 / $42,300,000	659 / $81,551,909	1,196

Wildfire Risk within Municipal Boundaries

Table 9-6 lists the number of acres in each wildfire risk area contained within the municipal boundaries of the following cities in Grand County. Table 9-8 identifies the infrastructure found within wildfire areas.

Table 9-7 Wildfire Risk Area

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Moab	0	635	117
Castle Valley	0	1,253	2,888
Green River	0	0	0

Table 9-8 Infrastructure in Wildfire Area

Item	Length (Miles)	Replacement Cost
Local Roads	116.09	$232,176,800
State Highways	41.38	$99,877,629
US Highways	0.00	$0
US Interstates	29.41	$105,875,280
Power Lines	124.03	$5,988,168
Gas Lines	26.33	$6,355,799

Table 9-9 Wildfire History

Date	Fire Name	Cause	Size
6/19/84	Agate Oilfield	Lightning	300 - 999 Acres
6/9/85	East Cisco	Equipment	300 - 999 Acres
6/25/85	Cottonwood	Lightning	300 - 999 Acres
7/4/85	Sager 2	Equipment	300 - 999 Acres
7/7/85	Little Hole	Lightning	300 - 999 Acres
8/14/85	Border R733	Lightning	300 - 999 Acres
8/16/85	Mile Post 222	Lightning	300 - 999 Acres
8/31/85	Brewster 1	Incendiary	300 - 999 Acres
6/8/86	Westwater 2	Debris Burn	300 - 999 Acres
6/19/86	East	Railroad	300 - 999 Acres
7/6/86	Harley	Lightning	300 - 999 Acres
7/12/86	Westwater Comp	Lightning	1000 - 4999 Acres
8/5/86	Bitter Creek	Lightning	300 - 999 Acres
7/1/89	Diamond Peak	Lightning	> 5000 Acres
7/8/89	Ryan Creek	Lightning	1000 - 4999 Acres
7/10/93	Whipsaw Flat	Lightning	300 - 999 Acres
8/13/93	Westwater 2	Lightning	300 - 999 Acres
6/9/94	Thompson	Equipment	1000 - 4999 Acres
7/23/94	Mm 213	Miscellaneous	300 - 999 Acres
8/30/94	Westwater 3	Lightning	1000 - 4999 Acres
6/19/95	Valley City 2	Lightning	1000 - 4999 Acres
6/24/95	Valley City 3	Miscellaneous	300 - 999 Acres
8/16/96	One Eye	Lightning	300 - 999 Acres
7/1/99	Little Hole	Lightning	1000 - 4999 Acres
5/28/00	Fisher	Lightning	300 - 999 Acres

3. Landslide

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas. Manti-La Sal National Forest, near foothills on steep slopes, cliff faces, canyon walls.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

The map "Grand County Landslide Hazard" shows the locations of high-risk landslide areas by identifying historical landslide locations. The main historical landslides in Grand County occurred in the Southeastern portion of the Manti-La Sal National Forest, just east of Green River. Generally, landslides are located in well-defined, localized areas. The identified historical areas will most likely be the location of future landslides.

Vulnerability Assessment

The hazard analysis indicates that there are no business or critical facilities in Grand County that are located within the high landslide risk area. There are residential units as well as general infrastructure within the risk area (Tables 9-10, 9-11).

Table 9-10 Inventory of Properties Located in Landslide Risk Areas in Grand County

Businesses	Residential Units	Population
Number\Annual Sales	Number\Replacement Cost	
0 /$0	97 \ $12,003,847	127

Table 9-11 Infrastructure in Landslide

Item	Length (Miles)	Replacement Cost
Local Roads	5.77	$11,540,000
State Highways	0.00	$0
US Highways	0.00	$0
US Interstates	0.00	$0
Power Lines	2.56	$123,597
Gas Lines	0.00	$0

4. Problem Soil

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	See map in Section H. Central and southern portions of the county.		
Seasonal Pattern or Conditions	Spring and Summer		
Duration	Constant problem		
Analysis Used	Review of information and maps provided by County soil classification books, Soil Conservation Service, local input, UGS, DESHS, and AGRC.		

Description of Location and Extent

In 1991 the Soil Conservation Service (SCS) studied the Canyonlands area just south of the Grand County border. The soils within the study area range from well-drained silty soils to impervious rock. Based upon the soil makeup, permeability in the bluffs of the southeastern portion of the county is considered by the SCS to be generally moderate, meaning they have medium to rapid runoff conditions. The soils according to SCS in the Moab City developed region have moderate to rapid permeability which means they have slow to medium runoff. Expansive soil and rock affect the central and southern portions of the county and minor amounts of silica dune are found in the mid-southern portion.

Using the problem soils and major roadways map from DESHS developed for the State of Utah and Census 2000 block data, the two maps were overlaid to indicate where households and roadways exist in relation to problem soil areas. The results from the analysis are presented in Table 9-12 below (no households were identified in problem soil areas). Roadway replacement was calculated assuming a cost of $2 Million per mile. The map "Grand County Problem Soils" shows the areas of Problem Soils within Grand County.

Table 9-12 Roadways in Grand County located on Problem Soil Areas

Roadway	Miles	Estimated Replacement Cost
I-70	42.53	$148,858,010
West Main St.	0.41	$826,729
East Main St.	0.53	$1,065,863
Main St.	0.19	$380,063
South Main St.	0.51	$1,029,283
North Main St.	0.32	$634,556
State Route 10	40.91	$81,814,581
State Route 155	5.64	$11,278,533
State Route 24	4.78	$9,560,011
State Route 29	4.87	$9,737,116
State Route 31	4.50	$8,998,304
State Route 57	9.74	$19,474,253
U.S. Highway 6	35.69	$71,389,921

F. Hazard History

Identifying past hazard events is key in predicting where future events are likely to occur. The following available relevant information such as date, location, area impacted, and damage costs are identified in the table below (Table 9-14). Due to the frequency and geographic extent of problem soil, and some severe weather events past events have not been recorded and are therefore not identified in the table below.

Table 9-14 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Cloudburst storm	August 28, 1939	Moab City	Mill Creek	$5,000 in damage to homes, businesses and streets, serious damage to the powerhouse
Flood	August 31, 1939	Town of Cisco	Diamond Creek	One death
Flash Flood	July 23, 1953	Moab City		Thousands of dollars of damage to a movie production set at Fisher Towers
Flash Flood	August 6, 1957	Moab City	Mill Creek	Several thousand dollars damage to property and crops, and culinary water lines across Mill Creek
Flash Flood	August 29-30, 1957	Moab City	Thompson	Heavy rains caused flooding along streets and highways, destroying several homes
Tornado	May 4,1961	Grand County		F1 tornado
Flash Flood	August 25-26, 1961			Thousands of dollars of damage was recorded to motels and homes. Highway 160 was blocked
Flood	June 29-30, 1962	Moab City	Walker Subdivision	Moab city park flooded
Flood	August 8, 1963	Moab City	Mill Creek and Pack Creek	Destroyed sewer mains. Streets and roads were damaged and several hundred acres of land were covered with silt
Flood	October 15, 1965	Moab City	Mill Creek and Pack Creek	$1,500 damage to culverts, roads, and bridges
Flood	June 5, 1967	Moab City	Northern Moab,	Worst flood in 20

			US 160, Main Street.	years. Destroyed homes, businesses, establishments, apartments, and streets. Thousands of dollars of damage.
Hail	August 14, 1968	Grand County		1.75 inches
Flood	August 17, 1968	Moab City		Destroyed homes, businesses, and roads; covered in mud and water. Damage totaled about $50,000
Thunderstorm/ High winds	April 06, 1969			
Tornado	June 10, 1970	Grand County		F2 Tornado
Avalanche	Winter 1970	Grand County	Miner's Basin	1 building destroyed
Avalanche	1970	Grand County		2 deaths
Thunderstorm/ High winds	August 30, 1971	Grand County		
Earthquake	March 14, 1974	Grand County	Cisco	3.2 Richter Magnitude
Hail	June 10, 1976	Grand County		1.75 inches
Hail	August 30, 1986	Grand County		1.00 inches
Avalanche	February 1991	Grand County	Talking Mountain	4 deaths 6 buried
Funnel Cloud	October 07, 1993	Moab City		
Lightning	August 16, 1995	Moab City		1 death, 1 injury
Lightning	September 29, 1995	Moab City		1 injury
Lightning	August 17, 1996	Moab City		1 death
Flash Flood	September 06, 1997	Moab City		$175,000 property damage
Hail	September 20, 1997	Crescent Junction		1.75 inches
Winter Storm	December 07, 1997	Grand County		1 death, 20 injuries, $200,000 property damage
Heavy Rain	September 12, 1998	Moab City		
Winter Storm	December 19, 1998	Grand County		10 injuries, $100,000 property damage
Extreme Cold	December 21, 1998	Grand County		$20,000 property damage
High Winds	April 09, 1999	Grand County		60 kts. $2,000 property damage
Lightning	May 29, 1999	Cisco		1 death
Wildfire	June 20-21, 1999	Westwater		
Flash Flood	July 08, 1999	Moab City		
Lightning	July 14, 1999	Crescent Junction		
Flash Flood	July 14, 1999	Moab City		$60,000 property damage
Heavy Rain	July 27, 1999	Moab City		$10,000 property

				damage
Flash Flood	July 30, 1999	Thompson		$2,000 property damage
Flash Flood	August 11, 1999	Moab City		
Thunderstorm/ High Winds	August 30, 1999	Canyonlands		50 kts.
Tornado	April 18, 2000	Grand County	Moab City	F0 Tornado, $1,000 property damage
High Winds	April 18, 2000	Grand County		60 kts. $20,000 property damage
Thunderstorm/ High Winds	May 24, 2000	Moab City		50 kts.
Thunderstorm/ High Winds	May 25, 2000	Canyonlands		50 kts.
Wildfire	July 04, 2000	Cisco		
Flood	July 09, 2000	Moab City		
Lightning	July 09, 2000	Moab City		$100,000 property damage
Wildfire	July 15, 2000	Cisco		
Lightning	July 22, 2000	Moab City		$2,000 property damage
Wildfire	July 24, 2000	Westwater		
Wildfire	August 15, 2000	Westwater		
Thunderstorm/ High Winds	August 20, 2000	Canyonlands		50 kts.
Tornado	September 08, 2000	Grand County		F0? Tornado
Hail	September 21, 2000	Cisco		1.00 inches, $10,000 property damage
Heavy Snow	December 24, 2000	Grand County		
High Winds	April 20, 2001	Grand County		50 kts. $10,000 property damage
Flood	July 08, 2001	Moab City		
Flood	July 09, 2001	Moab, Canyonlands		
Flash Flood	July 10, 2001	Moab City		
Flood	August 13, 2001	Moab City		
Winter Storm	January 28, 2002	Grand County		
Drought	May 01, 2002	Grand County		
Thunderstorm/ High Winds	May 15, 2002	Cisco		67 kts.
Drought	June 01, 2002	Grand County		
Wildfire	June 20, 2002	Thompson		
Wildfire	June 22, 2002	Thompson		
Wildfire	June 27, 2002	Thompson		

G. Mitigation Goals, Objectives, Actions

Mitigation Strategies Workbook
Grand County

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Thompson Springs, Cisco, Castle Valley and Moab City.

Grand County and Moab City have certified Emergency Service Personnel including, City Police, Grand County Sheriffs, EMT, Building Inspectors, and the Moab Valley Fire Department.

The following documents are the documents used for mitigation and action plans.

- The Grand County Storm Drainage Master Plan as amended to date.
- The Grand County Land Use Code, specifically Articles 4, 5, & 6, as amended to date.
- Moab City Code Chapter 15.40, Flood Damage Reduction as amended to date.
- The FIRM Flood Map for Moab City Panel 2 of 2.
- Grand County Emergency Operations Plan, as amended to date
- Moab Valley Wildfire Mitigation Plan as amended to date.
- International Building Codes as adopted.

FLOODING

Countywide Problem Identification
The rapid development of the county has caused a need to re-evaluate the system and establish a plan and level of service to manage stormwater. Development also directly impacts the historical drainage ways with culverts roads and structures.

Goal 1 – Priority HIGH

Objective 1.1 – Continue to support and update Storm Water Management Plan.

Action: Review and revise Storm Water Management Plan as development warrants.
Time Frame: Ongoing
Funding: County and impact fees
Estimated Cost: Depends on extent of identified projects within Plan.
Staff: County, Private Contractors
Background: The Storm Water Management Plan as protected the County from flood losses. This Plan also contains identified storm water basins and other structural control projects.

Problem Identification: Flood occurs primarily from spring snowmelt in the higher elevations and summer flash flooding. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.

Goal 1 – Priority High

Objective 1.1 Encourage 100% participation in the National Flood Insurance Program (NFIP).

Action: Assist Unincorporated Grand County in joining NFIP
Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Engineer, And State Floodplain Manager

Background: Special Flood Hazard Areas have been identified by FEMA in the Unincorporated County. The County has chosen not to participate in the NFIP. Flood insurance is not available in the Unincorporated County.

Objective 1.2 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.

Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager, and DES
Background: General public is usual not aware they can purchase flood insurance.

Objective 1.2 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County

Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.3 Ensure EOC(s) is equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.

Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: An alternate EOC(s) also need adequate communication capabilities are essential between all response agencies within the County.

Objective 1.4 Support updating of flood hazard data

Action: Support and encourage participation in the NFIP Flood Map Mod Program.

Time Frame: Ongoing
Funding: Federal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager
Background: Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County. County must join the NFIP to be able to participate in Map Mod.

SEVERE WEATHER

Countywide Problem Identification
Snowstorms, summer thunderstorms, hail, and high winds over southeastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 1 – Priority High

Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participates in the Storm Ready program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Action 2: Encourage avalanche preparedness for county backcountry users in the northeastern portion of the County
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Grand County. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOC's to ensure they are grounded lightning, to include buildings with towers, etc.
Time Frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Background: EOC's and alternate EOC's**,** Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.

SLOPE FAILURE (LANDSLIDE AND DEBRIS FLOW)

Countywide Problem Identification
There is a potential risk to structures located in areas identified by the SECAOG GIS as landslide risk areas.

Goal 1 – Priority Medium

Objective 1.1 Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.

Action: Assess the probability of landslides and identify specific structures at risk
Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown
Background: Soil surveys and other engineering surveys are needed.

Problem Identification: Rockfall may impact structures within the County

Goal 1 – Priority Medium

Objective 1.1 Remove risk to homes by removing rocks.

Action 1: Remove large rocks overhanging existing developments.
Time Frame: Undetermined
Funding: Not applicable
Estimated Cost: Not applicable
Staff: City, County Planning
Background: Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains.

Action 2: Remove potential rock hazards prior to building homes.
Time Frame: 5 year
Funding: None
Estimated Cost: Unknown
Staff: Planning Departments
Background: Prior to building, require builder/owner to secure or remove possible rock hazard.

EARTHQUAKE

Countywide Problem Identification
Although there is a limited impact to earthquakes, there is an opportunity to evaluate transportation and utilities services could be impacted form secondary effects of earthquake.

Goal 1 – Priority Low

Objective 1.1 Provide for emergency response and relief

Action: Identify and maintain critical transportation and utility services
Time Frame: Ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: County and City staff.
Background: Critical transportation, utility and communication systems need to be maintained.

DROUGHT

Countywide Problem Identification
Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority Medium

Objective 1.1 Conserve culinary water by educating the public

Action: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: City funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: Use a newsletter to educate the public

Objective 1.2 Conserve culinary water by conservation

Action: Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: County should evaluate a tiered water system.

Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

Goal 1 – Priority Medium

Objective 1.1 Meet current and future water needs of community

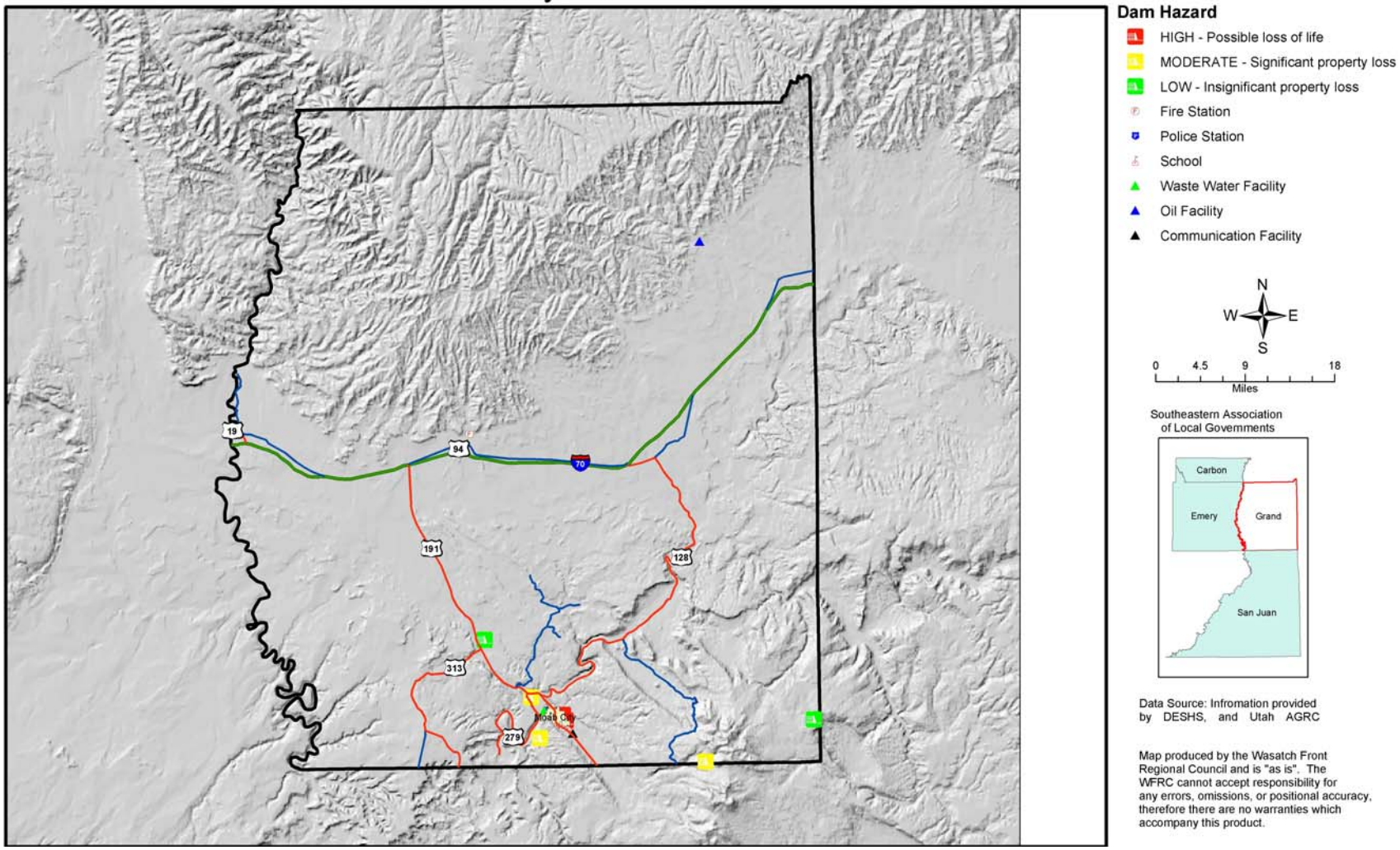
Action: Develop additional source and storage as well as implement conservation plans implemented.
Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: County Staff, Professional Services, and Contractors
Background: To meet the needs of a community's residential and businesses water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.

H. Maps

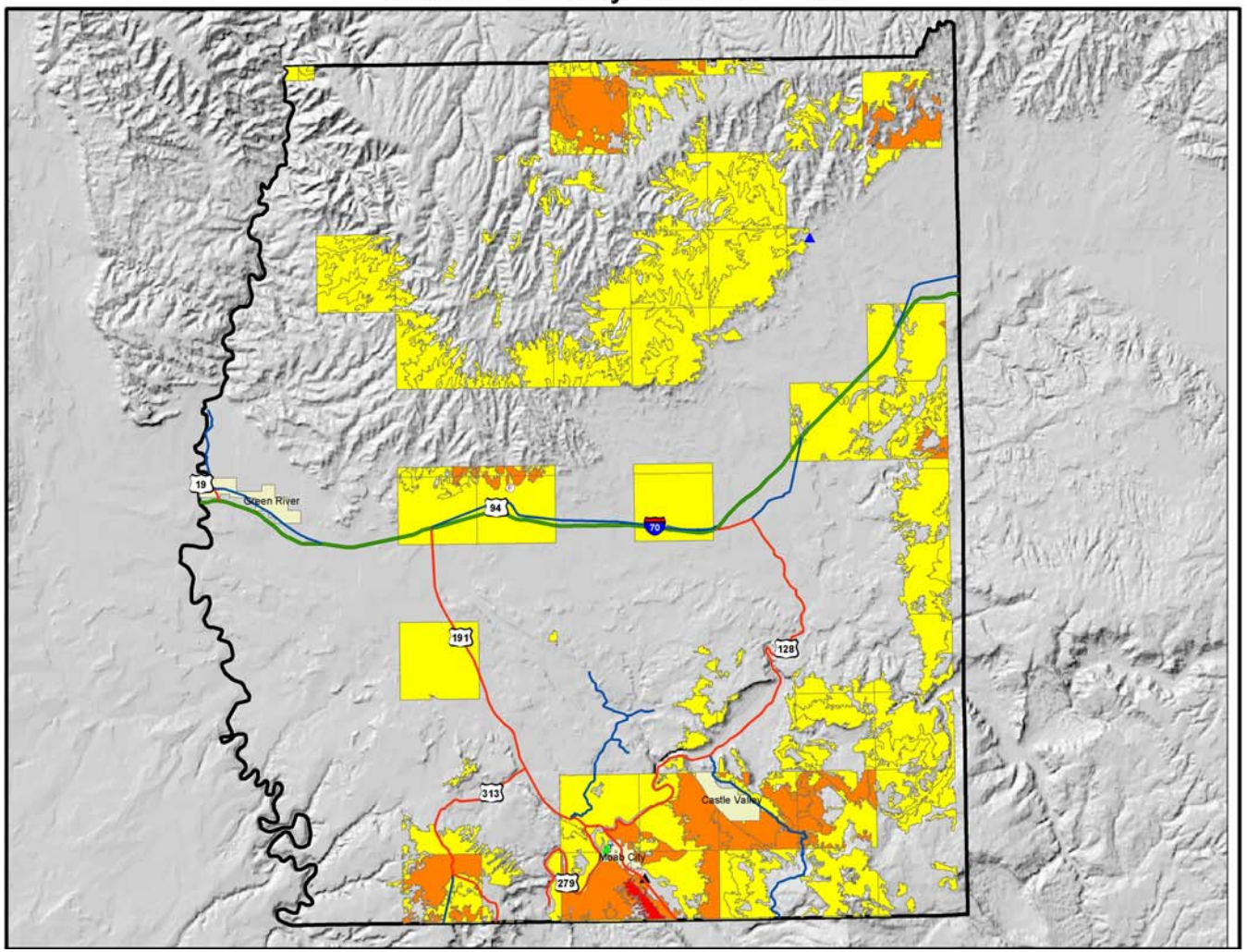
All of the following maps have been created for the Pre-Disaster Mitigation Plan using the best available data at the time of the creation of this plan. Because data was obtained from federal and other external sources, Grand County, Moab City, SEUALG and WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 9.1.1 Dam Hazard
Map 9.2.1 Wildfire Risk
Map 9.3.1 Landslide Hazard
Map 9.4.1 Problem Soils

Grand County Dam Hazard



Grand County Wildfire Risk



Wildfire Risk

- Extreme
- High
- Medium
- Fire Station
- Police Station
- School
- Waste Water Facility
- Oil Facility
- Communication Facility

N
W E
S

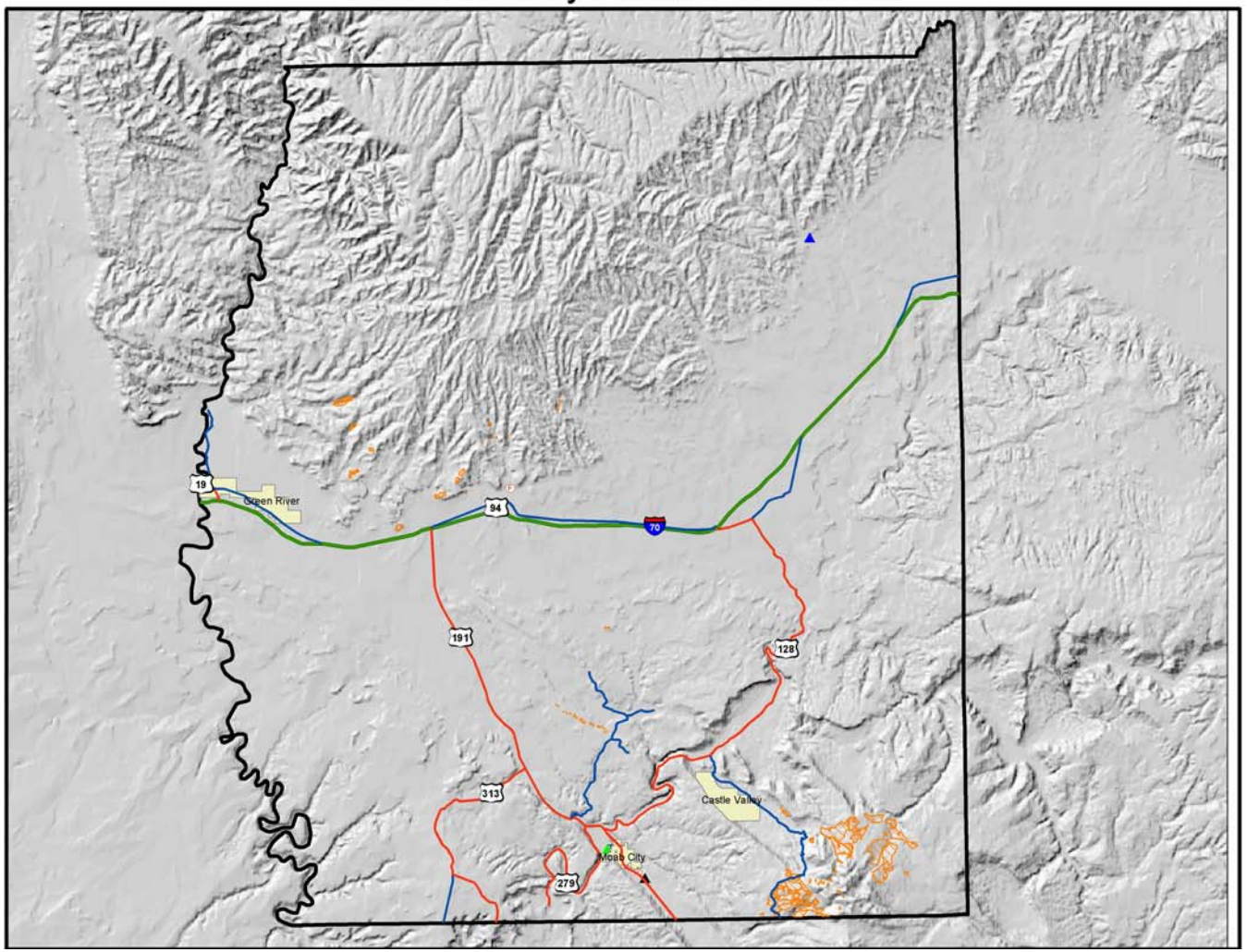
0 4.5 9 18
Miles

Southeastern Association of Local Governments

Data Source: Infromation provided by DESHS, and Utah AGRC

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Grand County Landslide Hazard



LANDSLIDES
Fire Station
Police Station
School
Waste Water Facility
Oil Facility
Communication Facility

N
W E
S

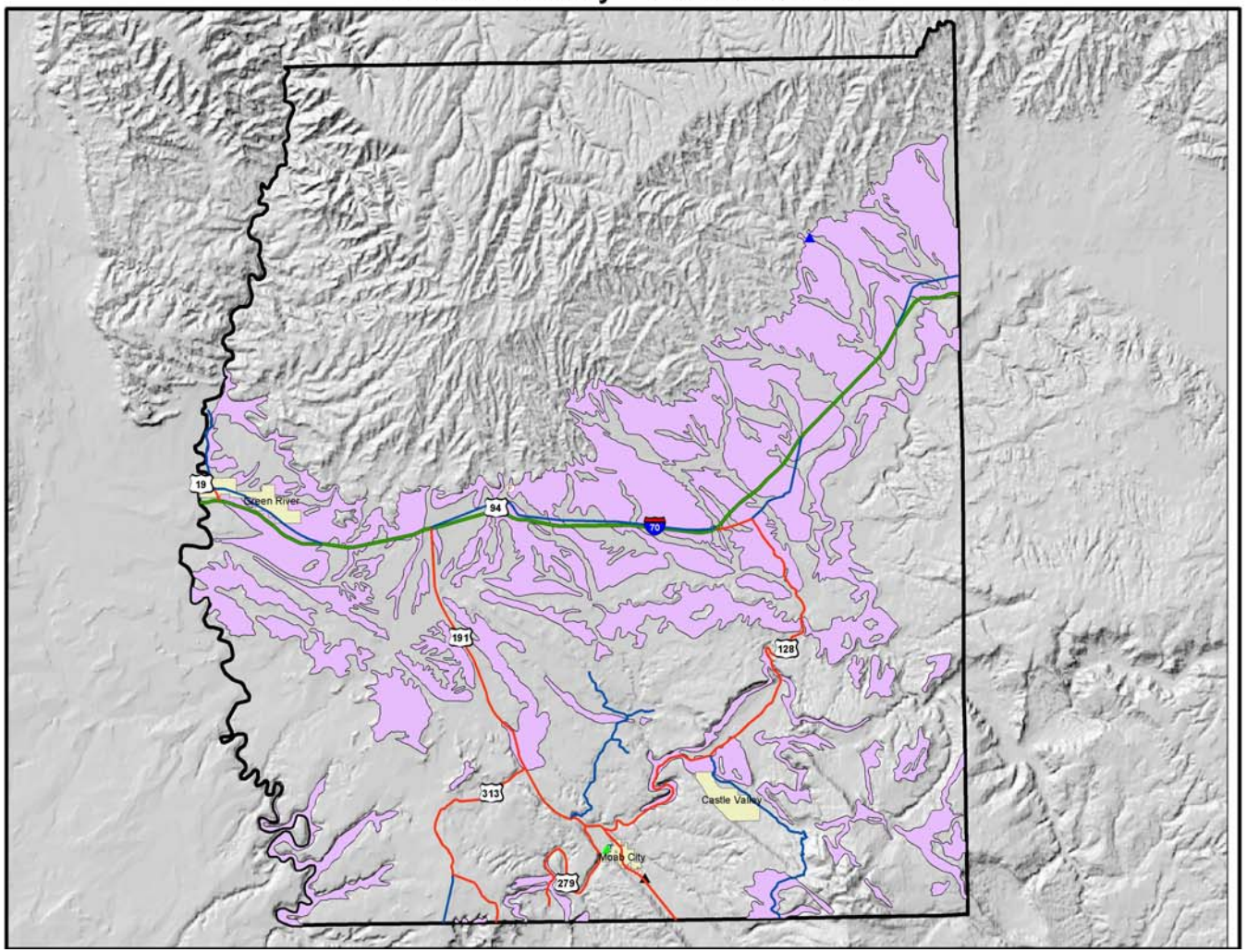
0 4.5 9 18
Miles

Southeastern Association of Local Governments

Data Source: Infromation provided by DESHS, and Utah AGRC

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Grand County Problem Soils



Expansive Soil or Rock
Fire Station
Police Station
School
Waste Water Facility
Oil Facility
Communication Facility

N
W E
S

0 4.5 9 18
Miles

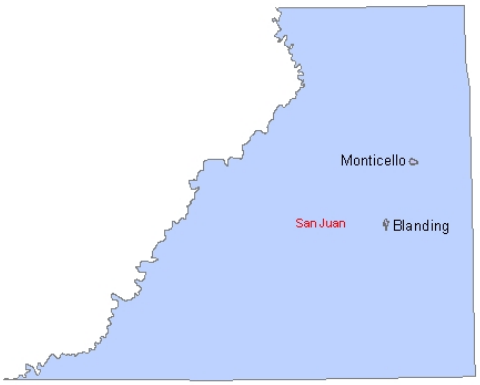
Southeastern Association of Local Governments

Data Source: Infromation provided by DESHS, and Utah AGRC

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Part 10. San Juan County

San Juan County includes two main municipalities, Monticello and Blanding. San Juan County is located in the southeastern corner of the state. Other jurisdictions that have been included in the risk assessments including Mexican Hat, Bluff, and Montezuma Creek; these jurisdictions are not incorporated municipalities and have not been mapped.



A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rates of Change, and Population and Development Trends is important in understanding the impacts a natural hazard may have on a local community now and in the future (Table 10-1). Monticello and Blanding are the two principal cities in San Juan County. Smaller significant communities include Aneth, Bluff, Eastland, White Mesa, Mexican Hat, Las Sal, Spanish Valley, Holly Village, Oljato, Red Mesa, Monument Valley, Halchita, Goulding, Rainbow Village, and Montezuma Creek. The Navajo Nation and the Ute Mountain Reservations account for 1,231,000 acres (Utah Water Master Plan).

Table 10-1 San Juan County Population

Geographic Area	1990	1997	2000	2020	2050	AARC 1990-2000	Rank by 2000 Population
Blanding Annex Area	3,162		3,162	4,991	7,138	0.0	
Monticello Annex Area	1,806	1,859	1,958	2,565	4,009	0.8	
Spanish Valley		126		166	253		
La Sal		201		264	401		
Bluff		192		250	379		
Mexican Hat		78		102	155		
Eastland Service Area		84		112	170		
Balance of Private Lands		1,034		214	508		
White Mesa Reservation		290		384	582		
Navajo Reservation		6,012		8,225	12,405		
Dennehotso Chapter		32		41	56		
Navajo Mtn. Chapter		427		557	787		
Oljato Chapter		1,769		2,333	3,346		
Mexican Water Chapter		329		541	1,037		
Red Mesa Chapter		1,150		1,706	2,854		
Teec Nos Pos Chapter		105		133	182		
Aneth Chapter		2,225		2,914	4,143		
Total San Juan County	12,621	13,284	14,413	17,273	26,000	1.3	16
Balance of San Juan County	7,653	9,293				2.0	

Table 10-2 Population by County 1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
Southeast Region	54,124	49,801	54,180	54,559	57,699	62,754	66,489	67,867	0.75%
San Juan County	12,253	12,621	14,413	14,734	15,823	17,441	18,696	19,459	1.01%
Sources: http://www.governor.state.ut.us/projections/EDPT3.pdf; U.S. Bureau of the Census; Utah Population Estimates Committee; 2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System. Notes: AARC is average annual rate of change. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations.									

B. Economy

San Juan County has three main land-based economic opportunities that are expected to lead growth. These are agriculture, hunting and fishing, and tourism. Other factors that affect economic enrichment involve mineral production, governmental operations, tribal operation, oil and gas exploration, and wildlife recreation (Scherick 63-71).

Economic growth for the first quarter of 2002 was centered on tourism, construction, and health care. The service production industries accounted for much of the job growth and a drop in unemployment during the first quarter of 2002. The current October 2002 unemployment rate is 7.8 percent, a 1.2 percent drop from October 2001 (San Juan County Trends). The 2000 estimated average house value is $123,751 (Annual Statistical).

C. Transportation and Commuting Patterns

San Juan County has no public railway, bus, or passenger air transportation. The major U.S Highways include 191 and 491 (formerly known as "The devil's highway" or route 666). State highway 191extends from the northern San Juan County line south through Monticello, Blanding, Bluff, and Mexican Water on into Arizona. State highway 491 extends from the Colorado State line west through Monticello. State highway 163 runs perpendicular to US 191, extending from Montezuma Creek west through Bluff, and then southwesterly through Mexican Hat and on to the Arizona state line (Scherick 36).

D. Land Use and Development Trends

The Federal Government owns the majority of land within San Juan County. The Bureau of Land Management administers approximately 41% of the land, the National Park Service and the U.S Forest Service handle 11% and 9%, respectively. State lands make up 8% with State Parks occupying less than 1%. Private land ownership consists of roughly 8% of the land base (Scherick 35). The Navajo nation occupies roughly 23% of San Juan County. Development trends indicate that San Juan County will continue to grow. The service and trade industry have had a large impact on population growth and with the above-mentioned population forecast numbers, the county will continue to create more local tourism opportunities.

Risk Assessment

The risk assessment process revealed that wildfire, flood, dam failure, infestation, severe weather, earthquake, and drought have typically affected this geographic region. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section (Refer to Part 6 for an explanation of the risk assessment process). According to this data there are 28 critical facilities in San Juan County (Please refer to Appendix C for a complete list of critical facilities for the entire county). Severe weather, earthquake, and drought are considered to be regional hazards and have been profiled as such (Part 4 Regional Data).

1. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	See map in Section H. Countywide, URWIN areas around Monticello and Blanding.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

A wildfire is an uncontrolled fire spreading through both naturally occurring and non-native vegetative fuels. Often wildfires threaten nearby structures. Wildfires often begin unnoticed and spread quickly. They are usually signaled by dense smoke that fills the area for miles around. Wildfire can cover a large geographic area, can be ignited by natural or human sources, and are hard to predict. According to the local emergency manager, the county had fires in 1994, 1996, 2001, and 2002. They were all isolated but did considerable damage to property and suppression was costly. The Division of Emergency Services and Homeland Security list below five categories to wildfire risk. Wildfire maps provided by DESHS show five categories of wildfire risk:

- Extreme
- High
- Medium
- Low
- Very Low

These ratings cover all of San Juan County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within San Juan County. The population within each of the areas is also included (Table 10-3).

Table 10-3 Households and Population in Wildfire Area

	Extreme Risk	**High Risk**	**Moderate Risk**
Residential Units/Replacement Cost	144/$11,323,728	65/$5,111,405	170/$13,368,290
Population	456	84	328

Table 10-4 details the annual sales of the businesses inside each wildfire risk area, and the assessed value of residential property in each wildfire risk area. Residential loss estimates do not include contents. Including the value of contents would increase the values listed by 50%.

Table 10-4 Businesses in Wildfire Area

City Name	Businesses in Extreme/ Annual Sales	Businesses in High/ Annual Sales	Businesses in Moderate/ Annual Sales
Blanding	6/ $3,900,000	4/ $900,000	5/ $6,900,000
Monticello	No known risk	No known risk	47/ $54,900,000
Montezuma Creek	No known risk	No known risk	1/ $600,000

Table 10-5 contains the number of acres in each wildfire risk area, within the municipal boundaries of the following cities in San Juan County.

Table 10-5 Wildfire Risk Area

	Acres of Extreme	Acres of High	Acres of Moderate
Monticello	90.93	92.16	90.93
Blanding	162.17	109.44	15.79

The following tables list the critical facilities and infrastructure within Extreme, High or Moderate wildfire risk areas (Table 10-6, 10-7). Refer to Table 10-8 for a list of the recorded fire history within the county.

Table 10-6 Critical Facilities in Wildfire Zones

Critical Facility	Name	Location
Oil Facility	Gary-Williams Energy Facility	¾ Mile South of Montezuma, Montezuma Creek
Oil Facility	Unocal Lisbon Plant	
Natural Gas Facility	Northwest Pipeline	22 Miles South of hwy 191, Near Moab
School	Monticello High	Monticello
School	Monticello School	Monticello

Table 10-7 Infrastructure in Wildfire Area

Item	Length (Miles)	Replacement Cost
Local Roads	230.65	$461,300,000
State Highways	144.95	$349,846,962
US Highways	0.00	$0
US Interstates	0.00	$0
Power Lines	111.50	$5,383,220
Gas Lines	45.24	$10,920,484

Table 10-8 Historical Wildfires

Date	Fire Name	Cause	Size
6/8/86	White Mesa	Miscellaneous	E
6/1/87	White Mesa # 2	Incendiary	D
6/18/87	McCracken Mesa	Miscellaneous	E
6/19/87	White Mesa # 4	Incendiary	E
6/23/87	White Mesa # 6	Debris Burn	D
7/4/87	Tank Draw	Equipment	F
8/15/87	Two Mile Creek	Lightning	D
6/15/89	Pehrson	Lightning	E
7/23/90	Horny Toad	Lightning	D
8/9/90	Alfred Frost	Lightning	D
6/14/94	Willow Basin	Equipment	F
6/25/94	Haller (Wheatfield)	Lightning	D
6/29/94	Mustang	Lightning	D
7/14/94	Iron Canyon	Lightning	D
7/14/94	Peters Hill (Iron Canyon)	Miscellaneous	D
3/21/96	Montezuma	Debris Burn	D
6/8/96	Dove Creek	Lightning	D
6/21/96	Eastland	Lightning	D
7/16/97	Wray	Lightning	D
7/17/97	Cajon Mesa	Lightning	E
6/1/98	Aneth Point	Cigarette	D
7/9/99	McCracken	Lightning	E

2. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	See map in Section H, the San Juan and Colorado Rivers and their respective larger tributaries.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study, Hazard Analysis Plans, GIS data, and have worked with local residents of the community.		

Description of Location and Extent

The WFRC, San Juan County GIS staff members, and Utah DESHS have reviewed the county's most recent FIRM and FIS, EOP, Hazard Analysis Plan, and have worked with local residents of the community to compile all available data to profile the flooding hazard in San Juan County. A rudimentary Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003 (Appendix E).

The following communities are situated in floodplains and have suffered property damage in the past. McElmo Creek, Comb Wash, Cottonwood Wash, and Montezuma Creek near Bluff, Cottonwood Wash near Blanding, Butler Wash near Bluff, Comb Wash near Bluff and Blanding, White Canyon near Hite, and Lime Creek near Mexican Hat.

Bluff is located in an alluvial fan below Cottonwood Wash, and therefore is in a floodplain area as well as in a shallow ground water zone. Mexican Hat is located near the San Juan River and is also in the floodplain. The city of Blanding resides on or near expansive soils; when water is introduced into these types of soils they expand and damage or destroys foundations in homes and businesses.

Monticello, Bluff, Blanding, and Mexican Hat are likely to experience another flood event in the future. Flash flooding is also possible in San Juan County in gullies, washes and canyons.

Vulnerability Assessment

Due to the lack of digitized floodplain maps potential dollar loss estimates were unable to be completed during the making of this plan.

3. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H Dam locations are mainly located in the mid-eastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights, Utah Division of Water Rights and Dam Safety, local input.		

Description of Location and Extent

Twenty-eight dams are located in San Juan County with only four dams listed as having a high threat rating. A high threat rating means there is a possibility of life being lost due to dam failure. Two dams are listed, as having a moderate hazard rating, meaning there would be significant downstream property loss if the dam were to fail. The remaining seventeen dams have a low hazard rating; if a dam failure were to occur there would be insignificant property loss, however they should still be monitored (Table 10-9). The classification of a high hazard dam does not mean that the dam has a high probability of failure. Dam safety hazard classifications simply delineate the downstream consequences if a dam were to fail (Table 10-10). Potential dam failure in San Juan County is rated as "possible." If a dam were to breach in the county, the cities identified in Table 10-10 would be affected.

Table 10-9 San Juan County Dam Risk

Dam Name	Hazard Risk
1. Kens Lake	High
2. Lloyds Lake/ Monticello	High
3. Starvation Canyon	High
4. Recapture Creek	High
5. Blanding City #3	Moderate
6. Blanding City #4	Moderate
7. Camp Jackson	Moderate
8. Dry Wash #2	Moderate
9. Gordon	Moderate
10. Keller	Moderate
11. Monticello Lake	Moderate
12. Rattlesnake Ranch #1, Upper	Moderate
13. Rattlesnake Ranch #2, Lower	Moderate
14. Bailey, Upper	Low
15. Bankhead, Lower	Low
16. Blanding Wastewater Winter Storage	Low
17. Dugout	Low
18. Iron Springs	Low
19. Monticello City #1	Low

20. Monticello City #2	Low
21. Monticello City #3	Low
22. Provancha	Low
23. Rio Algom, Lower	Low
24. Rio Algom, Upper	Low
25. Snyder #2	Low
26. White Mesa Tailings #1	Low
27. White Mesa Tailings #2	Low
28. White Mesa Tailings #3	Low

Monticello
Lloyds Lake is a High hazard dam owned by San Juan Water Conservancy District and was completed in 1984. The reservoir storage at spillway crest is 3,500 acre-feet and the reservoir storage at dam crest is 4,300 acre-feet. The spillway type is an open channel and the maximum dam breach flow would be 86,000 cfs with a 13 square mile drainage basin area. The first downstream town is Monticello 1 mile away.

Blanding
Starvation Canyon Reservoir is a High hazard dam owned by Blanding City and was completed in 1985. The reservoir storage at spillway crest is 600 acres and the reservoir storage at dam crest is 875 acres. The spillway type is an open channel and the maximum dam breach flow would be 28,000 cfs with a 1 square mile drainage basin area. The first downstream town is Blanding 3 miles away.

Recapture Creek has a High hazard dam rating. It is owned by San Juan Water Conservancy and was completed in 1984. The reservoir storage at spillway crest is 9,319 acre-feet and the reservoir storage at dam crest is 16,000 acre-feet. The spillway type is open channel and the maximum dam breach flow would be 220,000 cfs with a 61 square mile drainage basin area. Recapture Creek does not have a downstream town; the dam water would flow into the San Juan River.

Table 10-10 Dam Breach Downstream Town

Dam Name	First Downstream Town	Distance in miles
Bankhead, Lower	La Sal	5
Blanding City #3	Blanding	4
Camp Jackson	Blanding	17
Dry Wash #2	Blanding	14
Gordon	Monticello	5
Kens Lake	Moab	6
Lloyds Lake	Monticello	1
Monticello City #1	Monticello	1
Monticello City #2	Monticello	1

Vulnerability Assessment
The risk assessment values for dam failure were difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. The municipalities, roads, critical facilities, and GIS layers were superimposed over the dam identification layers. This analysis reveals the geographic extent of the dams and the critical facilities within the hazard areas. This analysis could not identify potential dollar loss estimates using the available data.

4. Infestation

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Agricultural lands, forested areas, areas of extreme drought.		
Seasonal Pattern or Conditions	Summer, drought related		
Duration	Months to years		
Analysis Used	Reviewed information provided by UGS, DESHS, AGRC, Idaho's Forest Health Protections agency, Utah Forestry Fire and State Lands, Utah Forest Service, Utah State University Extension Service, and local input.		

Description of Location and Extent

San Juan County has experienced infestation problems in the past. The following information has been gathered from surveyors from Boise, Idaho's Forest Health Protection with help from the Forest Health Coordinator from Utah Forestry Fire and State Lands:

In 1998, 14 % of San Juan County was surveyed (or 690,067 out of 5,065,358 total acres). The survey identified 291 acres that were affected by Mountain Pine Beetle Ponderosa, 74 acres affected by Douglas-Fir Beetle, 198 acres affected by the Spruce Beetle, 398 acres affected by Aspen Blight, 354 acres from Sub-Alpine Fir Mortality Complex, and 5 acres from Pinyon Mortality.

In 1999, 8 % of San Juan County was surveyed or 411,622 out of 5,065,358 total acres. The survey identified that 186 acres were affected by Mountain Pine Beetle Ponderosa, 20 acres affected by Douglas-Fir Beetle, 429 acres affected by the Spruce Beetle, 40 acres affected by Fir Engraver Beetle, 1,349 acres from Sub-Alpine Fir Mortality Complex, and 15 from Aspen defoliation.

In 2000, 8 % of San Juan County was surveyed or 417,045 out of 5,065,358 total acres. The survey identified that 243 acres were affected by Mountain Pine Beetle Ponderosa, 77 acres affected by Douglas-Fir Beetle, 407 acres affected by the Spruce Beetle, 140 acres affected by Fir Engraver Beetle, 802 acres from Sub-Alpine Fir Complex, 251acres from Aspen defoliation, and 461 acres from Needle Disease Ponderosa.

In 2001, 10 % of San Juan County was surveyed or 482,600 out of 5,065,358 total acres. The survey identified that 383 acres were affected by Mountain Pine Beetle Ponderosa, 94 acres affected by Douglas-Fir Beetle, 506 acres affected by the Spruce Beetle, 226 acres affected by Fir Engraver Beetle, 2,287 acres from Sub-Alpine Fir Complex, 295 acres from Aspen Blight, 34 avalanche, and 3,337 acres from Frost Damage Oak.

In 2002, 10 % of San Juan County was surveyed or 499,557 out of 5,065,358 total acres. The survey identified that 191 acres were affected by Mountain Pine Beetle Ponderosa, 219 acres affected by Douglas-Fir Beetle, 82 acres affected by the Spruce Beetle, 31 acres affected by Fir Engraver Beetle, 1,463 acres from Sub-Alpine Fir Complex, and 64 Forest Tent Caterpillar.

During 2002 and 2003, Armyworms and Grasshopper crickets have been a major problem in the entire county of San Juan.

Cutworms have also been a problem within the cities and communities of San Juan County. This type of infestation has a direct correlation to drought and is considered to be one of the secondary threats of drought. San Juan County is located within Climate Division 7. This division experiences a drought almost every two years. Each drought can last five or more years.

Infestation will continue to happen in the future because of Utah's climate. Drought, vegetation, and species diversity are all affected by climate and will continue to be a limited problem for Utah's forestlands and cities and towns.

Vulnerability Assessment
Potential loss estimates were unable to be completed during the making of this plan due to the lack of digitized datasets related to infestation. Future studies and maps need to be completed to fully understand this hazard.

F. Hazard History

Identifying past hazard events is key in predicting where future events are likely to occur. The following available relevant information such as date, location, area impacted, and damage costs are identified in the table below (Table 10-11). Due to the frequency and geographic extent of problem soil, and some severe weather events past events have not been recorded and are therefore not identified in the table below.

Table 10-11 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Tornado	May 21, 1947	San Juan County		F0 on the Fujita Scale.
Tornado	May 23, 1947	San Juan County		F0 on the Fujita Scale.
Flash Flood	August 17, 1955	Monticello	Northeast Section of City	Damage to homes and businesses
Flood	August 2, 1956	Monticello		City and some homes were flooded; one motel resulted in $50,000 in damage.
Flood	July 31, 1965	Monticello		Farmland and crop damage, Johnson Creek Road damaged.
Flood	August 1, 1968	Bluff		Residential and business property damaged. Damage estimated over $16,000.
Winter Storm	1974	San Juan County		Runoff damage
Winter Storm	1986	Countywide		Road closures and property damage.
Winter Storm	1992	Countywide		Road closures and property damage.
Blizzard	January 1, 1997	Countywide		3 deaths, 50 injuries and $40 million in property damage.
Winter Storm	April 2, 1997	Countywide		No property damage no loss of life
Winter Storm	October 15, 1998	Countywide		Several thousand dollars of property damage.
Rainstorm	October 30, 1998	Bluff		No significant damage.
Winter Storm	December 19, 1998	Countywide		Several thousand dollars in property damage.
Wildfire	June 16, 1999	Monticello		No property damage or loss of life.
Wildfire	July 17, 2000	Blanding		No property damage or loss of life.
Wildfire	July -August, 2000	Monticello		
Funnel Cloud	August 20, 2000	Mexican Hat		
Funnel Cloud	August 21, 2000	Monticello		

G. Mitigation Goals, Objectives, Actions

Mitigation Strategies Workbook
San Juan County

Valuation
The following table shows possible damage costs of identified hazards based on maps of hazard areas and on records of previous events (Table 10-12).

Table 10-12

Type of Hazard	Possible Damage Costs (approx.)
Severe Weather	$5,000-$10,000 per event
Flooding	$10.5 Million (flood hazard area)
Wildfire	$9 Million (wildfire risk area)
Drought	Requires further study
Landslide	Requires further study
Dam Failure	$3 Million (rebuild golf course)

Prioritization
The following table summarizes each of the hazards, rated according to Probability (the likelihood of an event occurring in a given period) and Severity (lives and property that would be affected). None of the hazards were rated as Highly Likely and Catastrophic (Table 10-12).

Table 10-12

Type of Hazard	Probability	Severity	Rank
Severe Weather	Highly Likely	Limited	1
Flooding	Possible	Critical	2
Wildfire	Possible	Limited	3
Drought	Highly Likely	Negligible	4
Landslide	Possible	Negligible	5
Dam Failure	Not Likely	Limited	6

SAN JUAN COUNTY
UTAH PORTION OF THE NAVAJO NATION
MITIGATION GOALS AND OBJECTIVES

Wildfire

Problem Identification: Provide fire breaks around residences and commercial business that may be of threat from a wildfire. Most of the area does not have a high impact potential from wildfire.

Goal 1-Priority Medium

Objective 1.1 - Provide fire breaks around residences and commercial business that may be of threat from a wildfire by blanding and other methods.

Action: Blade firebreaks as needed
Time Frame: Ongoing
Funding: Local, Chapter, Tribal and Federal Funds
Estimated Cost: 5,000 annually
Staff: Local, chapter, tribal and federal agencies
Background: Work with chapter officials to determine areas for firebreaks

Problem Identification: Specific areas of the Utah strip are susceptible to wildland fire danger.

Goal 2- Priority Low

Objective 1.2 - Reduce the threat in Navajo Mountain and Aneth/Red Mesa areas.

Action: Map potential areas on the Utah Strip that may have wildland fire threat.
Time Frame: next fiscal year
Funding: Local, Tribal and Federal
Estimated Cost: Minimal
Staff: Local, tribal and federal agencies
Background: Review fire reports from previous years to determine threat areas.

Landslide

Problem Identification: Potential landslides on the Utah portion of the Navajo Nation, particularly those areas that have had prior threats or incidents.

Goal 1- Priority Medium

Objective 1.1 - Map areas on the Utah portion that have had historical incidents of landslides.

Action: Review historical information and reports, interview with citizens.
Time Frame: FY2005
Funding: Local, Chapter, Tribal and Federal funding.
Estimated Cost: 1000.00
Staff: County, Chapter, Tribal, and Federal Agencies.
Background: Historical information and interviews/

Problem Identification: Potential risk of structures in mountainous areas to be damaged by landslides.

Goal 2-Priority Medium

Objective 1.2 Reduce potential of landslides on county and state highways.
Action: Removal of material, placement of larger culverts, re-routing of existing highways.
Time Frame: Undetermined
Funding: Local, State, Chapter, Tribal and Federal
Estimated Cost: Unknown
Staff: Local, State, Chapter, Tribal and Federal
Background: Soil surveys and other engineer surveys, historical incidents.

Earthquake

Problem Identification: Unknown number of seismically unsafe structures around the Utah portion of the Navajo Nation. The risk based on historical incidents has not been high.

Goal 1- Priority Low

Objective 1.1 - Public Awareness

Action: Conduct pubic awareness campaign.
Time Frame: Ongoing
Funding: Federal and state grants, local sources.
Estimated Cost: Unknown
Staff: Agency personnel and volunteers.
Background: Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.

Goal 2- Priority Low

Objective 1.2 - Community Emergency Response Teams (CERT)

Action: Assist with the organize Community Emergency Response Teams by Navajo Nation, if it is determined to be a local priority.
Time Frame: Ongoing
Funding: Federal, Tribal, and State grants.
Estimated Cost: Unknown
Staff: Tribal, State and local personnel.
Background: Navajo Nation Department of Emergency Management, Utah Chapters, and Utah.

Flood

Problem Identification: Identify and map areas that are prone to flood based on historical reports and incidents and encourage flood loss reduction measures

Goal 1- Priority High

Objective 1.1 - Identify flood prone areas on the Utah portion of the Navajo Nation.

Action: Mapping of potential flood areas.
Time Frame: FY2005
Funding: unknown
Estimated Cost: $5000.00
Staff: Local, Chapter, Tribal and State
Background: Contact DESHS flood map specialist.

Problem Identification: Reduce impact on State and County Highways from Flooding.

Goal 2- Priority High

Objective 1.2 - Reduce or eliminate flooding impacts on State and County highways based on historical incidents/

Time Frame: Ongoing
Funding: State, Local, and Federal...
Estimated Cost: Unknown.
Staff: County and State
Background: County Road and UDOT, NNOT and Engineers.

Problem Identification: Many reservoirs have been filled in and/or broken through out the years and have not been repaired.

Goal 3- Priority Medium

Objective 1.3 - Repair numerous reservoirs throughout the Utah portion of the Navajo Nation.

Action: Repair and/or clean out reservoirs.
Time Frame: Ongoing
Funding: State, Federal, and Tribal
Estimated Cost: Unknown.
Staff: Federal, Chapter and Tribal
Background: Chapter and Farm Service Agency Personnel

Problem Identification: Reduce economic loss due to flooding

Goal 4 – Priority High
Objective 1.1 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County and City Floodplain Administrators, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Drought

Problem Identification: Water Storage

Goal 1- Priority High

Objective 1.1 - Develop more water storage tanks and systems for culinary and agriculture use on the Utah portion of the Navajo Nation.

Action: Conduct feasibility study.
Time Frame: Unknown
Funding: Unknown
Estimated Cost: Unknown
Staff: County, Chapter, Tribal, Federal (IHS)
Background: Chapter, Tribal, and Farm Service Agency personnel.

Problem Identification: Water storage for animals.

Goal 2- Priority Medium

Objective 1.2 - Develop more reservoirs on the Utah portion of the Navajo Nation.

Action: Develop new reservoir.
Time Frame: Ongoing
Funding: State and Federal grants
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, etc.
Background: NRCS, Chapter, USU Extension, Tribal

Problem Identification: Lack of public awareness of efficient water usage.

Goal 3- Priority High

Objective 1.3 - Education

Action: Use several ways in educating the public on efficient water usage.
Time Frame: Ongoing
Funding: State and Federal grants, federal program, NTUA
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, IHS and NTUA.
Background: Research problem areas. Create programs to make the public aware. Use newsletters and the newspapers. Hold field trips.

Insect Infestation

Problem Identification: Infestations of Army Cut-Worms and other insects on the Utah portion of the Navajo Nation.

Goal 1- Priority Medium

Objective 1.1 - Have government agencies develop better control methods on federal grounds.

Action: Improve control methods on reservation lands/.
Time Frame: 5 years
Funding: Federal government.
Estimated Cost: Unknown
Staff: APHIS, Tribal other federal and state agencies.
Background: Educate land owners to control methods and more into their lifecycles.

Severe Weather

Problem Identification: Wind damage to property and resulting loss of power to areas on the Utah portion of the Navajo Nation, prepare residents to have 72 hours kits and provide for residents and animals in the event of severe weather, such as high winds, winter storms, mud from rains and snow storms, etc.

Goal 1- Priority Medium

Objective 1.1 - Reduce power outages.

Action: Improve infrastructures to minimize power outages.
Time Frame: Ongoing
Funding: Multiple groups.
Estimated Cost: Unknown
Staff: Private people and local utilities (UPL and NTUA)

Background: Contact utilities on current situation. Gather data on power outage, and frequency of outages.

Problem Identification: Education for residents.

Goal 2- Priority High

Objective 1.2 – Provide education to resident of the Utah portion of the Navajo Nation.

Action: Provide education to residents including 72-hour kits, etc.
Time Frame: Ongoing
Funding: County, State, Tribal, and Federal
Estimated Cost: 5000.00
Staff: Chapters, County, Tribal, Federal, and USU Extension
Background: CERT Teams, Health Officials, and Newsletters

Problem Identification: Snowstorms, summer thunderstorms, hail, and high winds over southeastern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 3 – Priority High
Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participates in the Storm Ready program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Problem Soils

Problem Identification: Wind Erosion

Goal 1- Priority Medium

Objective 1.1 - Reduce damage to crops, grazing lands, etc. from wind erosion.

Action: Improve conditions to reduce soil erosion.
Time Frame: Ongoing
Funding: USDA government programs.
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension
Background: Unknown

Rockslide

Goal 1
Minimize safety risk and property damage to Bluff Town due to Rockslide

Objective 1.1: Develop an Emergency rockslide reaction plan
Action: Coordinate with emergency response.
Timeframe: 1 year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Low

Wildfire

Goal 1
Protect Lives and Property from Wildfire

Objective 1.1: Maintain adequate fire breaks between wildfire zones and residences
Action: Thin Tamarisk/undergrowth along river bottom.
Timeframe: 1 Year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Medium

HAZMAT Spill

Goal 1
Protect Lives and Property from Hazardous Material Spillage

Objective1.1: Prevent a vehicle transporting hazardous material from flipping over on US 191 in Bluff by the sharp corner near Bluff Elementary School, forcing an evacuation of the school and several residences in town and re-routing traffic through town.
Action: Post Better signage;
Timeframe: 1 Year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Medium

Action: Erect cement protective railings around corner;
Timeframe: 1 Year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Medium

Action: Develop an emergency HAZMAT response plan.
Timeframe: 1 Year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Medium

Action: Coordinate with UDOT, county HAZMAT team.
Timeframe: 1 Year
Funding: Federal Grant; amount unknown
Staff: Bluff Fire Department
Priority: Medium

Goal 2
Protect Lives and Property from Hazardous Waste Tailings

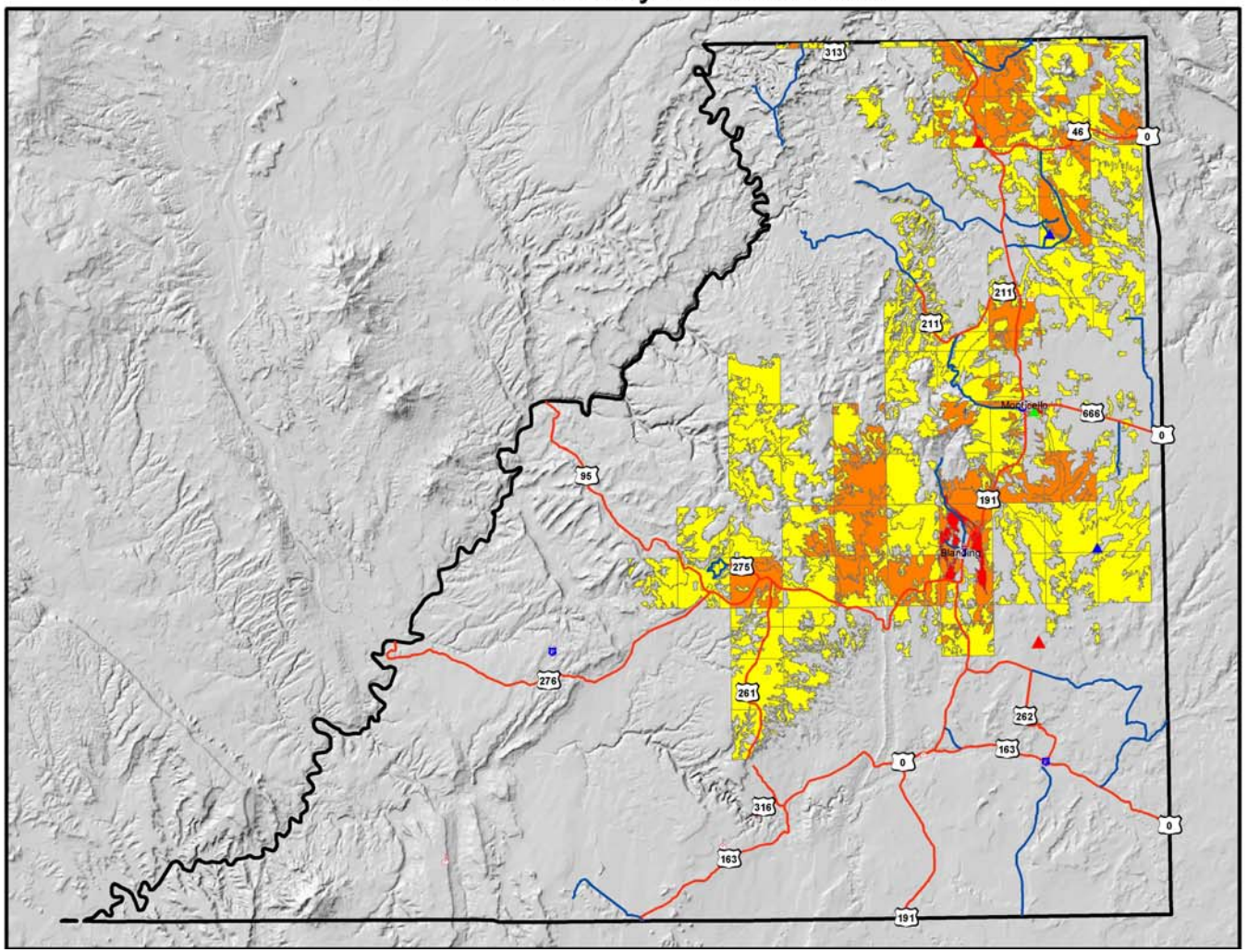
Objective 2.1: Prevent White Mesa Uranium Mill contaminates from entering the town's sole source of drinking water by Working to prevent additional radioactive waste from being stored at White Mesa Mill.
Action: Garner Continuing support of community in these efforts.
Timeframe: Ongoing
Funding: None
Staff: Bluff Service Area
Priority: Low

H. Maps

All of the following maps have been created for the Pre-Disaster Mitigation Plan using the best available data at the time of the creation of this plan. Because data was obtained from federal and other external sources SEUALG, WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 10.1.1 Wildfire Risk
Map 10.3.1 Dam Hazard

San Juan County Wildfire Risk



Wildfire Risk

- Extreme
- High
- Medium
- Fire Stations
- Police Stations
- Schools
- Waste Water Facility
- Oil Facility
- Naural Gas Facility

N
W E
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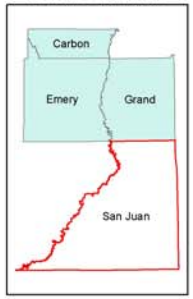
0 5 10 20
Miles

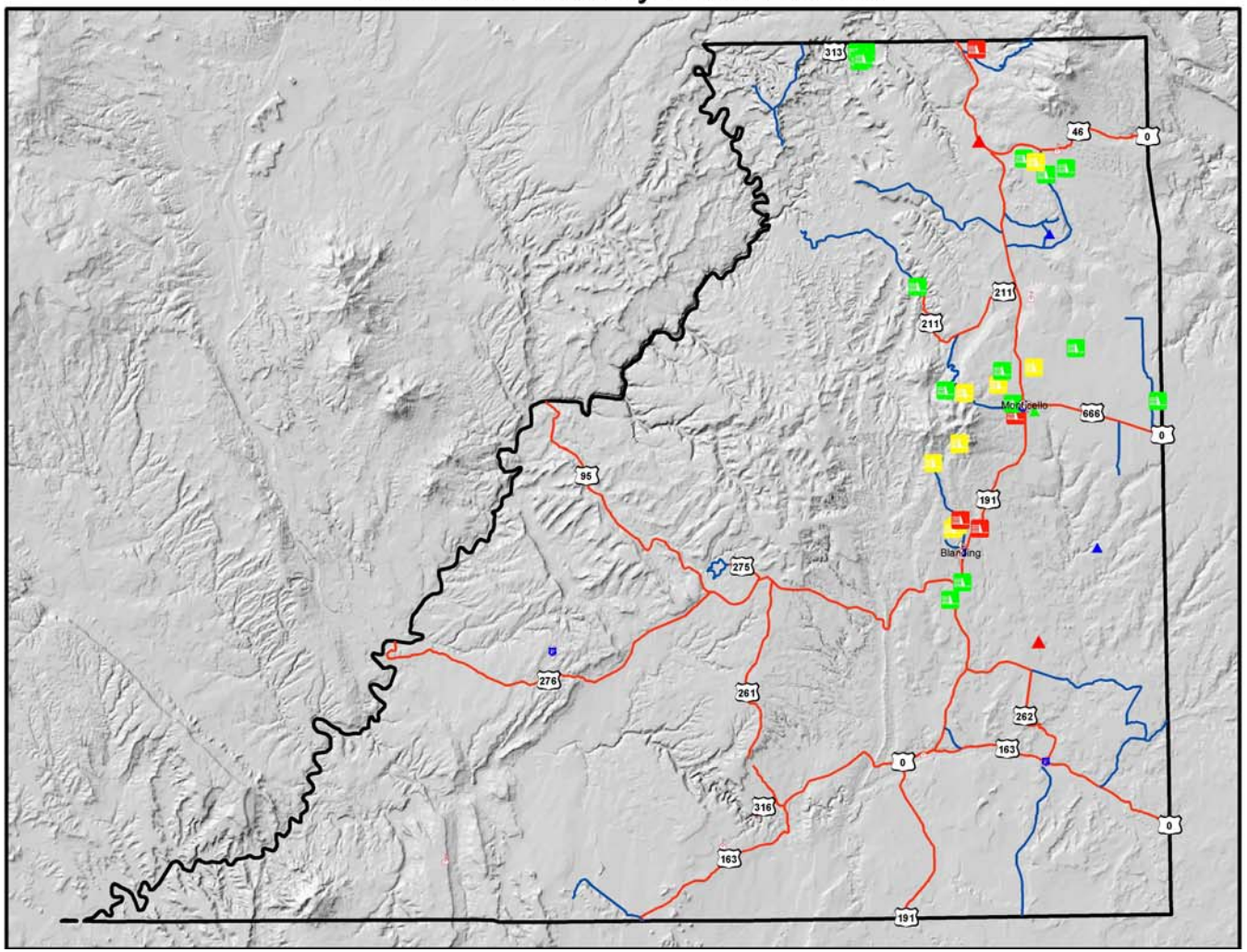
Southeastern Association of Local Governments



Data Source: Infromation provided by DESHS, and Utah AGRC

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

San Juan County Dam Hazard



DAM HAZARD

- HIGH - Possible loss of life
- MODERATE - Significant property loss
- LOW - Insignificant property loss
- Fire Stations
- Police Stations
- Schools
- Waste Water Facility
- Oil Facility
- Naural Gas Facility

N
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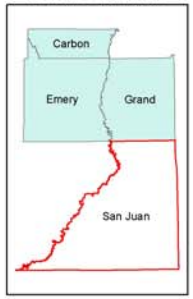
0 5 10 20
Miles

Southeastern Association of Local Governments



Data Source: Infromation provided by DESHS, and Utah AGRC

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Part 11. Maintenance and Implementation Procedures

Monitoring, Evaluating and Updating the Plan
Periodic monitoring and reporting of this plan is required to ensure that the goals and objectives for the region are kept current and that local mitigation efforts are being carried out. This plan has therefore been designed to be user-friendly in terms of monitoring and implementing.

Annual Reporting Procedures
This plan shall be reviewed annually, as required by the Utah DESHS, or as situations dictate such as following a disaster declaration. Each year the Wasatch Front Regional Council, Community Development Department and/ or Southeastern Association of Local Governments will review the plan and ensure the following:

1. The Executive Director will receive an annual report and/or presentation on the implementation status of the plan.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan.

3. The report will recommend, as appropriate, any required changes or amendments to the plan.

If the Executive Director, participating Jurisdictions, or Utah DESHS determines that a modification of the plan is warranted, an amendment to the plan may be initiated.

Revisions and Updates
Periodic revisions and updates, based on funding, of the plan are required to ensure that the goals and objectives for the region are kept current. More importantly, revisions may be necessary to ensure the plan is in full compliance with Federal regulations and State statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review
The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the region that would affect the plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the plan.

The Natural Hazard Pre-Disaster Mitigation Planning Committees, with a potential membership representing every jurisdiction in the area, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review will be summarized in the annual report prepared for this plan under the direction of the Executive Director. The annual report will include an evaluation of the effectiveness and appropriateness of the plan, and will recommend, as appropriate, any required changes or amendments to the plan.

If the Executive Director, participating jurisdictions, or Utah DESHS determines that the recommendations warrant modification to the plan, an amendment may be initiated as described below.

Plan Amendments

An amendment to the plan should be initiated by Utah DESHS, or the Executive Director, either at its own initiative or upon the recommendation of the State Hazard Mitigation Officer, Community Development Director or Mayor of an affected community.

Upon initiation of an amendment to the plan, WFRC and/ or SEUALG will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full planning committee may be reconstituted. At a minimum, the information will be made available through public notice in a newspaper of general circulation or on the SEUALG website.

Information will also be forwarded to the Utah DESHS. This information will be sent out in order to seek input on the proposed plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Community Development Director for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Community Development Director will review the proposed amendment along with comments received from other parties and submit a recommendation to the Executive Director within sixty (60) days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the plan; and/or

3. There has been a change in information, data or assumptions from those on which the plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, a public hearing will be held. The Executive Director will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Executive Director will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Defer the amendment request for further consideration and/or hearing.

4. Reject the amendment request.

Implementation and Administration through Existing Programs
Once this plan is promulgated participating cities and counties will be able to include the valuable information in this plan into existing programs and plans. These can include the General or Master Plan, Capital Improvements Plan, Emergency Operations Plan, State Mitigation Plan, City Mitigation Plans. Many of the mitigation actions developed by the cities and counties have elements of mitigation implementation including the NFIP, Fire Code, BCEGS, and CRS all of which have been implemented.

Administration will be carried out on a local level by existing and/ or new staff members dependant on the size and funding of each the projects.

Process
It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Funding Sources
Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The local jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the plan identifies the primary Federal and State grant programs for local jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal Programs
The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for “small and impoverished communities”, who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local Natural Hazard Pre-Disaster Mitigation Planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA’s Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings,

manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA’s Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility’s operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

State Programs
The state of Utah maintains a philosophy of local responsibility for hazard mitigation. State agencies still provide an integrated network of support, services, and resources for hazard mitigation activities. As demonstrated during past disasters, these agencies are well organized in their delivery and coordination of services. The following is a review of State departments with disaster responsibilities describing their existing and planned mitigation programs.

An evaluation of the laws, regulations, authorities, policies, and programs used in Utah to mitigate hazards demonstrate that they work exceptionally well, as evidenced by the massive amount of mitigation accomplished in Utah, the few numbers of disasters, and the limited nature of those emergencies that do occur. According to the Utah SHMT, the only changes that could be considered by the Legislature might be ones that parallel the Federal Disaster Mitigation Act of 2000, which would integrate pre-disaster mitigation considerations into the code of various state agencies.

Utah Division of Emergency Services and Homeland Security (DESHS)
The capabilities of DESHS Hazard Mitigation Program include:

- Prepare, implement, and maintain programs and plans to provide for preventions and minimization of injury and damage caused by disasters.
- Identify areas particularly vulnerable to disasters.
- Coordinate hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters.
- Assist local officials in designing local emergency actions plans.
- Coordinate federal, state, and local emergency activities.
- Coordinate emergency operations plans with emergency pans of the federal governments.

Through the State Hazard Mitigation Program, the following occurs:

- Provides a state coordinator for hazard mitigation, the State Hazard Mitigation Officer.
- Provides a central location of the coordination of state hazard mitigation activities.
- Provides coordination for the Federal Pre-Disaster Mitigation Program.
- Provide for coordination of Project Impact.
- Provide coordination for Comprehensive Multi-hazard Mitigation Plan development, implementation, and monitoring.
- Provide for interagency coordination
- Provide development of procedures for grant administration and project evaluation.
- Provide State Hazard Mitigation Team assistance to local governments.
- Provide for development of specific hazard mitigation plans, such as drought and wildfire.
- Provide for local hazard and risk analysis.
- Provide for development of SHMT mitigation recommendations following disasters.

Utah Department of Agriculture
The Utah Department of Agriculture administers programs serving the state's large agricultural sector. The department's response role during and after a disaster period has been to coordinate damage reports for funding needs and provides loan and recovery program information and assistance to disaster victims. This service is provided for flood, drought, insect infestation, fire, livestock disease, and frost.

<u>Assistance During Drought Disasters</u>
A damage reporting network coordinated through the existing County Emergency Board was established during the drought disaster of 1996. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

Loans Handbook
The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and applications procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage:

1) Rural Rehabilitation Loan Program (federally funded and operated by the state)
2) Agriculture Resource Development Loan Program (state funded)
3) Emergency Loan Program (state funded)

Soil Conservation Program
The Department of Agriculture also administers the ongoing Soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service, which provides most of the technical assistance. The ongoing program is not regulatory, but is directed towards improved water use and soil conservation.

Disaster Easements
Because of the similarity between past events, the department is now working on a permanent hazard mitigation concept known as "Disaster Easements", which may have widespread agreements with irrigation companies, water districts, or water users' associations for the purpose of routing flood water through local communities.

Monitoring Ground Water Quality
The Department also monitors the quality of groundwater, including individual wells and springs throughout the State.

Non-Point Source Pollution
The Department's Non-Point Source Pollution Program focuses on flood prevention through reduction of erosion, vegetating streams, and restoring "natural stream structure". The Department also monitors drought conditions, which are a precursor to wildfire.

Department of Community and Economic Development

Community Impact Board
The Utah Permanent Community Impact Fund Board provides loans and/or grants to state agencies and sub-divisions of the state, which may be socially or economically impacted by mineral resource development of federal lands.

Permanent Community Impact Fund
The Permanent Community Impact Fund provides loans and/or grants to state agencies and subdivisions of the state, which are or may be socially or economically impacted, directly or indirectly, by mineral resource development on federal lands.

Under the Federal Mineral Lease Act of 1920, leaseholders on public land make royalty payments to the federal government for the development and production of non-metalliferous minerals. In Utah, the primary source of these royalties is the commercial production of fossil fuels on federal land held by the U.S. Forest Service and the Bureau of Land Management. Since the enactment of the Minerals Lease Act of 1920, a portion of these royalty payments, called mineral lease payments, have been returned to the state in an effort to help mitigate the local impact of energy and mineral developments on federal lands.

Funding Options
The Board has the option of funding projects with loans and/or grants. The Board's preferred financing mechanism is an interest-bearing loan.

Loan Requirements
In providing financial assistance in the form of a loan, the Board may purchase an applicant's bonds only if the bonds are accompanied by legal opinion of recognized municipal bond counsel to the effect that the bonds are legal and binding under applicable Utah Law.

The Board may purchase either a taxable or tax-exempt bond. The board may purchase taxable bonds if it determines, after evaluating all relevant circumstances, including the applicant's ability to pay, that the purchase of the taxable bonds is in the best interest of the state and the applicant.

Grants
Grants may be provided only when the other financing mechanisms cannot be utilized, where no reasonable method of repayment can be identified, or in emergency situations regarding public health and/or safety.

Community Development Block Grant
The Community Development Block Grant, or CDBG program, provides funding from the federal government's Department of Housing and Urban Development or HUD, to small cities and counties in the State of Utah.

Utah Division of State History

The Utah State Historical Society, Utah's Division of State History, was founded in 1897 on the 50th anniversary of the first settlement in the Salt Lake Valley by the Mormon Pioneers. The Society became a state agency in 1917, now housed in the historic Rio Grande Depot since 1980. The Division stimulates archaeological research, study; oversees the protection and orderly development of sites; collects and preserves specimens; administers site surveys; keeps excavation records; encourage and supports the preservation of historic and pre-historic sites and publishes antiquities records. The Division also issues archaeological permits and consults with agencies and individuals doing archaeological work.

Preserving and Sharing Utah's Past
The mission of the State Division of History is "preserving and sharing Utah's past for the present and the future".

State Historical Preservation Officer (SHPO)
The SHPO administers the Section 106 process (national Historic Preservation Act) in Utah. The SHPO also serves on the Utah State Hazard Mitigation Team, providing guidance on historical and cultural preservation regulations.

Historic properties include districts, buildings, structures, objects, landscapes, archeological sites, and traditional cultural properties that are included in, or eligible for inclusion in, the National Register of Historic Places. These properties are not just "old buildings" or "well-known historic sites, but places important in local, state, or national history. Facilities as diverse as bridges and water treatment plants my, be considered historic.

Utah Geological Survey (UGS)
The Utah Geologic and Mineral Survey is the principal state agency concerned with geologic hazards. Through years of study, the UGS has developed considerable information on Utah's geologic hazards. When geologic events occur or threaten to occur, the UGS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat from natural hazards. The UGS works in partnership with other agencies, such as DESHS, in relating the threats from natural hazard to the communities at risk.

Functions
The functions of the UGS include the following:

- Evaluation of individual geological hazards;
- Participation on local government and state agency technical teams;
- Prediction of the performance on individual slides once they began to move;
- Coordination and awareness of research efforts undertaken by other agencies;
- Provide information on status of individual geologic hazards;
- Reconnaissance reports on status of hazards statewide;
- Advise Division of Water Rights on geologic hazards associated with dam sites; and
- Provide geologic information for use during planning of remedial actions.

Laws/authorities/policies of the Utah Geological Survey for conducting mitigation

Utah Code Annotated
Chapter 73 Geological and Mineral Survey
Section 68-73-6 Objectives of Survey
(1) Determine and investigate areas of geologic and topographic hazards that could affect the safety of, or cause economic loss to, the citizens of this state; (f) assist local and state government agencies in their planning, zoning, and building regulations functions by publishing maps, delineating appropriately wide special earthquake risk areas, and, at the request of state agencies, review the citing of critical facilities:

Utah State Office of Education (USOE) Rule R277-455 Standards and Procedures for building plan review

R277-455-4 Criteria for Approval; to receive approval of a proposed building site, the local school district must certify that:

Staff of the Utah Geologic Survey have reviewed and recommended approval of the geologic hazards report provided by the school districts geo-technical consultant.

Division of Water Resources
The Divisions role of planning, funding and constructing water projects serves as both active and passive hazard mitigation against drought and flood situations throughout the state. The various State water plans contain brief summaries of flood threat and risk for each drainages.

The Division is one of seven agencies in the State Department of Natural Resources. The eight member Water Resources Board, appointed by the governor, administers three state water conservation and development funds. These include:

- Revolving Construction fund – This fund started in 1947 with 1 million legislative appropriation to help construct irrigation projects, wells and rural culinary water systems. Further appropriations have added to this fund.
- Conservation and Development Fund – This fund was created in 1978 wit the sale of 25 million in general obligations bonds. Money was added to this fund with bond sales in 1980 and 1983. The C & D Fund generally helps sponsors finance larger multi-purpose dams and water systems.
- Cities Water Loan Fund – Established with an initial legislative appropriation of 2 million dollars in 1974, and with continued appropriations, this fund provides financing to help construct new culinary water projects for cities, towns, improvement districts, and special service districts.

Construction Funds
In addition to overseeing these three construction funds, the Division also manages the State funds appropriated each year for renovation and reconstruction of unsafe dams. As the funding arm of the state for water resource projects the Division works closely with Water Rights, the Regulatory arm of the state charged with jurisdiction over all private and state owned dams.

Water Resource Planning

The Division is also charged with the general water resource planning for the state. The State Water Plan is a process that is coordinated to evaluate existing water resources in the state, determine water-related issues that should be confronted and recommend how and by whom issues can be resolved. The plan identifies programs and practices of state and federal agencies, water user groups and environmental interests and describes the state's current, future, and long-term water related needs. The plan is continually updated using current hydrologic databases, river basin simulations, water supply and demand models and water related land use inventories. Revisions reflect the latest water conservation and development options concerning water rights, water transfers, population, zoning, and many other complex issues for the next 50 years in the state's major river basins.

Utah Division of Forestry, Fire, and State Lands

The Division of Forestry, Fire & State Lands utilizes the principles of stewardship and ecosystem management to assist non-federal landowners in management of their natural resources. The agency provides wildland fire protection for non-federal landowners commensurate with risk; and optimizes the benefits from ecosystem based, multiple-use management of resources held in the public trust. Wildfires are managed from six area offices 1) Bear River Office, 2) Northeast Area, 3)Wasatch Front Area, 4) Central Area, 5) Southwest Area, and 5) Southeast Area. The Division operates under the authority of the Utah Code Annotated 65-A-3-1 though 10.

The Flame-n-Go's (pronounced Flamingoes)

In 1978 the Division of Forestry, Fire, and State Lands and the Utah State Prison signed a cooperative agreement establishing Utah's first volunteer, inmate wildland fire hand-crew. The inmates named themselves the "Flame-N-Go's" and designed a logo that has become well known in the wildland fire fighting community.

All Flame-N-Go's are carefully screened for the program. They must complete rigorous training and sign a yearly contract committing themselves to preserving Utah's natural resources and building responsible lives.

The Flame-N-Go's are divided into three crews, each of which can respond to fires anywhere in the United States. A twenty-man type II hand line crew is the backbone of the group, responding to each assignment with all tools and equipment needed to do battle on the fire line. An Engine Strike Team, (five fire engines, outfitted with men and equipment) is ready to respond when needed as an Engine Strike Team or a Type II Hand line Crew. The Hotshot crew is trained to tackle the most dangerous fires in the most rugged terrain. All crews during peak fire season are on 24-hour call to respond within an hour's notice. These crews respond to an average of 50 fires per year and typically spend 45,000 hours fighting fires each season. At least one Division of Forestry, Fire, and State Lands supervisor and two Department of Corrections staff accompany each crew.

Each year, Flame-N-Go's are put through at least 80 hours of extensive training including classroom work and practical field exercises. Safety, individual, and team skills, and professionalism are stressed.

National Fire Plan

The Division administers the State responsibilities of the National fire Plan, a current emphasis of the U.S. Congress, which also addresses hazard and risk analysis and hazard mitigation.

Living With Fire Committee

The Division works in partnership with the U.S. Forest Service, Bureau of Land Management, and various other entities tasked with suppressing wildland fires on the "Living With Fire" program promoting wildland fire mitigation.

Utah Division of State Parks and Recreation
The goal of the Division of Parks and Recreation is to enhance the quality of life for residents and visitors of our state through parks, people, and programs. They are responsible for protecting, preserving, and managing many of Utah's natural and heritage resources.

Hazard and Risk Analyses
The Division develops hazard and risk analyses for the State Parks as part of the park resource management plans. The Utah Division of Emergency Services and Homeland Security produced one analysis for Snow Canyon State Park in Washington County.

Non-Motorized Trail Program
The Recreational Trails Act of 1991 charged Utah State Parks and Recreation with coordinating the development of a statewide network of non-motorized trails. The Non-Motorized Trail program makes state and federal funds available on a 50/50 matching basis to any federal, state, or local government agency, or special improvement district for the planning, acquisition, and development of recreational trails.

Grants from State Parks Boards
The council advises the Division of Parks and Recreation on non-motorized trail matters, reviews requests for matching grant fiscal assistance, rates and ranks proposed trail projects and along with State Park's staff provides recommendations for funding to the State Parks Board.

Riverway Enhancement Program
In 1986, the Utah Legislature passed a bill, which established the Riverway Enhancement Program. The program makes state funds available on a 50/50 matching basis to state agencies, counties, cities, towns, and/or special improvement districts for property acquisition and/or development for recreation, flood control, conservation, and wildlife management, along rivers and streams that are impacted by high density populations or are prone to flooding. Public outdoor recreation should be the primary focus of the project.

Utah Division of Water Rights
The Division of Water Rights is the state agency that regulated appropriation and distribution of water in the State of Utah. It is an office of public record. The Utah State Engineer's Office was created in 1897. The State Engineer's Office is the chief water rights administrative officer. A complete "water code" was enacted in 1903 and was revised and reenacted in 1919. This law, with succeeding complete reenactments of State statutes, and as amended, is presently in force mostly as *Utah Code, Title 73*. In 1963, the name was changed from State Engineers office to the Division of Water Rights.

All water in Utah are public property. A water right is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use.

Regulate Dams
The State engineer has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.

Stream Alterations Program
The Utah State Engineer's Office administers a Stream alterations program with the purpose of regulation activities affecting the bed or banks or natural streams. The State Engineer's working definition of a natural stream is any natural waterway in the state, which has flows of sufficient duration to develop a characteristic ecosystem distinguishing it from the surrounding environments. Any individual planning an activity that will affect a natural stream must first obtain a Stream Alterations Permit from this office.

Most proposals reviewed by the State, are covered by General Permit 40, which authorizes the state to have its Stream Alteration Permit fulfill the requirements of Section 404 of the Clean Water Act for most activities. General permit 40 does not apply in some instances and a U.S. Army Corps of Engineers Individual Permit is required. Projects requiring this additional permit include those involving wetlands, threatened or endangered species, properties listed on the National Historic Register, stream relocation, or the pushing of streambed material against a stream bank.

Dam Safety Program

The Dam Safety Section of the Division of Water Rights was established under Chapters 73-5a 101 thru 73-5a 702 including chapters 73-2-22 for Flood Control and the Chapter 63-30-10 Waiver of Immunity of the Utah Code and Rules R655-10 thru R655-12-6A. The program basically has jurisdiction over all private and state owned dams in the state during design, construction, operation, and decommissioning. This involved periodic inspections according to hazard classifications, inventory maintenance, design, and construction approval and systematic upgrade of all the high hazard structures to current dam safety Minimum Standards and creation of Emergency Action Plans for High Hazard dams. Since 1991, detailed dam reviews have been undertaken by the staff and by private consulting firms. Since 1995, the State Legislature has provided 3-4 million dollars per year to finance 50 % of the instrumentation, investigations, and design and 80 to 90 % of the construction costs of retrofitting and upgrading deficient dams, starting with the worst dams in the most hazardous locations.

The impetus for this dam safety program has been in reaction to dam failures, both in Utah and in other states, including the Teton Dam in Idaho and the Trial Lake Dam in Summit County and the Quail Creek Dam near St. George Utah. Since the establishment of our Minimum Standards program we have fostered the repair of dozens of dams and have not had a catastrophic failure since.

Future recommendations include continuation of the funding for dam upgrades for all the high hazard dams, and then the moderate hazard dams, continued annual inspections for maintenance items and dangerous deficiencies, upgrading EAP, and hazard assessment to reflect downstream development. Inclusion of the scanned design drawings and inundation maps from the EAP studies is being considered for our web page for public information and emergency access. Possible expansion of the program to cover canals and dikes has been considered.

Utah Division of Wildlife Resources

It is the mission of the Utah Division of Wildlife Resources to serve people of Utah as trustee and guardian of the State's wildlife. Regulates hunting, fishing and trapping, and promotes recreational, educational, scientific and aesthetic enjoyment of wildlife.

Wildlife Habitats and Hazards

Wildlife species and/or their habitats are frequently exposed to hazards. These may be either natural or human influenced (i.e. drought, flood, fire, wind, snow, wetland drainage, water diversions, hazardous material spills, improper/illegal chemical use, earthquake, and other land or water construction/development). Impact resulting either directly or indirectly, from individuals or an accumulation of several hazards, may cause but not be limited to: decreased water supply, stream/lake channel/basin morphology change, riparian/upland vegetation loss or degradation, and impairment of water quality. These in turn have a varying influence, in the extreme causing death or at a minimum temporary stress, on wildlife populations and their habitats. Hazards mentioned may affect a fairly large geographic area or be very localized in nature.

While the Division of Wildlife Resources (DNR) is charged with the management of wildlife, they do not have regulatory authority over water appropriations, water quality, development, or land management; except as allowed or occurring on properties they own. Therefore, when hazards occur, outside DWR property, DWR is limited to be a participating influence only through comments to the other regulatory agencies or individuals.

DWR management of wildlife is carried out largely through regulation of taking controlling, disturbance and/or possession of wildlife, and introduction of movement of species. However, there are numerous non-regulatory means (i.e. conservation agreements, memorandum of understanding, contract, lease agreements, cooperative agreements, and technical assistance) by which DWR interacts with other agencies, groups and individuals, to have an influence on wildlife and/or their habitat.

Hazard Areas of Commentary Interaction

While not being able to control/regulate many of the elements necessary for the benefit of wildlife; DWR provides technical comments for the maintenance, protection, and enhancement of wildlife and/or habitats for various value reasons. It is too extensive list all the areas of comment; however, the following are examples of fairly frequent concern:

- Steam Channel Alteration Permit Applications
- Water Rights Filings
- Energy and Mineral Exploration and Extraction Applications
- Federal Agency land management plans
- Waste Water Discharge Permit Applications
- Hydroelectric plant licensing or regimenting
- Urban and rural development project planning
- Utility transmission line style and locations
- Wetland alteration
- Federal land management planning
- Highway constructions

The Utah Division of Drinking Water

Division of Drinking Water's Mission Statement is to " protect the public against waterborne heath risks through assistance, educations, and oversight". The Division acts as the administrative arm of the Utah Drinking Water Board. It implements the rules, which they adopt. As such, it is engaged in a variety of activities related to the design and operation of Utah's public drinking water system. The Utah Drinking Water Board is an 11-person board appointed by the Governor. It is empowered by Title 19, Chapter 4 of the Utah Code to adopt rules governing the design, operations, and maintenance of Utah's "public drinking water system".

Safe Drinking Water Act

There is a Federal Safe Drinking Water Act, which applies to all public drinking water systems in the country. The U.S. Environmental Protection Agency (EPA) has given Utah "primacy" for enforcing the federal act within its boundaries. To qualify for this Utah's laws and rules governing public drinking water systems must be at least as strict as the federal law.

Sanitary Surveys

The Division performs sanitary surveys on the water systems, which is a compliance action that identifies system deficiencies.

Emergency Response Plans

The Division of Drinking Water requires water utilities to prepare emergency response plans under the State Safe Drinking Water Act, Utah Code Section 19-4. The Division operates according to DDW Rules: R309 gives them authority to administer actions: R309-301 through R309-104 and R309-113, R309-150, R309-301, and R309-211.

Utah Division of Solid and Hazardous Waste

The Tier II Chemical Inventory report, required by the Federal Emergency Planning and community Right-to-Know Act, requires facilities to submit lists of hazardous chemicals present on site. These reports are computerized and the information is provided to local emergency planning committees, the general public, and others for contingency planning purposes. To implement the Federal law, the State operates under Utah State Code, Section 63-5-5. The Division of Solid and Hazardous Waste requires that hazardous waste

treatment storage and disposal facilities prepare and emergency response plan as required by regulations authorized by the State Solid and Hazardous Waste Act, Utah Code Section 19-6.

Other Agency programs are regulatory in nature requiring proper use or disposal of hazardous substances or pollutants. For example the Division of Solid and Hazardous Waste regulates the disposal of hazardous waste, the Division of Radiation Control regulates the proper usage and disposal of radioactive materials. As such there is a threat mitigation nature to these programs.

Utah Division of Water Quality
The Utah Division of Water Quality protects, maintains, and enhances the quality of Utah's surface and underground water for appropriate beneficial uses; the Division of Water Quality regulates discharge of pollutants into surface water, and protects the public health through eliminating and preventing water related health hazards which can occur as a result of improper disposal of human, animal, or industrial wastes while giving reasonable consideration to the economic impact.

Water Quality Fund and Wastewater Treatment Project Fund: The Division Manages the Water Quality Revolving Fund that can be used by local governments for water quality projects and a Wastewater Treatment Project Fund.

Abating Watershed Pollution: Federal and State regulations charge the Division with "preventing, controlling, and abating" watershed pollution. Other state and local agencies have similar responsibilities. The Watershed Approach forms partnerships with these groups to pool resources and increase the effectiveness of existing programs. For each watershed management unit, a watershed plan will be prepared. The watershed plan addresses management actions at several spatial scales ranging from those that encompass a watershed management unit to specific sites that are tailored to specific environmental conditions. Ground water hydrologic basins and eco-region areas encompassed within the units will also be delineated.

<u>State Revolving Fund Program</u>
In 1987, Congress replaced the Construction Grants Program, with the State Revolving Fund Program. Rather than provide direct grants to communities, the federal government provides each state with a series of grants, then each state contributes a 20 percent state match. Grants from the federal government are combined with state funds in the Water Quality Project Assistance Program (WQPAP) and are used to capitalize a perpetual source of funds to finance water quality construction control activities at below market interests rates. Projects eligible for WQPAP financing include such traditional activities as construction of wastewater treatment plants and sewers. The program also will finance non-traditional water quality-related activities such as agricultural runoff control, landfill closures, contaminated industrial property (Brownfield) remediation, stream bank restoration, and wellhead protection.

Local
Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

Non-Governmental
Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this plan.

Continued Public Involvement
Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. The plan will be available on the SEUALG and Utah DESHS website's to provide opportunities for public participation and comment. The plan will also be available for review at the offices of the Wasatch Front Regional Council and/ or Southeastern Utah Association of Local Governments.

The Wasatch Front Regional Council has been designated as the lead agency in preparing and submitting the Southeastern Utah Association of Local Governments Natural Hazard Pre-Disaster Mitigation Plan, which includes coverage for all incorporated cities and counties within the four county region, i.e. Carbon, Emery, Grand, and San Juan Counties. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The AOG will publicly advertise all hearings, requests for input and meetings directly related to the Natural Hazard Pre-Disaster Mitigation Planning process. Meetings of the regional council where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the AOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the local newspapers. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Natural Hazard Pre-Disaster Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Natural Hazard Pre-Disaster Mitigation Plan will be presented to the SEUALG Executive Director for adoption and approval to submit the document to State authorities. SEUALG policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the plan, the plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Natural Hazard Pre-Disaster Mitigation Plan as open and convenient as possible:

A. Participation:

All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings:
Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information:
Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Natural Hazard Pre-Disaster Mitigation Plan, and/or any other documents prepared for distribution by the AOGs that may be adopted as part of the plan by reference. The AOG may charge a nominal fee for printing of documents that are longer than three pages.

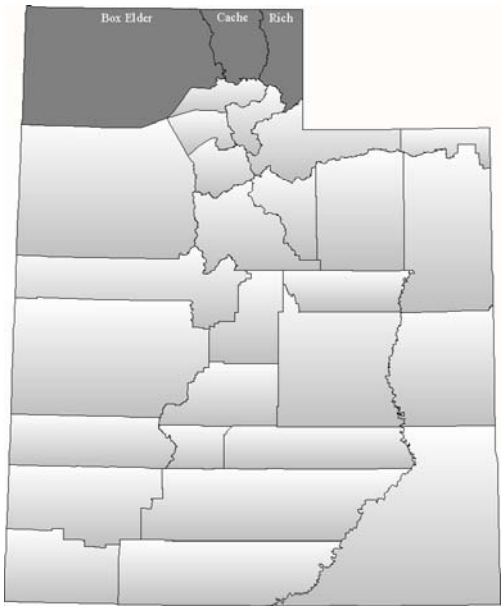
D. Technical Assistance:
Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings:
The AOG will plan and hold public hearings according to the following priorities:

1. Hearings will be conveniently timed for people who might benefit most from mitigation programs.
2. Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy).
3. Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: Identify and profile hazards, Develop mitigation strategies, and Review plan goals, performance, and future plans.

F. Future Revisions:
Future revisions of the plan shall include:

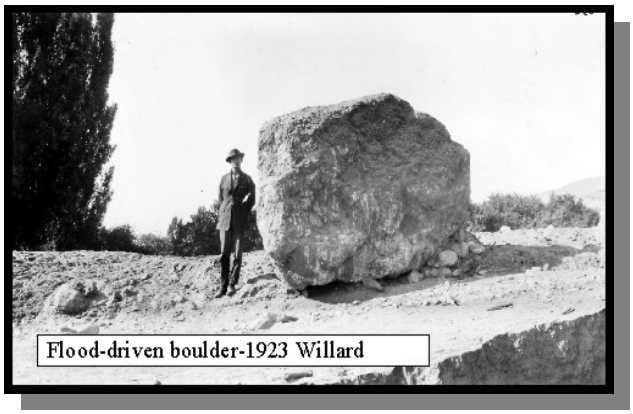
1. Expanded vulnerability assessments to include flood and dam failure inundation.
2. Continue the search for more specific mitigation actions.
3. An analysis of progress of the plan as it is revised.
4. Expanded look into how the identified natural hazards will affect certain populations including the young and elderly.

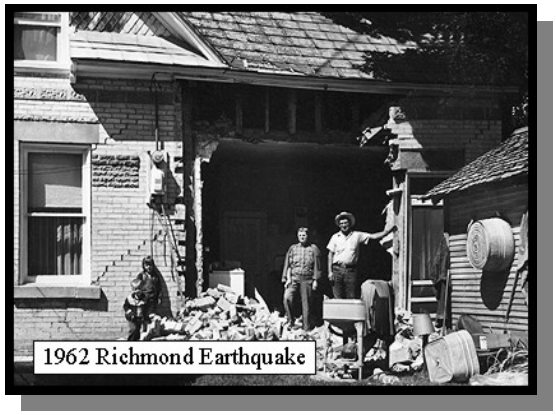


Pre-Disaster Mitigation Plan

Northernmost Utah's Bear River District

Box Elder, Cache & Rich Counties


Flood-driven boulder-1923 Willard


1962 Richmond Earthquake

1962 Richmond, Earthquake

Main Street Willard-1923 Flood

Bear River Association of Governments
December 2003

Photographs Courtesy of Special Collections
Utah State University

PRE-DISASTER MITIGATION PLAN
BEAR RIVER DISTRICT, UTAH

December 2003

Bear River Association of Governments

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PART I: PRE-REQUISTES & ADOPTION BY THE LOCAL JURISDICTIONS

INTRODUCTION

The three northernmost Utah counties that makes up the Bear River District is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery, both in terms of potential loss of life or property, from potential disasters can be lessened when attention is turned to mitigating their impacts and effects before they occur or re-occur.

This plan attempts to identify the region's hazards, understand our vulnerabilities and craft solutions that can significantly reduce threat to life and property. The plan is based on the premise that hazard mitigation works! With increased attention to managing natural hazards, communities can do much to reduce threats to existing citizens and avoid creating new problems in the future. In addition, many solutions can be implemented at minimal cost.

This is not an emergency response or management plan. Certainly, the plan can be used to identify weaknesses and refocus emergency response planning. Enhanced emergency response planning is an important mitigation strategy. However, the focus of this plan is to support better decision making directed toward avoidance of future risks and the implementation of activities or projects that will eliminate or reduce the risk for those that may already have exposure to a natural hazard threat.

HOW THE PLAN IS ORGANIZED

Part I of the plan provides a general overview of the process, the scope, purpose and overall goals of the plan. Part II documents the planning process and public involvement component of the plan. Part III gives some general background on the region's demographic, economic and physiographic characteristics.

Part IV the Risk Assessment section provides definitions for each natural hazard and documents how the hazards were chosen for analysis and discussion. Organized by "Annex" histories were compiled, and a risk assessment was performed for each of the identified natural hazards. Because of the uniformity of the hazard risk through out the region and the similarity of the vulnerabilities, agricultural related hazards (severe weather, drought, insect infestation) were analyzed at the regional or Bear River District level (Box Elder, Cache and Rich Counties) in the Bear River District Annex. All the other hazards were analyzed and discussed at the county/community level in each of the three "county annexes". This allowed the core of the location specific information for each county to be in one section.

Part V presents a capability assessment for the district. This section documents the staffing and personnel capabilities for each of the included jurisdictions. Finally, Part VI discusses the ongoing plan maintenance strategy and details efforts to get the recommendations of the plan incorporated in local land use planning and other decision making processes.

HOW THE PLAN SHOULD BE USED

First, the plan should be used to help local elected and appointed officials plan, design and implement programs and projects that will help reduce their community's vulnerability to natural hazards. Second, the plan should be used to facilitate inter-jurisdictional coordination and collaboration related to natural hazard mitigation planning and implementation. Third, the plan should be used to develop or provide guidance for local emergency response planning. Finally, if adopted, the plan will bring communities in compliance with the Disaster Mitigation Act of 2000.

WHAT IS HAZARD MITIGATION?

Hazard mitigation is defined as any cost-effective action(s) that has the effect of reducing, limiting, or preventing vulnerability of people, property, and the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation measures, which can be used to eliminate or minimize the risk to life and property, fall into three categories. First: are those that keep the hazard away from people, property, and structures. Second: are those that keep people, property, and structures away from the hazard. Third: are those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation measures must be practical, cost effective, and environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

The primary focus of hazard mitigation actions must be at the point at which capital investment decisions are made and based on vulnerability. Capital investments, whether for homes, roads public utilities, pipelines, power plants, or public works, determine to a large extent the nature and degree of hazard vulnerability of a community. Once a capital facility is in place, very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning and other ordinances, which manage development in high vulnerability areas, and building codes, which insure that new buildings are built to withstand the damaging forces of hazards, are often the most useful mitigation approaches a city can implement.

Previously, mitigation measures have been the most neglected programs within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures take time to implement. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to eliminating long-term risk to people and property in Utah from hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

The State Division of Emergency Management and Homeland Security (DESHS) have identified the following hazards to be analyzed by each county. These hazards include avalanche, dam failure, debris flow, drought, earthquake, flood, flash flooding, infestation, landslide, problem soils, summer storm, tornado, urban and rural fires, and winter storm.

This regional/multi-jurisdictional plan evaluates the impacts, risks and vulnerabilities of natural hazards in a jurisdictional area affected by a disaster. The plan supports, provides assistance, identifies and describes mitigation projects for each annex. The suggested actions and plan implementation for local and tribal governments could reduce the impact of future disasters. Only through the coordinated partnership with emergency managers, political entities, public works officials, community planners and other dedicated individuals working to implement this program will it be accomplished.

To develop the mitigation plan, Utah DESHS, based on consultation with the Governor's Office of Planning and Budget, the Utah League of Cities and Towns, and the U.S. Department of Housing and Urban Development, chose to use the planning services of the Utah Association of Governments.

Seven regional Associations of Governments:

1. Bear River Associations of Governments
2. Wasatch Front Associations of Governments / Wasatch Front Regional Council
3. Mountainland Associations of Governments
4. Six County Associations of Governments
5. Southeast Utah Associations of Governments
6. Southwestern / Five County Associations of Governments
7. Uintah Basin Associations of Governments

PURPOSE

To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is an aid in enhancing city and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability and risk of each Utah jurisdiction.

SCOPE

Utah PDM Planning phase is statewide. The State of Utah will work with all local jurisdictions by means of the seven regional Association of Governments. The *Bear River Association of Governments*, which encompasses all of Northern Utah, including the counties of Box Elder, Cache, and Rich Counties, will have a plan completed by December 31, 2003 to give to the Utah Division of Emergency Services. Future monitoring, evaluating, updating and implementing will

take place as new incidents occur and or every three to five years and will be included in the local mitigation plans as well.

OVERALL GOALS

To coordinate with each participating local government to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document and any additional State planning expectation, both regionally and specifically, as needed, by gathering local input and to also meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

LOCAL GOALS

These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social, and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards.
- Accomplish mitigation strategies in such a way that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources.

PART II --PLANNING PROCESS

BEAR RIVER DISTRICT PDM PLANNING PROCESS

This mitigation plan is the result of a comprehensive and coordinated planning process. Beyond involvement of the general public, a great deal of the effort focus was on coordinating and getting input from the thirty nine cities, towns and counties located in the Bear River District.

How the Plan was Produced

Professional planning staff at Bear River Association of Governments (BRAG) was responsible for coordinating the planning process and producing the document. The process was overseen and coordinated with BRAG's fifteen member governing board who served as the Hazard Mitigation Steering Committee (see membership lists at the end of this section). In addition a Hazard Mitigation Technical Team was assembled to provide guidance, input and technical assistance to the planning process. This team was primarily comprised of emergency management coordinating staff as well as public works and planning staff representing interested entities in BRAG's three county region.

The first phase of the project was targeted to education outreach and input. BRAG's Hazard Mitigation Steering Committee was informed of the State of Utah's approach to meeting the planning requirements of the Disaster Mitigation Act of 2000 and endorsed the approach as well as providing suggestions on how the plan should be produced. See Appendix C for a full copy of the above article.

Prevention top priority in BRAG disaster plan

By Joe Rowley
Staff writer

"It's common sense stuff that hasn't received a concerted effort nationwide."

– Roger Jones
BRAG executive director

March 30, 2003- Logan Herald Journal Newpaper Article

On September 12, 2003 the first meeting of BRAG's Hazard Mitigation Technical Team convened to introduce the requirements of the DMA2000, to discuss solutions and respond to any questions or concerns. At this meeting it was decided that the community officials representing the 39 different municipalities in the region should be informed early about the process and their responsibility and given a chance to provide input. It was decided that since most of the cities are represented by volunteer part-time elected officials any information would need to be concise, simple and targeted to be effective.

At this meeting it was decided that a one page "fact sheet" should be produced and disseminated to elected officials and other interested parties (See Appendix C). In addition it was suggested that a short survey form be produced and mailed along with the fact sheet and cover letter to the chief elected official of each jurisdiction (See Appendix A for the results). Agreement was reached that the survey instrument needed to be non-technical and be short enough to be completed in a half hour or less. Given the time constraints for most of the volunteer elected officials, survey response rates will be reduced for lengthy technical surveys.

It was also decided rather than set ongoing meetings for the Hazard Mitigation Technical Team, we should communicate on an "as needed" basis and use phone, email and postal mail to keep connected. Arrangements were made to obtain all hazard mapping, ordinances, reports, plans and documents related to natural hazard identification, mitigation or response.

On October 12, 2002 BRAG staff met with the Cache County Mayor's Association at one of their regular meetings. Elected officials from all of the incorporated municipalities in Cache County were present as well as county officials. The purpose of the meeting was to introduce them to the requirements of DMA2000 and describe the BRAG region's approach and process. Elected officials in attendance were given a fact sheet and survey and encouraged to complete it soon. The need for local input was emphasized in terms of history of hazard events, identification of problems and development of mitigation strategies. In addition, the cities were informed of their role in adopting the plan when complete (See Appendix C).

Later in October 2002 BRAG staff met with the Box Elder Council of Governments. This meeting had a focus on homeland security and natural hazard mitigation planning. A good representation of the county's elected officials were in attendance as well as emergency management personnel. Topics of discussion were similar to the Cache County meeting (See Appendix C).

All but two of the chief elected officials for Rich County, sit on the Natural Hazard Mitigation Steering Committee. Coordination with the others was achieved on an individual basis.

Next, a great deal of time was spent collecting information related to natural hazards from local jurisdictions and other sources. This effort was guided by the surveys completed by most of the jurisdictions. Many hours were spent in the special collections section of Utah State University's library collecting local reports, studies, thesis and dissertations related to natural hazards in the tri-county area. A rather exhaustive inventory of papers and reports documenting past natural hazard problems or events was compiled.

At the same time a natural hazard GIS database was being developed. Local sources of data were investigated and many GIS data layers were collected (almost 4 gigabytes). Most of this data already existed and was clipped and incorporated into the database. Some data was not in digital form and was deemed so essential to the quality of the planning effort that BRAG digitized the data to use in the GIS. For example, the FEMA flood plain maps were not in GIS digital format. Flooding threat is such a significant issue in terms of ongoing, predictable risk it was decided to "heads up" digitize these maps by "rubber sheeting" scanned copies. This effort took a considerable amount of time, but in our view was necessary to a quality, complete analysis of hazards.

The next phase of the process was to analyze the data to identify hazard conflicts as it relates to developed areas and to complete the risk assessment part of the plan. Meeting the FEMA requirements in this regard proved challenging with the data we had available. In terms of a GIS parcel level data source with property values included, the database is incomplete for the three county areas. We had to develop our own approach given the data we had available. We spent a

great deal of time developing, testing and refining an approach that produced the output we required, given the information available (See discussion on "Hazard Analysis Process in Part IV).

All along in this process various local elected officials, city personnel and emergency management officials were kept in touch with in terms of process updates, requests for verification of analysis results and confirmation of data accuracy and relevancy that may be from a statewide source in their local areas. Also as clarification on the Hazard Mitigation Planning Process came from FEMA in the form of a series of "How-to Guides" became available. These documents were ordered and disseminated to emergency management contacts so we all had a common understanding of the process and goals.

At a November 8th, 2003 "Citizen Planner" training workshop attended by over **forty local Planning Commissioners and other elected and appointed community officials**, a presentation was made on hazard mitigation planning and the draft plan material was made available to attendees for review and comment. Attendees were also directed to the plan's Internet web site for the full content of the plan (http://www.brag.dst.ut.us/develop-hazard%20mit.htm).

In November 2003 the final draft version of the plan was promulgated for review and comment. Again, elected officials were asked to help identify and describe any potential hazard mitigation projects they would like to see included in the plan. **The planning process, general regional data, risk assessment sections along with their jurisdiction's county annex was mailed in hardcopy form to each mayor and county commissioner in the three county region.** Again, elected officials were directed to the BRAG website if they wished to see the full version of the plan. Also, an advertisement was placed in all of the newspapers of general circulation in the three county area making the draft plan available for public review and comment either at the BRAG office or on the Internet (See Appendix C).

In addition, individual meetings were held with most of the emergency managers in the region to discuss the draft plan and gain comments and input. Besides the emergency managers, a draft version was mailed to the Cache Countywide Planning Office, Cache Metropolitan Transportation Organization, Bear River Health Department, Cache County Chapter of the American Red Cross, Bear Lake Regional Commission and the Utah Association of Conservation Districts for comment.

Regional Hazard Mitigation Steering Committee

Commissioner Clark Davis
Box Elder County

Mayor Lou Ann Christensen
Brigham City

Commissioner Suzanne R. Rees
Box Elder County

Commissioner Scott Hansen
Box Elder County

Mayor H. Paul Orme
Honeyville City

County Executive M. Lynn Lemon
Cache County

Councilmember Darrel L. Gibbons
Cache County

Mayor Alma Leonhardt
Providence City

Mayor Doug Thompson
Logan City

Councilmember Cory Yeates
Cache County

Commissioner Norman Weston
Rich County

Commissioner Bill Cox
Rich County

Mayor Mckay Willis
Laketown

Mayor Craig Showalter
Woodruff Town

Commissioner Thomas J. Weston
Rich County

Regional Hazard Mitigation Technical Team

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Brigham City Corp. (Box Elder)

Jim Buchanan
Emergency Management Dir.
Brigham City Corp. (Box Elder)

Roger Jones
Executive Director
BRAG

Paul Fulgham
Emergency Management Dir.
Tremonton City (Box Elder)

Stephen W. Hodges
Police Chief
Tremonton City (Box Elder)

Public Works Dir.
Logan City Corp. (Cache County)

Scott Douglas
Emergency Management Dir.
Logan City Corp. (Cache County)

Thad Erickson
Water Advisory Board
Cache County

Denton Beecher
Emergency Management Dir.
Box Elder County

Darrin Henry
Emergency Management Dir.
Cache County Corp.

Mark Teuscher
Countywide Planner
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Jim Gass
City Manager
Smithfield City (Cache County)

Kelly Pitcher
Fire Chief
Cache County Corp.

GIS Coordinator
Logan City Corp. (Cache County)

Kevin Maughan
Emergency Management Dir.
Hyrum City Corp. (Cache County)

PART III: GENERAL REGIONAL DATA

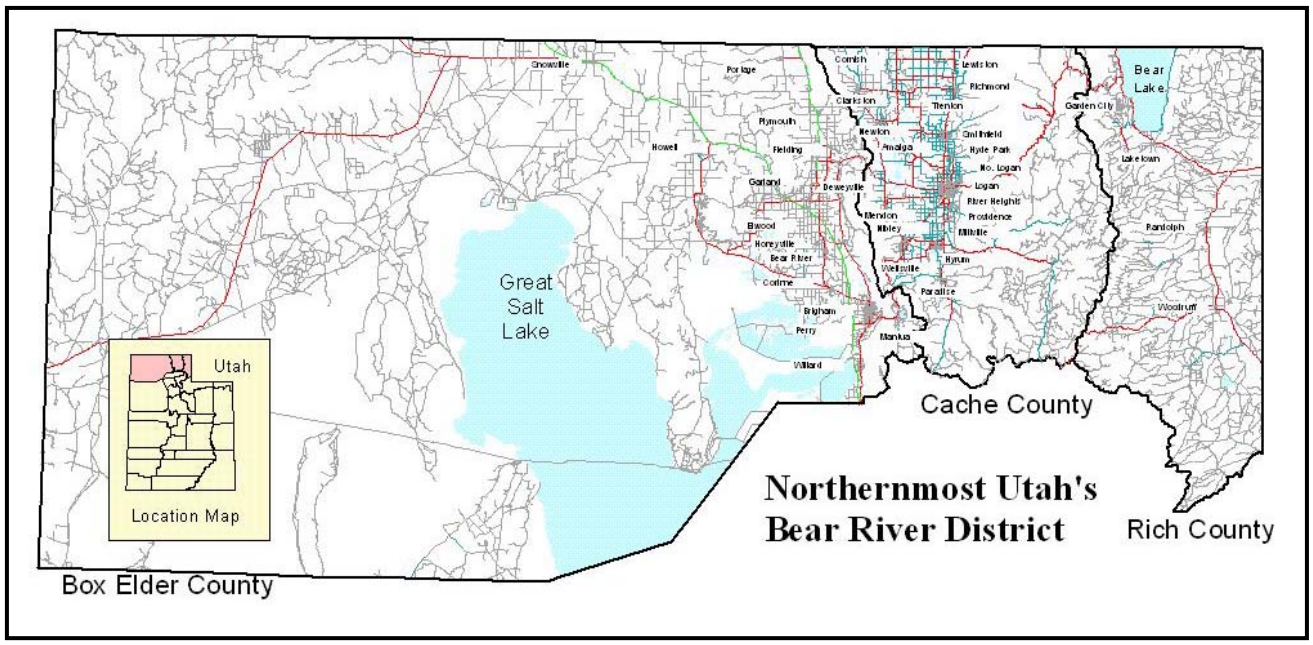
GEOGRAPHIC AND PHYSIOGRAPHIC BACKGROUND

Bear River Association of Governments is composed of Box Elder, Cache and Rich counties located in the far northern territory of Utah. This district is spread over 7,900 square miles.

Box Elder County comprises 5594 square miles and is bordered on the east by the Wellsville Mountains and Cache County, Weber County as well as the Great Salt Lake and the salt flats on the south, Nevada on the west, and Idaho to the North. Several small ranching communities occupy this area of the basin and range province. The eastern geography is mainly rolling ranch land and small rural communities. The largest fresh water feature is the Bear River that flows from Cache County into the Great Salt Lake.

Cache County covers approximately 1174 square miles and is bordered by the Wellsville Mountains on the west and the Bear River Range on the east. The surface water features include Little Bear, Blacksmith Fork and the Logan River in the south and Bear and Cub River in the north. The "bench" is a elongated plateau that surrounds the valley from the sea- shores of ancient Lake Bonneville.

Rich County comprises 1022 square miles and is bordered on the west and south by the Bear River and Monte Cristo Ranges and on the east by the rolling desert highlands of southwestern Wyoming. To the north lie's more uplands and the mountain ranges of southeastern Idaho. Bear Lake is the largest geographical feature in the county that extends 20 miles in length. Forty-four percent of Rich County is administered by federal and state agencies.



DEMOGRAPHICS

The total population for the Bear River District (Box Elder, Cache and Rich Counties) grew over 29% from 1990 to 2002 for a total of 139,693 persons in the three county region (Census Bureau estimates). This growth rate represents an 8% increase from the previous decade (See Table III-1).

Cache County saw the largest increase of the three counties with an expansion of over 30% for the decade of the 1990's (21,208 persons added for a total of 91,391 persons). This represented a 7% increase over the previous decade but not as high as the period from 1970-80 which recorded a 35% growth rate. The fastest growing incorporated city in Cache County was Nibley City with an overall growth rate of over 75% for the 1990s. During the same time, North Logan City also grew at a rate significantly higher than other Cache County towns with at a rate of nearly 64%. Logan City grew at a relatively modest rate of just over 30%. In terms of the actual numbers of persons proportionally added to the overall county growth during the 1990s, Logan was by far the largest contributor by adding nearly 10,000 persons. In fact, this number is probably lower than it should be due to the likely significant number of Utah State University students that did not complete Census 2000 forms and thus were not included in the Logan City/Cache County count. Logan City's 2000 population was determined to be 42,670.

The more urbanized portions of Cache County are part of a Metropolitan Planning Organization (MPO). This area comprises the Logan Urbanized Area (LUA). In addition, in 2003 Logan City was designated the central city in a Metropolitan Statistical Area that encompasses all of Cache County and Franklin County Idaho.

Box Elder County's overall growth rate for the decade of the '90s was 17.2%. The year 2002 total population count was 44,032 (actual population added was 7,547 persons). While lower than the state average, this figure represents nearly a doubling in the county's growth rate from the decade of the 1980's. Due to its size (in terms of actual increase in the 2000 Census) Brigham City recorded the largest increase by adding 1,767 persons. However, this still only represents a rather modest 11% overall increase for Brigham City. Perry City, Brigham's neighboring community to the south added almost as many persons to their population as Brigham did during the 1990's. The difference is that Perry City started the decade with only 1,211 people and by the time the decade ended they had nearly doubled their population to 2,383. The 96% growth rate is not only the highest growth rate in the County and the Bear River District, but also one of the highest in the state. The only other communities in Box Elder County that showed any sort of significant growth rate during the 1990's were Tremonton and Willard City with 31.1% and 25.6% respectively. Most the other communities in the county saw stable or minor increases in their population with the exception of four towns that actually declined in population during the 1990's.

Rich County's overall population increase for the 1990's was 13.7% for a year 2002 total of 1,966. While modest by comparison to district or state growth rates, Rich County's 1990's population growth was significantly higher then the previous decade which saw a negative growth rate of nearly 18%. Garden City marked the highest growth rate in the county for the 1990's by adding 164 of the total 236 persons for the entire county. This represents a 85%

growth rate for Garden City. With the exception of Woodruff Town which grew by 59 persons or nearly 44%, the other two communities in Rich County kept nearly level or decrease population slightly. Population numbers generated by the census every ten years do not fully describe the demographic situation with regard to Garden City and some unincorporated portions of the county around Bear Lake. In recent years, Garden City and areas on the east shore of Bear Lake have seen significant growth and development in the form of part-time "summer home" dwelling units. The people that occupy these homes generally do not live in them for more than nine months required by the Census Bureau to be considered resident and usually complete the Census form at their home address. This presents a unique challenge for these jurisdictions that must provide infrastructure and services to a population that does not show up on any of the Census counts. **(See the "Population Density Map" in the map section of each county's annex)**

Table III-1 Population Estimates for the Bear River District

Jurisdiction Name	2002 Population	Annual Average Rate of Change 1990-2000	2020 Projected Population
BOX ELDER COUNTY	44,032	1.60%	63,391
Bear River City	778	.69%	1,112
Brigham City	17,389	1.08%	25,821
Corinne City	651	-.29%	921
Deweyville Town	296	-1.34%	412
Elwood Town	675	1.66%	1,005
Fielding Town	450	.60%	664
Garland City	1,970	1.73%	2,881
Honeyville City	1,265	.88%	1,800
Howell Town	232	-.70%	328
Mantua Town	802	1.75%	1,173
Perry City	2,740	7.00%	3,534
Plymouth Town	359	2.08%	486
Portage Town	259	1.66%	381
Snowville Town	177	-3.43%	262
Tremonton City	5,996	2.79%	8,293
Willard City	1,639	2.30%	2,417
Unincorporated	8,354	1.31%	11,898
CACHE COUNTY	93,695	2.68%	137,966
Amalga Town	427	1.55%	587
Clarkston Town	685	.65%	826
Cornish Town	259	2.37%	259
Hyde Park City	2,938	3.04%	3,787
Hyrum City	6,303	2.72%	8,438
Lewiston City	1,862	2.05%	2,457
Logan City	42,922	2.68%	59,587
Mendon City	938	2.76%	1,782
Millville City	1,501	2.29%	1,973
Newton Town	706	.59%	1,045

Table III-1 Population Estimates for the Bear River District			
Jurisdiction Name	**2002 Population**	**Annual Average Rate of Change 1990-2000**	**2020 Projected Population**
Nibley City	2,210	5.77%	4,235
North Logan City	6,745	5.04%	9,043
Paradise Town	753	3.07%	1,093
Providence City	4,845	2.73%	13,512
Richmond City	2,043	.48%	2,592
River Heights City	1,490	1.62%	1,657
Smithfield City	7,604	2.69%	12,601
Trenton Town	450	-.33%	595
Wellsville City	2,724	2.18%	3,574
Unincorporated	6,290	1.81%	8,323
RICH COUNTY	1,966	1.29%	2,351
Garden City	365	6.34%	428
Laketown	182	-3.23%	225
Randolph City	471	-.10%	579
Woodruff Town	190	3.69%	233
Unincorporated	758	1.32%	886
Source: Bear River Association of Governments projections based on GOPB county totals. Governors Office of Planning and Budget.			

ECONOMIC PROFILE

Box Elder County has 3,541,541 acres of land and a population density of 7.5 persons per square mile. From 1990 to 2000, the county grew at an average rate of 1.6 percent per year, slower than the state average of 2.7 percent. Manufacturing accounts for almost half of the employment in the county; the county also leads the state in many measures of agricultural productivity. Box Elder County experienced a 3.1 percent decrease in the civilian labor force from 1999 to 2000. In addition, the unemployment rate in the county in 2000 was 4.5 percent, significantly higher than the state rate of 3.2 percent.

The median family and household incomes are slightly lower than the state averages. The changes in per capita income reflect the economic downturn currently experienced by the county. In 1990, Box Elder County's per capita income was 1.5 percent higher than the state average, but by 1999 it had dropped to 93 percent of the state per capita income.

PER CAPITA INCOME COMPARISON*

	1990	**1999**
Box Elder County	$15,218	$21,554
State of Utah	$14,996	$23,276

*Demographic & Economic Analysis, GOPD, 2002

Another indicator of the number of families living at very low and low-income levels is the number of school age children enrolled in the free/reduced lunch program. In the 2001-2002 school year, Box Elder School District had a total of 10,763 students; 3,527 were enrolled in the

free/reduced lunch program. This statistic would indicate that 33 percent of the children enrolled in school belong to very low or low-income families.

Housing stock and property values vary widely throughout the county. Data from the 2000 Census shows that the median age of homes in the county is 33 years, indicating a somewhat aging housing stock. There are a total of 6,882 homes that were built prior to 1979. The median value of owner-occupied housing reported by the 2000 Census was $118,900. It should be noted that there has been a significant increase in the median value of existing owner-occupied housing from 1990 to 2000. The average countywide increase in property values was 83 percent, but some areas experienced over a 100 percent increase in value. Data from the Utah Association of Realtors (2002) confirm that home prices in the county have risen dramatically. The average sales price of homes in the county increased from $65,244 in 1995 to $112,370 in 2002, an increase of 72 percent in a seven year period. The data also demonstrate wide variation in prices throughout the county.

Cache County covers approximately 1,165 square miles, and there are 19 incorporated communities within the county. The Logan Urbanized Area includes Smithfield, Hyde Park, North Logan, Logan, River Heights, Providence, Millville, Nibley, Hyrum and Wellsville. The area has grown tremendously over the past decade; the 2000 Census indicated a total population of 91,897, an increase of 30 percent from the previous Census. The majority of these residents live in Logan City, which has a population of 42,670. Logan City is home to Utah State University and Bridgerland Applied Technology College; as a result, the educational level of Cache County residents is quite high. The high number of students also impacts housing in Logan City; the area east of Logan's Main Street contains a large number of rental units with students typically living at low incomes (Bear River District Overall Economic Development Plan, (OEDP), 1999). Cache Metropolitan Planning Office (2002) estimates indicate that only 50% of the 16,485 single-family dwelling units in Logan City are owner-occupied; there are an additional 7,020 multi-family rental units.

Cache County has one of the state's most diverse economies and lowest unemployment rates. In 2001, the county's unemployment rate was 2.9 percent, compared to Utah's rate of 4.4 percent. However, the effect of the high student population and the low unemployment rate creates keen competition for jobs, with many "residents looking for higher paying positions while they work at lower paying jobs" (OEDP, 1999) This is demonstrated by income measures that are noticeably lower than the state averages, including family income, household income, per capita income, and persons living in poverty. Tracking the changes in these measures also indicates that the gap is increasing. For instance, Cache County's 1990 per capita income was 88 percent of the state average; by 2000 it had dropped to 82 percent.

PER CAPITA INCOME COMPARISON*

	1990	**1999**
Cache County	$13,259	$19,177
State of Utah	$14,996	$23,276

*Demographic & Economic Analysis, GOPD, 2002

In the 2001-2002 school year, Logan School District had a total of 5,875 students; 41 percent (2,388) were enrolled in the free/reduced lunch program. Cache County School District had a

total of 13,103 students, and 26 percent (3,439) participated in the program. This is a countywide average of 31 percent of the total school age population whose families' incomes are sufficiently low enough to qualify them for the free or reduced lunch program.

Housing stock and property values vary widely throughout the county. Census data show a wide range in the median value of homes as reported by the owners, from $97,700 in Clarkston to $168,300 in Avon. In 1994, BRAG conducted a Comprehensive Housing Affordability Survey (CHAS) which found that 23.7 percent of all homes in Cache County were built prior to 1939. Census data show that the median age of homes in Cache Valley is 27 years, demonstrating an aging housing stock that will continue to require rehabilitation and remodeling for energy efficiency.

PER CAPITA INCOME COMPARISON*

	1990	1999
Rich County	$12,369	$16,958
State of Utah	$14,996	$23,276

*Demographic & Economic Analysis, GOPD, 2002

In 2000, Rich County had a population of 1,961 people; it is the third smallest county in the state. The county has 658,039 acres of land; 523,744 acres in farms, of which 60 percent are full-time farms. Three-quarters of Rich County's land is used for grazing. Total nonagricultural employment in 2000 was 559 employees. Bear Lake's recreational uses have also provided employment in real estate and tourism-related trades.

The average family and household size are both slightly smaller than the state averages. The median age in 2000 was 34.3 years, compared to the state median of 27.1 years. Data from the 2000 Census showed that 14.1 percent of the population was over age 65. The Garden City/Laketown area's median age in 2000 was 40.9 years, a decline from 30 years in 1990 (BRAG Consolidated Plan, 2002).

It is interesting to note that the most significant growth in the Garden City/Laketown area has been in the unincorporated areas outside of the city boundaries, where many of the Bear Lake recreational developments are located. In the past ten years, the population in the unincorporated area around Garden City/Laketown has increased 90 percent, from 181 to 334 persons. The number of households also increased, from 56 to 127. Garden City experienced similar growth from 1990 to 2000, both the total population and the number of households increased 85 percent. However, the population and number of households decreased in Laketown, due in part to culinary water problems and the availability of land (BRAG Consolidated Plan, 2002).

Rich County has the lowest wage rate among Utah's 29 counties. In 2000, the average annual wage was $15,564; 54 percent of the state average of $28,812 (BRAG Consolidated Plan, 2002). Other income measures show similar results; median family, household, and per capita income are all significantly lower than state averages. In 1999, 11.3 percent of the county population lived below the poverty rate, as compared to a statewide rate of 9.2 percent. Unemployment rates in the county are also slightly higher than the state average, 3.7 percent versus 3.2 percent.

Tracking per capita income changes over the past ten years indicates that Rich County has traditionally lagged behind the state average, and the gap has continued to grow. The per capita income decreased from 82 percent of the state's average in 1990 to 73 percent in 2000.

Data from the Utah Department of Workforce Services estimate that while the Randolph/Woodruff area saw a decrease of 21 employees (11%) from 1990 to 2001, the Garden City/Laketown area added 223 employees (137%) during the same time period. However, 60 percent of the 2001 nonagricultural employment in the Garden City/Laketown area was in the service and trade industries. The service sector saw the greatest increase in employment from 1990 to 2001, adding an additional 112 employees. Employees in the service industry have an estimated average annual income of $10,488; 36 percent of the state's average income. Trade employees have an estimated average annual wage slightly lower than the service industry at $10,428. Examining the data demonstrates that the increase in nonagricultural employment has created households who are in the greatest need for affordable housing. The extremely low wages in Rich County, particularly in the expanding trade and service sectors, imply a strong need for affordable housing (BRAG Consolidated Plan, 2002).

Further proof of the economic difficulties Rich County residents are facing is found in the number of school-age children enrolled in the free/reduced lunch program. In the 2001-2002 school year, Rich County School District had 473 students; 341 of them were enrolled in the free/reduced lunch program. This is 72 percent of the total student body; a number that strongly demonstrates the number of very-low and low-income families in the county who are require suitable affordable housing.

CLIMATE

Elevations in the region vary from 4,200 to over 10,000 feet. Annual precipitation ranges from 9 inches to over 40 inches. The high mountain valleys experience long cold winters and short cool summers.

Rich County is regarded as having severe winters. An early settler described the climate as "nine months of winter and three months of late fall". Woodruff holds the statewide records for the lowest yearly temperatures (-50 F).

GEOLOGY

This area is comprised of Box Elder, Cache and Rich counties and is home to the Wellsville Mountain Range and the Bear River Range. Notable physiographic features of the region include: the Crawford Mountain, Bear Lake Plateau, Goose Creek/Raft River Mountains, Curlew Valley, Hansel Mountains-Blue Springs Hills, Great Salt Lake Desert, Lakeside Section and the Clarkston Mountain/Junction Hills (Stokes, 1988).

The Wellsville Range is east of Brigham City and is known for its long, upward-faulted ridge of Precambrian metamorphic rocks covered by Paleozoic aged sedimentary rocks.

The Paleozoic section of the rock sequence is quite consistent throughout this area with sandstone on bottom, shale, and finally limestone or dolomite. Most of the rocks are of marine or near shore deposits from the ancient Lake Bonneville. The Wasatch Fault is evident in the

western edge of the Wellsville Mountain Range with the eastern portion lifted thousands of feet than the western edge. The Eastern portion is comprised of mainly Pennsylvanian and Permian aged rocks. Cache Valley is a dropped portion between the East Cache Fault and the Bear River Range. The Cache Valley was once an arm of Lake Bonneville. Logan Canyon is made up of Paleozoic ant Tertiary rocks with the same sequence as mentioned above. The Bear River Range is situated on the east of the western extent of the Middle Rocky Mountain Physiographic Province. The Overthrust Belt Geologic Province is what uplifted these mountains about 50 million years ago. The Intermountain Seismic Belt is a result of the Overthrust Belt. "The Intermountain Seismic Belt forms a boundary between the Basin and Range and the Middle Rocky Mountain Physiographic provinces" (Mabey, 1999). This zone because of the series of faults is the reason why we are able to see the older Paleozoic and Mesozoic rocks above the younger Tertiary and Quaternary aged sedimentary rocks. The ranges from the Bear River Range to the east are part of the Great Basin Physiographic province, which consists of mainly Quaternary age surface deposits such as alluvium, terrace deposits, sand dunes, and lakebed sediments.

The soil morphology in this region is characterized by deep to very deep well drained soils. Down cutting from the Bear River and its tributaries have resulted in massive erosion. Soils on old lake bottoms in the middle of Cache and Salt Lake valleys are nearly level, moderately well to poorly drained, very deep, and derived from lacustrine and alluvial deposits (Department of Landscape Architecture and Environmental Planning USU, 2001).

NATIONAL FLOOD INSURANCE PROGRAM PARTICIPATION

Table III-2: National Flood Insurance Program (NFIP)				
	Community Name * Unincorporated areas only	**CID**	**Date of Entry** (Emergency Program (E) or Regular Program (R))	**Current Effective Map** (No Special Flood Hazard Area (NSFHA), all zone (C))
Box Elder County	Box Elder County *	490005#	09/01/87 (R)	09/01/87 (L)
	Brigham City, City of	490006#	08/17/81 (R)	08/17/81
	Corinne, City of	490197#	07/15/80 (R)	07/15/80 (M)
	Honeyville, City of	490008#	07/29/80 (R)	07/29/80 (M)
	Mantua, Town of	490009#	07/08/80 (R)	07/08/80 (M)
	Perry City, City of	490010#	05/20/80 (R)	05/20/80 (M)
	Willard, City of	490011A	07/01/87 (R)	07/01/87 (L)
Cache County	Cache County*	490012#	02/01/87 (R)	02/01/87 (L)
	Clarkston, Town of	490014#	08/19/80 (R)	08/19/80 (M)
	Hyde Park, Town of	490016#	07/29/80 (R)	07/29/80 (M)
	Hyrum, City of	490017#	04/08/80 (R)	04/08/80 (M)
	Lewiston, City of	490018#	07/29/80 (R)	07/29/80 (M)
	Logan, City of	490019#	09/28/84 (R)	09/28/84
	Mendon, City of	490020 #	07/22/80 (R)	07/22/80 (M)
	Millville, Town of	490021	03/13/85	10/22/76
	Newton, Town of	490022#	07/22/80 (R)	07/2280 (M)
	North Logan, City of	490024#	03/18/86 (R)	03/18/86 (M)
	Providence, City of	490226	02/02/84 (R)	(NSFHA)
	Richmond, City of	490027#	08/12/80 (R)	08/12/80 (M)
	Smithfield, City of	490029#	03/18/86 (R)	03/18/86 (M)
	Wellsville, City of	490031#	07/29/80 (R)	07/29/80 (M)
Rich County	Laketown, Town of	490099	07/15/85 (R)	(NSFHA)
	Woodruff, Town of	490101#	07/22/80 (R)	07/22/80 (M)
Source: National Flood Insurance Program (FEMA)				

BUILDING CODE EFFECTIVENESS GRADING REPORTS (BCEGS)

The Building Code Effectiveness Grading Report was implemented in 1995 to evaluate current building codes in a particular community and determine how well the community enforces its building codes. This program assigns each municipality a grade of 1 to 10 with one showing excellent commitment to building code enforcement. The concept of the Building Code Effectiveness Grading Reports is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can be adjusted accordingly.

Table III-3 BCEGS Scores for the Bear River District

Jurisdiction Name	Score		Date
	Personal Lines	Commercial Lines	
Box Elder County	4	4	2001
Brigham City	3	3	2001
Tremonton	5	5	2000
Willard	5	5	1998
Cache County	3	3	2001
Hyde Park	3	3	2001
Logan	3	3	1999
No. Logan	3	3	1999
Smithfield	4	4	2000
Garden City	unknown	7	1998

Jurisdictions not listed are unclassified. BCEGS classifies a jurisdictions commitment to building code enforcement with a rating of 1 being "exemplary".

PART IV: RISK ASSESSMENT

HAZARD IDENTIFICATION PROCESS

Hazards were identified and evaluated for inclusion in this plan based on historical review of past events, synthesis of existing reports, data and hazard mapping analysis, and finally input from local level emergency management personnel and other community officials. Consideration for inclusion was based on the likelihood of a hazard's occurrence, location of the occurrence and the potential impact of the event in terms of it effect on human life and property (See Table IV-1).

Surveys were sent to the chief elected official for all jurisdictions in the Bear River District. Among other questions, the survey instrument requested local input on hazard identification, completed and needing hazard mitigation projects, participation in the National Flood Insurance Program and the existence of hazard maps and ordinance for their locality (See Appendix A).

Table IV-1: Hazard Identification & Justification for Inclusion

Hazard	How Identified	Why Identified
Earthquake	Local Official Surveys Review of Local Emergency Operations Plans Input from City and County Emergency Operations Managers United States Geological Survey Utah Geological Survey	Bear River District has experienced both the largest (1934 Hansel Valley 6.54 Magnitude) and the most damaging (1962 Richmond 5.7 Magnitude) in the state's modern history (cost $1 Million in 1962 dollars). Numerous faults throughout region Located in the Intermountain Fault Zone.
Flood	Local Official Surveys Review of Local Emergency Operations Plans JUB Study of Cache Canals Input from City and County Emergency Operations Managers Utah Geological Survey Flood Insurance Study Army Corps of Engineers	Several previous incidents have caused severe damage and loss of life Many of the rivers and streams are located near neighborhoods Many neighborhoods are located on floodplains, alluvial fans Exposure to risks are increasing
Landslide	Local Official Surveys Review of Local Emergency Operations Plans Input from City and County Emergency Operations Managers Utah Geological Survey	Historically problematic Can be deadly
Wildfire	Local Official Surveys Input from City and County Emergency Operations Managers Utah Forestry, Fire and State Lands	Historically Problematic Associated with flooding, earthquake
Dam Failure	Local Official Surveys Review of Local Emergency Operations Plans Input from City and County Emergency Operations Managers Utah Division of Water Rights, Dam Safety Section	Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc.

Table IV-1: Hazard Identification & Justification for Inclusion		
Hazard	**How Identified**	**Why Identified**
Drought, Infestation & Severe Weather	Local Official Surveys Review of Local Emergency Operations Plans Input from City and County Emergency Operations Managers Utah State University Agricultural Extension	Potential significant effect one of the largest sectors of the region's economy. Previous experiences

HAZARD DEFINITIONS

The following is a description of each of the hazards evaluated in the Bear River District Pre-disaster Mitigation Plan. These definitions, with minor modifications, were developed by DESHS and used by permission in this plan.

Flooding

Flooding is a temporary overflow of water onto lands not normally inundated by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss, and interruption of business. Floods also increase the likelihood of hazard such as transportation accidents, contamination of water supplies, and health risk increase after a flooding event.

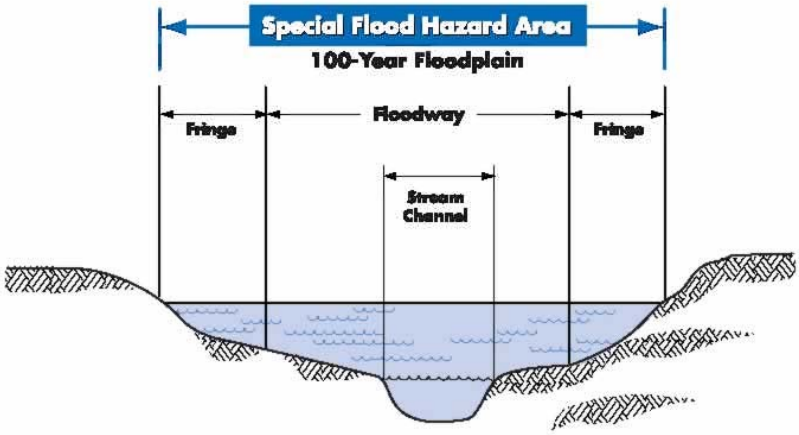
Several factors determine the severity of floods including rainfall intensity, duration and rapid snowmelt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having, impermeable surfaces such as large parking lots, paved roadways, or post burned areas with hydrophobic soils. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs during a particular season or in regions where annual flooding is due to spring melting of winter snow pack, areas at risk may be inundated nearly every year.

Conditions which my exacerbate floods include: steeply sloped watersheds, constrictions, obstructions, debris contamination, soil saturation and velocity.

Explanation of Common Flood Terms

FIRM: Flood Insurance Rate Map



100-year flood: Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100 year-flood is also referred to as the base flood.

Base Flood: Is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

Special Flood Hazard Area (SFHA): Is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

Floodway: Is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising that water surface elevation by more than one foot.

Earthquakes

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks when they can no longer withstand the stresses, which build up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. When rocks break they produce seismic waves that are transmitted through the rock outward producing ground shaking. Earthquakes are unique multi-hazard events, with the potential to cause huge amounts of damage and loss. Secondary effects of a sudden release of seismic energy (earthquake) include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, slope failure, and various types of flooding.

The Intermountain Seismic Belt

The Intermountain Seismic Belt (ISB), which the Bear River Region is part of, is a zone of pronounced earthquake activity up to 120 miles wide extending in a north south direction 800 miles from Montana to northern Arizona. The Utah portion of the ISB trends from the Easter Box Elder and Cache County area south through the center of the state, along the Wasatch Front, and the southwest through Richfield and Cedar City concluding in St. George. "The zone generally coincides with the boundary between the Basin and Range physiographic province to the west and the Middle Rocky Mountains and Colorado Plateau physiographic provinces to the east" (Eldredge 6).

Secondary Earthquake Threats

The major secondary effects of earthquakes include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, avalanches, rock fall, slope failure, and various types of flooding. Other sections discuss landslides, and flooding therefore they will not be discussed under secondary effects of earthquakes yet importance needs to be given to the fact that earthquakes can increase the likelihood of flooding and landslides.

Ground Shaking

Ground shaking causes the most impact during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated by earthquakes. Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves cause more damage to short stiff structures, were as low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). The PGA measures the rate in change of motion relative to the established rate of acceleration do to gravity.

Local geologic conditions such as depth of sediment and sediment make up, affect earthquake waves. Deep valley sediments increase the frequency of seismic waves relative to bedrock. In general, ground shaking increases with increased thickness of sediments" (Eldredge 8).

Surface Fault Rupture

During a large earthquake fault movement may propagate along a fault plain to the surface, resulting in surface rupture along the fault plain. Most faults in the Bear River District are normal (mountain building) faults with regards to movement, meaning the footwall of the fault moves upward and the hanging wall moves in a down direction. Thus faulting is on a vertical plain, which results in the formation of large fault scarps. In historic time surface fault rupture has only occurred once in Utah; the 1934 Hansel Valley earthquake in Box Elder County with a magnitude 6.6 produced 1.6 feet of vertical offset.

Surface fault rupture presents several hazards, anything built on top of the fault or crossing the fault has a high potential of being destroyed in the event of displacement. Foundations will be

cracked, buildings torn apart, damage to roads, utility lines, pipelines, or any other utility line crossing the fault. It is almost impossible to design anything within reasonable cost parameters to with stand an estimated displacement of 16 to 20 feet.

Surface fault rupture doesn't occur on a single distinct plain; instead it occurs over a zone often several hundred feet wide known as the zone of deformation. This zone of deformation occurs mainly on the down thrown side of the main fault trace. Tectonic subsidence, caused by antithetic faults moving in the opposite direction of the main fault, slide down hill on the main fault scarp creating grabens (down dropped blocks) within the zone of deformation.

Hintze described an “enigma” of Utah in that seismicity does not always coincide with surface fault scarps or faults (Geologic History of Utah, 1988). The epicenter of the earthquake may be miles away from the surface faulting.

Liquefaction

Soil liquefaction occurs when water-saturated cohesionless sandy soils are subject to ground shaking. When liquefaction occurs soils behave more like a viscous liquid (quicksand) and lose their bearing capacity and shear strength. Two conditions must be met in order for soils to liquefy: (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy (lips). The loss of shear strength and bearing capacity due to liquefaction causes buildings to settle or tip and light buoyant structures such as buried storage tanks and empty swimming pools to float upward. Liquefaction can occur during earthquakes of magnitude 5.0 or greater.

Lateral Spread

Soils, once liquefied, can flow on slopes with angles of .5 to 5 percent this movement of liquefied soils is known as lateral spread. "The surficial soil layers break up and sections move independently, and are displaced laterally over a liquefied layer" (Eldredge 10). Liquefaction can cause damage in several way, with lateral spreading being one of the most common. Displacement of three (3) or more feet may occur and be accompanied by ground cracking and vertical displacement. Lateral spreading causes roads, buildings, buried utilities, and any other buried or surface structure to be pulled apart.

Various Flooding Issues Related to Earthquakes

Earthquakes could cause flooding due to the tilting of the valley floor, dam failure and seiches in lakes and reservoirs. Flooding can also result from the disruption of rivers and streams. Water tanks, pipelines, and aqueducts may be ruptured, or canals and streams altered by ground shaking, surface faulting, ground tilting, and landsliding.

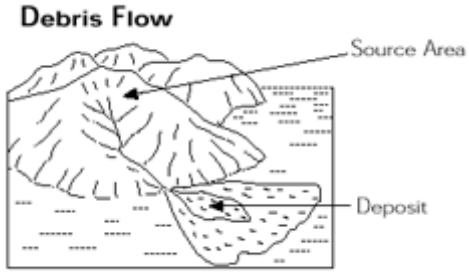
Seiches

Standing bodies of water are susceptible to earthquake ground motion. Water in lakes and reservoirs may be set in motion and slosh from one end to the other, much like in a bathtub. This motion is called a seiche (pronounced "saysh"). A seiche may lead to dam failure or damage along shorelines.

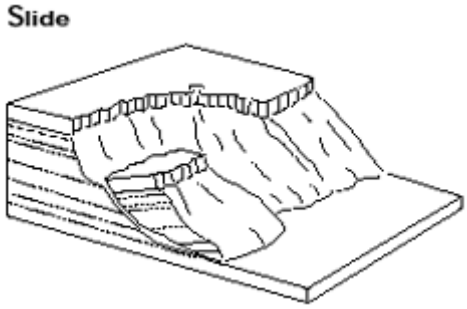
Landslides

Landslides are a "down slope movement of a mass of rock, earth, or debris". Landslides, often referred to as mass wasting or slope failures, are one of the most common natural disasters. (Cruden 36). Slope failures can vary considerably in shape, rate of movement, extent, and effect on surrounding areas. Slope failures are classified by there type of movement, and type of material. The types of movement are classified as falls, slides, topples, and flows. "The types of material include rock, debris (coarse grained soil) and earth (fine grained soil)" (Eldredge 17). "Types of slope failures then are identified as rock falls, rock slides, debris flows, debris slides, and so on" (Eldredge 17). Slope failures occur because of either an increases in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). "Geology (rock type and structure), topography (slope gradient), water content, vegetative cover, and slope aspect are important factors of slope stability" (Eldredge 18).

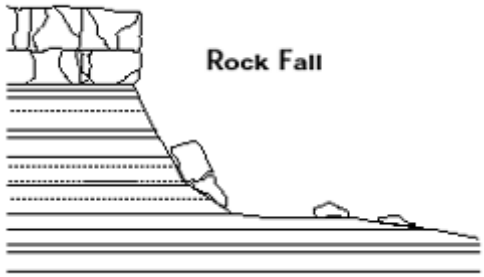
Three Common Types of Landslides in Utah



Debris flows consist of sediment-water mixtures that flow down a streambed or hillside, commonly depositing sediment at canyon mouths in fan like deposits know as alluvial fans.



Slides are down slope movements of soil or rock on slopes.



Rock falls consist of rock(s) falling from a cliff or cut slope and are very common in the canyon country of southern Utah.

Conditions That Make Slopes More Susceptible to Landslides

- Discontinuities: faults, joints, bedding surfaces.
- Massive Materials over soft materials.
- Orientations of dip slope: bedding plans that dip out of slope.
- Loose structure and roundness.
- Adding weight to the head of a slide area: rain, snow, landslides, mine waste piles, buildings, leaks from pipes, sewers, and canals, construction materials fill materials.
- Ground shaking: earthquakes or vibrations.
- Increase in lateral spread caused by mechanical weathering.
- Removal of lateral support.
- Human activities: cut and fill practices, quarries, mine pits, road cuts, lowering of reservoirs.
- Removing underlying support: under cutting of banks in a river.
- Increase in pore water pressure: snow melt, rain, and irrigation.
- Loss of cohesion.

Wildfire

A wildfire is an uncontrolled fire spreading through vegetative fuel often exposing or consuming structures. Wildfires often begin unnoticed and spread quickly and are usually sighted by dense smoke. Wildfires are placed into two classifications Wildland and Urban-Wildland Interface. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

When discussing wildfires it is important to remember that fires are part of a natural process and are needed to maintain a healthy ecosystem. Three basic elements are needed for a fire to occur (1) a heat source (2) oxygen and (3) fuel. Major ignition sources for wildfire are lightning and human causes such as arson, recreational activities, burning debris, and carelessness with fireworks. On average, 65 percent of all wild fires started in Utah can be attributed to human activities. Once a wildfire has started, vegetation, topography and weather are all conditions having an affect wildfire behavior.

Severe Weather

For the purpose of this mitigation plan the term severe weather is used to represent downbursts, lightening, heavy snowstorms, blizzards, avalanches, hail, and tornados.

Downbursts

A downburst is a severe localized wind, blasting from a thunderstorm. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories by size. Microbursts cover and area less than 2.5 miles in diameter. Macrobursts cover an area with a diameter larger then 2.5 miles.

Lightening

During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightening is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes to great, there is a discharge of electricity that we know as lightning.

Heavy Snowstorms

A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to 20° F or lower. All winter storms make driving extremely dangerous.

Blizzards

A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Hail Storms

Hailstones are large pieces of ice that fall from powerful thunderstorms. Hail forms when strong updrafts within, the convection cell of a cumulonimbus cloud carries water droplets upward

causing them to freeze. Once the droplet freezes, it collides with other liquid droplets that freeze on contact. These rise and fall cycles continue until the hailstone becomes too heavy and falls from the cloud.

Drought

Drought is a normal recurrent feature of climate, although many, in Utah, erroneously consider it a rare and random event. It occurs in virtually all-climatic zones, while its characteristics vary significantly from one region to another. Droughts, simple put, are cumulative hazards, which result from long periods of below normal precipitation. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate.

The State of Utah uses the Palmer Drought Severity Index or (PDSI) to quantify the existence of a drought. Using the PDSI, drought is expressed as a negative number. Much of the basis, used by the State, to determine drought years, or drought periods, comes from the PDSI. In addition, the PDSI is used by the State Climatologist, the National Geophysical Data Center of NOAA, and the National Drought Mitigation Center.

For the most part droughts no longer affect the availability of drinking water, thus no longer place peoples lives at risk, the same can not be said for a persons livelihood. Numerous water projects throughout the state have placed enough water in storage to insure drinking water. Prolonged droughts have a significant affect on agricultural and agribusinesses, within the state dependent on irrigation water. Droughts also stress wildlife, and heighten the risk of wildfire.

Dam Failure

Dam failures result from the failure of a man made water impoundment structure, which often results in catastrophic down grade flooding. Dam failures are caused by one or a combination of the following: “breach from flooding or overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, vegetation and rodents, poor construction, lack of maintenance and repair, misuse, improper operation, terrorism, or a combination of any of these” (Eldredge 46). The Utah State Engineer has been charged with regulating non-federal dams in the State dams since 1919. “In the late 1970's Utah started its own Dam Safety Section within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act (PL-92-367)” (Eldredge 46).

The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, the size, height, volume, and incremental risk/damage assessments or dams are all variables used to assign dam hazard ratings in Dam Safety’s classification system. Using the hazard ratings systems developed by the Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in

the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years.

HAZARD ANALYSIS PROCESS

Geographic Information Systems (GIS) was used as the basic analysis tool to complete the hazard analysis for this report. For most hazards a comparison was made between mapped sources of hazard data and mapped layers that delineate where existing development is located. Data sources of existing development was obtained from a 1996 study conducted by the State of Utah Division of Water Resources that mapped water related land uses. Although the type of development was not determined, this study did identify geographically those areas where some sort of development has occurred. 1992 digital ortho aerial photographs as well as 2000 Census Block Group data was also used to determine the areas at risk and the magnitude of the risk.

One of the goals of this study is to estimate the number of homes, number of people, and dollar value of residential structures within any given hazard area. To this end, census data and natural hazard maps are the basic information used in the analysis. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information. For instance, to find the census blocks that in some manner affected by a hazard area. Once the census blocks have been identified, it becomes a matter of adding up the desired information from the census data. In this case we tally up the number of people and houses in each block. It is also possible to determine total home values of each block by multiplying the average block-group house value with total number of homes in the block. Hence we estimate the dollar value of homes within a hazard area at a block level.

It was realized early on, however, that even at a block level, census data can still be too spatially disaggregate for suitable results. In other words, census blocks do not show exactly where the variables that are being measured (i.e. houses, people, and house value) really exist. For example, if a small portion of a census block is in a hazard area it causes the entire block to be counted. In effect, all the homes in a census block are considered within the hazard area instead of the one or two that may truly be affected by the hazard. If this method had been used, then the results of the analysis would have overestimated the amount of each variable in a hazard area. Due to the possibility of significant error additional steps have been added for the analysis.

The first change to the original method is to add an additional data set that shows developed areas throughout the study area. Called the Water Related Land Use (WRLU), this land use classification allows the census information to be more precisely placed on the landscape. For the analysis, the WRLU was merged with census block boundaries. It is then assumed each variable given in the Census data for a given block can be place on the land considered developed in that block. Unfortunately, this method still has its shortcomings. While it more precisely locates the where homes are, it still doesn’t fix the problem of a hazard only partially affecting a census block.

To deal with this situation, the census data for a given block is converted into a density value. Here is a hypothetical example, if the developed area of a given census block, say 10,000 meters^2, contains 150 people, then resulting population density is .015 people/meter^2. This same process can be used to calculate the two other variables, housing density (house/meter^2) and a housing value density (dollar/meter^2). Having calculated the three densities it is only a matter of determining the amount of space that a hazard occupies in the developed areas of each census block. Once that amount is known, it is multiplied by the density of the variable. Say, for example, that a hazard covers 2000 meters^2 of developed area in the hypothetical block above. The total people affected by the hazard would be 2000 meter^2 multiplied by .015people/meter^2 or 30 people. This process is performed for each block and the results are added together. It is in this manner that the total effects of a potential hazard are calculated for the study area.

A few assumptions had to be made in order to execute this model and produce results given the data available. The model is based on the assumption that both population and housing unit density is uniformly distributed across the areas identified as developed in the WRLU database (correlated to the census block). The housing unit value assigned to the Census Block was based on the figure provided in the Census Block Group (this variable is not available at the block level).

The potential loss estimates for commercial development (excluding home-occupation businesses) were determined by intersecting the various hazard data layers with a commercial\industrial business location GIS data layer. In this way, we were able to derive the number of businesses that were located in each hazard and their total estimated 2002 sales revenue.

Working with the various county tax assessors' offices, an attempt was made to look up the tax assessed value of all the businesses located in hazard zones. It was soon determined that the data could not be automatically extracted from the assessor's data bases. Each business would have to be looked up and pulled individually. With over 1000 businesses located in one or more hazard zones in the three counties, this proved too difficult.

As an alternative, the potential loss value of the commercial/industrial structures were determined by calculating an average 2002 value for each county and multiplying this figure by the number of businesses. The average value was calculated by dividing the total assessed value (land & buildings) obtained from a 2002 property tax report from the Utah State Tax Commission by the number of assessed businesses in each of the counties (obtained by each of the county's Assessors). Based on these calculations, the average business land & building value for Box Elder County was $343,872, Cache County $505,637 and Rich County $147,100. Unfortunately, this method will only provide a very rough approximation of commercial/industrial property at risk.

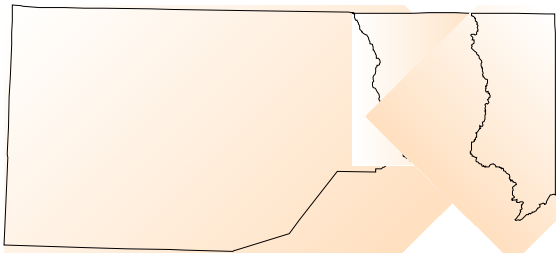
In terms of hazard mapping presentation in this document, portions of western Box Elder County and Eastern Cache County were excluded. These areas were not excluded from hazard identification and analysis. The decision to exclude these areas from the presentation mapping was designed to enhance the readability and usefulness of the mapping. Box Elder County has one of the largest geographic boundaries in the nation, yet only about 444 persons (1% of the

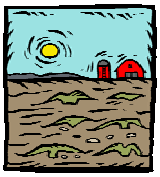
county's population) reside in the western portions; an area about five times the size of the more populated eastern portion of the county. Small unincorporated ranching communities such as Grouse Creek, Yost and Park Valley are located in Western Box Elder County. All incorporated cities were included in the mapping. Eastern Cache County was excluded from the mapping because it's mostly U.S. Forest Service land and virtually uninhabited (at least year round). Some second home cabin development is located in eastern Cache.

Areas not mapped in the presentation of the data were treated exactly the same as mapped portions in terms of hazard identification and analysis. Hazards issues for these portions excluded from mapping will be covered in the narrative portion of the document to the extent needed.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can identify general development trends and where potential conflicts may occur. No viable source of data exists to facilitate this sort of analysis. Zoning data does not necessarily indicate an area will be developed with a particular land use. Other development constraints such as availability of water/sewer or restrictions imposed by other general ordinances or regulations make the predictability of zoning difficult if not impossible. Nonetheless, an attempt was made to describe general growth trends as they related to particular hazards.

PART IV-BEAR RIVER DISTRICT ANNEX RISK ASSESSMENT





AGRICULTURAL RELATED HAZARDS

Background

Severe weather, drought, insect infestation and invasive noxious weeds have all had significant harmful impacts on the agricultural industry in the Bear River District. While these factors also impact the general public, the negative impacts are most acutely experienced by those in the agricultural sector. The agricultural sector is critical to the economies of Box Elder, Cache and Rich Counties. In Cache and Rich Counties the agricultural sector generates the greatest share of output to there respective county's economy.

History of Severe Weather in the Bear River District

Table IV-2: Prolonged Periods of Drought in the Region		
Box Elder County	**Cache County**	**Rich County**
1900-1903	1900-1903	1900-1903
1953-1960	1933-1935	1931-1935
1976-1977	1959-1961	1976-1979
1989-1992	1987-1992	1987-1992
1999-present	1999-present	1999-present
Palmer Drought Severity Index Chart from 1895-2001		

Table IV-3: History of Severe Weather Events in Box Elder County (1960-1999)			
Date	**Severe Weather Event**	**Date**	**Severe Weather Event**
April 1962	Wind	July 1982	Wind
October 1962	Wind	April 1983	Wind
November 1964	Wind	April 1986	Wind
September 1995	Hail, Lightning, Severe Storm/Thunder Storm, Winter Weather	December 1990	Sever Storm/Thunder Storm, Wind
March 1967	Wind, Winter Weather	January 1991	Fog
April 1967	Wind	January 1993	Winter Weather
June 1969	Hail, Wind	February 1996	Winter Weather
December 1970	Winter Weather	March 1996	Winter Weather
February 1971	Wind	November 1996	Winter Weather
August 1971	Sever Storm/ Thunder Storm	December 1996	Winter Weather
March 1973	Winter Weather	January 1997	Winter Weather
November 1973	Wind	February 1997	Winter Weather
March 1974	Wind, Winter Weather	March 1997	Winter Weather
April 1974	Wind, Winter Weather	April 1997	Winter Weather
March 1975	Winter Weather	October 1997	Winter Weather
April 1975	Winter Weather	November 1997	Winter Weather
May 1975	Winter Weather	December 1997	Winter Weather
July 1975	Winter Weather	January 1998	Winter Weather
November 1975	Winter Weather	February 1998	Winter Weather
December 1975	Winter weather	March 1998	Winter Weather

Table IV-3: History of Severe Weather Events in Box Elder County (1960-1999)			
Date	**Severe Weather Event**	**Date**	**Severe Weather Event**
February 1976	Wind, Winter Weather	April 1998	Winter Weather
March 1976	Wind. Winter Weather	June 1998	Winter Weather
April 1976	Wind, Winter Weather	November 1998	Winter Weather
June 1976	Winter	December 1998	Winter Weather
August 1978	Hail, Severe Storm/Thunder Storm, Wind	January 1999	Winter Weather
January 1979	Winter Weather	April 1999	Winter Weather
May 1979	Hail, Wind	December 1999	Winter Weather
July 1981	Lightning		
Source: National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html)			

Table IV-4: History of Severe Weather Events in Cache County (1960-1999)			
Date	**Severe Weather Event**	**Date**	**Severe Weather Event**
June 1960	Hail, Frost	April 1990	Severe Storm/ Thunder Storm, Winter Weather
April 1962	Wind	December 1990	Severe Storm/Thunder Storm, Wind
November 1964	Wind	January 1991	Fog, Winter Weather
September 1965	Hail, Lightning, Severe Storm/Thunder Storm, Winter Weather	May 1991	Wind
March 1967	Wind, Winter Weather	January 1993	Winter Weather
April 1967	Wind	January 1993	Winter Weather
January 1971	Winter Weather	February 1996	Winter Weather
February 1971	Winter Weather	March 1996	Winter Weather
July 1971	Hail	October 1996	Winter Weather
August 1971	Severe Storm/Thunder Storm	November 1996	Winter Weather
December 1972	Wind, Winter Weather	December 1996	Winter Weather
November 1973	Wind	January 1997	Winter Weather
December 1973	Avalanche, Winter Weather	February 1997	Winter Weather
January 1974	Winter Weather	March 1997	Winter Weather
March 1975	Winter Weather	April 1997	Winter Weather
November 1975	Winter Weather	October 1997	Winter Weather
December 1975	Winter Weather	November 1997	Winter Weather
February 1976	Winter Weather	December 1997	Winter Weather
April 1976	Wind	January 1998	Winter Weather
June 1976	Winter Weather	February 1998	Winter Weather
November 1978	Winter Weather	March 1998	Winter Weather
November 1979	Winter Weather	April 1998	Winter Weather
January 1980	Wind	June 1998	Winter Weather
August 1980	Hail	November 1998	Winter Weather
July 1981	Lightning	December 1998	Winter Weather
April 1983	Wind	January 1999	Winter Weather
March 1984	Wind	April 1999	Winter Weather
July 1986	Sever Storm/Thunder Storm, Wind	December 1999	Winter Weather
September 1989	Tornado		
Source: National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html)			

Table IV-5: History of Severe Weather Events in Rich County (1954-1999)			
Date	**Severe Weather Event**	**Date**	**Severe Weather Event**
May 1954	Tornado	March 1997	Winter Weather
April 1962	Wind	May 1997	Winter Weather
September 1965	Hail, Lightning, Sever Storm/Thunder Storm, Winter Weather	October 1997	Winter Weather
March 1967	Wind, Winter Weather	November 1997	Winter Weather
January 1971	Winter Weather	December 1997	Winter Weather
December 1972	Wind, Winter Weather	January 1998	Winter Weather
March 1975	Wind, Winter Weather	February 1998	Winter Weather
November 1975	Winter Weather	March 1998	Winter Weather
December 1975	Winter Weather	April 1998	Winter Weather
July 1981	Lightning	June 1998	Winter Weather
December 1990	Severe Storm/thunder Storm, Wind	November 1998	Winter Weather
January 1991	Winter Weather	December 1998	Winter Weather
February 1996	Winter Weather	January 1999	Winter Weather
November 1996	Winter Weather	April 1999	Winter Weather
December 1996	Winter Weather	December 1999	Winter Weather
January 1997	Winter Weather		
February 1997	Winter Weather		
Source: National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html)			

Table IV-6: Bear River District Grasshopper Infested Acreage (1998-2002)					
County	1998	1999	2000	2001	2002
Box Elder	100,000	100,000	55,000	120,400	120,000
Cache	0	0	19,000	64,500	17,000
Rich	0	0	0	12,400	0
Source: 2002 Insect Report, Utah Department of Agriculture and Food					

Table IV-7: Bear River District Mormon Cricket Infested Acreage (1998-2002)					
County	1998	1999	2000	2001	2002
Box Elder	0	0	0	0	108,300
Cache	0	0	19,000	8,100	4,400
Rich	0	0	0	0	0
Source: 2002 Insect Report, Utah Department of Agriculture and Food					

Regional Hazard Assessment

Drought Hazard Profile	
Frequency	Frequent
Severity	Severe mostly for agricultural producers
Location	Un-irrigated areas are most impacted
Seasonal Pattern	Water supply dependent on winter snowfall. Summer is when impact is realized.
Duration	As many as 10 years
Speed of Onset	Incremental with impact increasing
Probability of Future Occurrences	High-the region is one of the worst drought cycles in many years.

Severe Weather Hazard Profile	
Frequency	Frequent
Severity	Severe mostly for agricultural producers
Location	Everywhere (Some areas have more inherent risk due to geographic conditions)
Seasonal Pattern	Summer severe thunderstorms/hail & wind, Late spring freezing, and heavy winter storms
Duration	Days
Speed of Onset	Immediate
Probability of Future Occurrences	High

Insect Infestation Hazard Profile	
Frequency	Sporadic
Severity	Severe mostly for agricultural producers
Location	Everywhere
Seasonal Pattern	Spring & early summer
Duration	Months
Speed of Onset	Days
Probability of Future Occurrences	High

The State of Utah is currently in the fifth year of a drought. While data has not yet been compiled, 2003 is shaping up to be one of the worst insect infestation years in recorded history. All three counties have been declared agricultural disaster areas by the U.S. Department of Agriculture. Certainly, the drought cycle has exacerbated the insect infestation problem.

Severe weather can potentially impact agricultural crop production. Increased risks are associated with certain times in the crop growth cycle. These vary depending on the crop. In general, many crops can be damaged by heavy rainstorm, hail or high winds. Unusually late frost can damage some crops. Fruit production located mostly in Eastern Box Elder County can be significantly damaged by late frosts as well as other severe weather.

Assessing Vulnerability: Identifying Assets & Estimating Losses

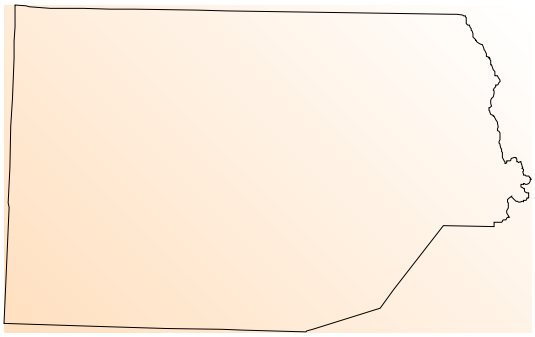
Table IV-8: Bear River District 1997 Agriculture Economic Profile				
County	**Number of Farms**	**Acres in Farm**	**Market Value of Ag products sold**	**Estimated Average Value of land & building (per farm)**
Box Elder	1,077	523,744	$102,173,000	$547,243
Cache	1,232	266,374	$104,809,000	$329,665
Rich	162	1,357,734	$15,538,000	$853,906
Source: 1997 Census of Agriculture, U.S. Department of Agriculture				

Although the final tally has not been compiled, to-date the USDA Crop Insurance Program has paid out a total of $13.2 Million in disaster assistance to farmers in Box Elder, Cache and Rich Counties for 2001-2002. Since payouts only represent a portion of actual damages, it is estimated that actual damages for 2001-2002 were over $26 Million from severe weather, insect infestation and drought in the Bear River District (Phone conversations with Box Elder, Cache and Rich Farm Services Agency, USDA).

Assessing Vulnerability: Analyzing Development Trends

The urbanization of eastern Box Elder County and the Cache Valley means access to irrigation water for agricultural purposes will become increasing more difficult. In terms of competition for limited water resources, agricultural uses often lose out to increasing urban demands. This problem is likely to get worst for agricultural users and especially becomes evident during a drought period such as the one we are currently experiencing. Even today some rumblings of legal action have occurred between urban users and agricultural users.

PART IV-BOX ELDER COUNTY ANNEX RISK ASSESSMENT



GENERAL BACKGROUND INFORMATION

Box Elder County is located in the northwest corner of Utah extending from the western edge of the Wasatch Mountains to the Idaho border and then west to the Nevada border. Box Elder County is surrounded by Cache, Weber, Tooele, and Davis Counties, and is the fourth largest of Utah's counties. Created in 1856, it was named for its abundance of Box Elder trees throughout the County.

Early inhabitants of the County were prehistoric hunters and gatherers that roamed the area as early as 12,000 years ago. In the 1820s and '30s fur trappers, including Peter Skene Ogden and Joseph Walker explored the eastern and northern parts of the County. Permanent white settlement began in 1851 when a group of Mormon pioneers settled in present day Willard. The area was already inhabited by Shoshone Indians when the Mormon settlers entered the area. This resulted in livestock raids and violent confrontations between the Indians and the settlers. On July 30, 1863, Territorial Governor James Duane Doty negotiated the Treaty of Box Elder ending the conflict between the Shoshone Indians and the settlers. In 1856 the territorial legislature created Box Elder County from part of Weber County.

Box Elder is historically known for the Golden Spike National Historical Site where, in May of 1869, the driving of the Golden Spike, in Promontory, joined the Union Pacific Railroad from Omaha, Nebraska, and the Central Pacific Railroad from the Pacific Coast. A dramatization of that ceremony is reenacted every year, allowing visitors to witness the event.

The County contains rich farmlands consisting of 43% of the County's land use, and leads all Utah counties in the economic value of its' agricultural products. The standard crops are hay, grain, alfalfa, and the County is also known for its peaches and other fruit crops. Besides its agriculture, Box Elder County is home to several large manufacturing facilities including ATK Thiokol Propulsion Corporation, the single largest employer in the County which operates two rocket motor and missile plants and produces fuel for space vehicles. Autoliv, the automobile airbag manufacturer, is also a major employer which is expanding rapidly. Others include Nucor Steel, Vulcraft and LA-Z-Boy of Utah.

Box Elder County is a county whose economy and fortunes have been closely tied to individual industries throughout its history. Starting with early reliance on the opportunities made available by the trans-continental railroad, the sugar beet industry, and then most recently, the Thiokol Corporation and the military industrial complex.

The County recently has increased efforts to diversify its economy to avoid reliance on single markets and it shows signs of succeeding in this effort. The growth trend in Box Elder County is less rapid than Cache County but as the Wasatch Front becomes built out there will be increased pressure on Box Elder County to absorb future growth.

Although Box Elder County had its economic beginnings in agriculture and livestock production, manufacturers in the defense and space industry have given the county higher employment rates and per capita incomes than the rest of the state. Agriculture still plays a large part in the regional economy, but is increasingly seen as a source of supplemental income. Primary crops

include hay, silage corn and grain used to feed livestock and dairy herds. Only one-fifth of Box Elder County residents remain farmers. The manufacturing sector has diversified and grown at a steady rate in Box Elder County reducing the importance of agriculture to local economies. Simultaneously, employment opportunities have steadily moved from the agricultural sector to the manufacturing sector. Many employees have migrated from national and international locations for high paying jobs at ATK Thiokol Propulsion Corporation, a major aerospace and defense contractor that has historically been Box Elder County's largest employer. In fact, mostly because of Thiokol, Box Elder County has traditionally been a county of higher employment and higher per capita income than most Utah counties. (See the "Population Density and "Land Ownership" map in the map section of the county annex)

Table IV-9: Box Elder County Participating PDM Jurisdictions			
Box Elder County	Bear River City	Brigham City	Corinne City
Deweyville Town	Elwood Town	Fielding Town	Garland City
Honeyville City	Howell Town	Mantua Town	Perry City
Plymouth Town	Portage Town	Snowville Town	Tremonton City
Willard City			

BOX ELDER COUNTY FLOODING

Background

Areas in Box Elder County have experienced significant impacts related to flooding in the recently recorded history. Box Elder County has several large rivers and smaller tributaries that are susceptible to flooding. The Bear River is the largest river in the county. A hydroelectric dam is located on the Bear River shortly after it enters the county from Cache County. Located mostly in Cache County, Cutler reservoir is formed as a result of this dam. The existence of this dam does provide some meaningful flood control for downstream portions of the Bear in Box Elder County. Other major rivers are the Malad River and Box Elder Creek. A number of smaller often intermittent streams are located in some of the canyons of the Wellsville and Wasatch Mountains. Each of these streams can pose a threat in terms of flooding. In addition a number of canals are located in the county that under certain conditions may fail or overflow and result in flooding.

Most flooding in Box Elder County is attributed to snowmelt rates in surrounding watersheds that are in excess of the capacity of the drainage systems or unusually heavy storm events that temporarily overwhelmed drainage capacity (or a combination of the both). Some limited flooding is the result of rising groundwater levels. **See the "FEMA Flood Zone" Map in the county annex map section.**

History of Flooding in Box Elder County

In terms of property damage and disruption of community life, Brigham City along with the Willard/Perry area has been the communities most impacted historically by flooding. The floods of August 1923 in Willard were some of the most destructive in the State's recorded history. A significant portion of Willard was inundated by flood water and associated mud and debris flows. Four dwellings were destroyed and two women died when their homes were demolished (see cover photos).

In the mid-1980's large portions of Box Elder County were negatively impacted by the rise in the level of the Great Salt Lake. A significant amount of high value wetlands and agricultural land surrounding the lake were flooded by the rise of the briny water, including the Bear River Bird Refuge. Although their immediate value was reduced by a natural dry cycle that resulted in the lake level dropping, the State of Utah installed large pumps on the lake to moderate the rise of the lake by moving the water to the west desert. These pumps can return to operation if needed.

Following is a summary of significant flooding events in Box Elder County from 1847 to present:

Table IV-10: Box Elder County Flood History 1847-2003

Location	Date	Description
Brigham City	1851	Box Elder Creek flooding through early settlement.

Table IV-10: Box Elder County Flood History 1847-2003		
Location	Date	Description
	1881, 1907	No information available
	Feb 1911	Snowmelt and heavy rain resulted serious damage to homes, roads and bridges.
	Aug 1947	Crop & road damage, flooded homes
	May 1957	Low area flooding
	Aug 1959	Extensive road damage
	June 1960	Crop damage
	June 1963	Crop damage and flooded homes
	June 1969	Main Street flooding and one home
	Spring 1983	Homes flooded, waste treatment plant threatened by Box Elder Creek.
Fielding	July 1957	Flooded highway, crop damage
	1958, 1979, 1980	No information available
Garland	1899, 1918,1980	No information available
	Spring 1983	Dike along Bear River failed and damaged community water supply pump house.
Honeyville	Spring 1983	Homes flooded from high groundwater
Howell	1968,1969,1980	No information available
Perry	May 1949	Road, orchard and crop damage
Plymouth	1891,1941	No information available
Promontory	Sept 1959	Crop damage
Snowville	June 1953	Crop damage, road closure
	1954, 1980	No information available
Thatcher	1934,1980	No information available
Willard	1906,1912	No information available
	Aug 1923	Widespread flooding and debris flow. Significant property damage and loss of life.
	Aug 1952	$100,00 in damage to orchard
	Sept 1982	Flooding from Holmes Canyon east of Willard. Road damage as flood waters crossed U.S. 89 at about 680 South.
	Spring 1983	Several homes flooded, Facer Canyon Flooding
Land around the Great Salt Lake	1982-1984	Flooding of land around the Great Salt Lake (wetlands and agricultural land).
Entire County	Spring 1984	Debris flows on private land, debris basins in Willard filled to capacity. Widespread road damage.
FEMA Flood insurance study for Brigham City, 2-17-81, Local Surveys (see appendix A) (Butler & Marsell, 1972), (Division of Comprehensive Emergency Management, 1981)		

Box Elder County Flood Hazard Assessment
Hazard Profile

Frequency	Some flooding occurs nearly every year in Box Elder County
Severity	Moderate
Location	Generally along rivers, streams and canals.
Seasonal Pattern	Spring flooding as a result of snowmelt. Mid-late summer cloudburst events.
Duration	A few hours or up to three weeks for snowmelt flooding
Speed of Onset	1-6 hours
Probability of Future Occurrences	High-for delineated flood plains there is a 1% chance of flooding in any given year.

Taken as a whole, Box Elder County has relatively minor flood threats. This, in part, is reflected in the low number of communities participating in the National Flood Insurance Program (NFIP). Nonetheless, significant flooding has occurred in the past and with certainty will occur in the future. The question is when, where and to what extent?

Given existing and potential future development, areas around the Bear and Malad Rivers are most likely to see impacts related to flooding. At present most of the risk for flood damage is centered on potential agricultural loses. Certainly as more development occurs, if it is not properly managed, threats to structures and human safety will certainly increase.

Analysis of areas of Box Elder County mapped by FEMA for communities that participate in the NFIP indicate some conflict related to existing development located in what has been determined to be the 100 year floodplain. Digitized floodplain maps for Box Elder County were overlaid on a layer of Digital Ortho Aerial Photographs as well as a 1996 data layer that delineates "developed" areas (Water Related Land use Study produced for the State of Utah Division of Water Resources). An August 2003 report Flood Hazard Identification Study: Bear River Association of Governments by the U.S. Army Corps of Engineers was also used to determine flood risk for communities that do not have FEMA Firm flood plain maps (See Appendix B for the full report).

Numerous isolated pockets of development (generally limited to 1-3 farmsteads) are located in the **unincorporated portions of Box Elder County**. Some of these isolated developments located largely adjacent to the Malad River and to a lesser degree the Bear River and various intermittent streams are at least partially located in the 100 year floodplain.

Other areas of concern related to risk of flooding are the development located on the south side of 600 north in **Brigham City** as it extends from about 900 west to 1200 west. This area, as well a couple of small isolated areas in the center of Brigham City are located in Box Elder Creek's 100 year flood plain. Small areas adjacent to 500 north from about 200 west to 400 west may be impacted by overflow flooding of Box Elder Creek. This would likely impact about 7-10 homes. The area west of Brigham City on 600 north would mostly impact industrial development.

The Ogden-Brigham (Pineview) Canal flows into Brigham City from the south. It enters the southern part of the county and flows through or above Willard, Perry and Brigham City. The Perry Canal begins in an equalization pond below Mantua Reservoir and flows partially through Brigham as it flows to Perry City to the south. These two canals parallel each other for a time flowing in opposite directions. Historically, not much flooding has occurred related to these canals. About three years ago the Perry Canal overflowed with spring runoff around 6th South 800 East in Brigham due to a blocked culvert a one home was flooded. Brigham City could be impacted by upstream conditions on the Pineview Canal (see Willard discussion).

Deweyville Town is located east of the Bear River. However all development is located considerable distance from the river and does not seem to be at risk from Bear River flooding. Some eastern tributaries flowing off the Wellsville mountains present a threat to portions of the town from site specific flooding. However not many drainage routes exist on the Western side of the Wellsville Mountains. The soil types present essentially absorb most potential runoff. Flows occur only on extreme weather events. A similar situation occurs for **Honeyville Town**. Deweyville does not participate in the NFIP and has not been mapped for flooding (See appendix B).

The Eastern portion of **Plymouth Town** appears to be vulnerable to flooding. The north eastern portion seems especially vulnerable. Because the town does not participate in the NFIP no flood plain map has been produced. Some approximation is required in carrying the flood boundary that has been mapped for the adjacent unincorporated county through the town of Plymouth. Nonetheless, it appears that about 7-10 residential units are threatened from flooding by these intermittent drainages (See Appendix B).

Snowville Town has several relatively large Deep Creek tributary drainages that are located in or near the town. Snowville does not participate in NFIP and so no official flood plain map has been produced for the town. Flooding from the intermittent tributaries would seem to pose a significant flood threat for a large portion of the community (See Appendix B).

Tremonton City does not participate in the NFIP as a consequence flood plains have not been delineated for the community. For the most part the community has no risk from flooding. However the eastern part of the community along the Malad River suggest that some flooding is possible in developed portions of Tremonton City. “The limited detail floodplains identified on the adjacent county map reflect what should be considered a minimal flood hazard area” (See Appendix B). If the rough extend of the Malad River floodplain boundary mapped for the unincorporated county carried through the Tremonton Boundary, approximately seven residences are threatened by flooding based on a 100 year event.

Willard City has experienced some of the worst flooding in the state’s history (see cover photos). Certainly many changes have occurred and improvements made since the flooding in the early 1900s. Nonetheless some flooding vulnerability still exists for residents of Willard.

Much of the steep mountainous area east of **Perry City** to the north, Willard and the South Willard area extending to the Weber County line on the south are drained by a number of steep

mountain canyons. These include Facer, Willard, Cook, Holmes and Pearsons Canyons. A long history of flood related problems have occurred in some of these canyons (especially above Willard City). Further exacerbating the situation is the presence of the Ogden-Brigham Canal (Pineview) that runs perpendicular to these canyon drainages at the base of the foothills.

Responding to flooding, significant flood control work has been completed in these drainages (much of it done by Civilian Conservation Corps (CCC) crews). Detention basins have been constructed at Facer Creek, Willard Creek and Pearson Canyon. Land terracing has been completed on the upper portion of the Willard Creek drainage. Gabions have been installed to direct flood waters in Pearson and Holmes Canyons. In addition a number of debris basins have been constructed.

Community officials have also attempted to respond to flood water from east-west canyons entering the northern flowing Ogden-Brigham Canal. Chutes have been built over the canal and most of the sections of the canal subject to flooding have been piped to prevent flood waters and debris from entering the canal. Also storm water pipes have been installed to help handle storm water discharges for Perry and Willard cities (RB & G Engineering, Inc, 1999).

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-11: Box Elder County Flood Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Bear River City	Incomplete data-No flood plain map (See appendix B)				
Brigham City	43	16	$1,743,539	6	$9,200/$2,057
Corinne City	2	1	$63,524		
Deweyville Town	Incomplete data-No flood plain map (See appendix B)				
Elwood Town	4	1	$107,650		
Fielding Town	Incomplete data-No flood plain map (See appendix B)				
Garland City	Incomplete data-No flood plain map (See appendix B)				
Howell Town	Incomplete data-No flood plain map (See appendix B)				
Mantua Town	28	8	$1,196,045		
Perry City	16	5	$702,453		
Plymouth Town	Incomplete data-No flood plain map (See appendix B)				
Portage Town	Incomplete data-No flood plain map (See appendix B)				
Snowville Town	Incomplete data-No flood plain map (See appendix B)				
Tremonton City	Incomplete data-No flood plain map (See appendix B)				
Unincorporated	258	75	$9,462,303	68	$87,000/$23,000

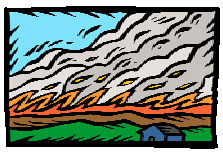
Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-12: Box Elder County Flooding Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Bear River City	Incomplete data-No flood plain map (See appendix B)			
Brigham City		.2 miles Interstate\$6 Million .9 miles two lane\$2.8 Million		.2 miles\$48,227
Deweyville Town	Incomplete data-No flood plain map (See appendix B)			
Elwood Town		.3 miles\$930,000		
Fielding Town	Incomplete data-No flood plain map (See appendix B)			
Garland City	Incomplete data-No flood plain map (See appendix B)			
Honeyville City	Honeyville School (closed)	1 mile Interstate\ $30 million 2.2 miles 2 lane\$6.8 million		.94 miles\$226,666
Howell Town	Incomplete data-No flood plain map (See appendix B)			
Perry City		.2 miles\$620,000		.05 miles\$12,056
Plymouth Town	Incomplete data-No flood plain map (See appendix B)			
Portage Town	Incomplete data-No flood plain map (See appendix B)			
Snowville Town	Incomplete data-No flood plain map (See appendix B)			
Tremonton City	Incomplete data-No flood plain map (See appendix B)			
Unincorporated		3.1 miles Interstate\$93 million 39.1 miles two lane\$121 million		6.07 miles\$1.5 million
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Assessing Vulnerability: Analyzing Development Trends

The area south of Willard along Highway 89 to the Weber County line is posed to be the county's high growth area. This area is in the process of developing a sewer system to accommodate new development demand. Design proposals are being developed for as many as 1000 new housing units. Some of this housing demand will come from Weber County residences looking to relocate.

If not properly sited, new development along this corridor could very likely be vulnerable to flooding from adjacent mountain drainages. At least some of the new development growth is likely to go on the east side of U.S 89 above and below the Ogden-Brigham Canal. This poses a potential flood threat from the canal itself but also would add new stormwater runoff to the canal. It would be generated from the impervious surfaces of new development upslope from the canal. This could impact downstream residences in Willard City, Perry City and Brigham City.



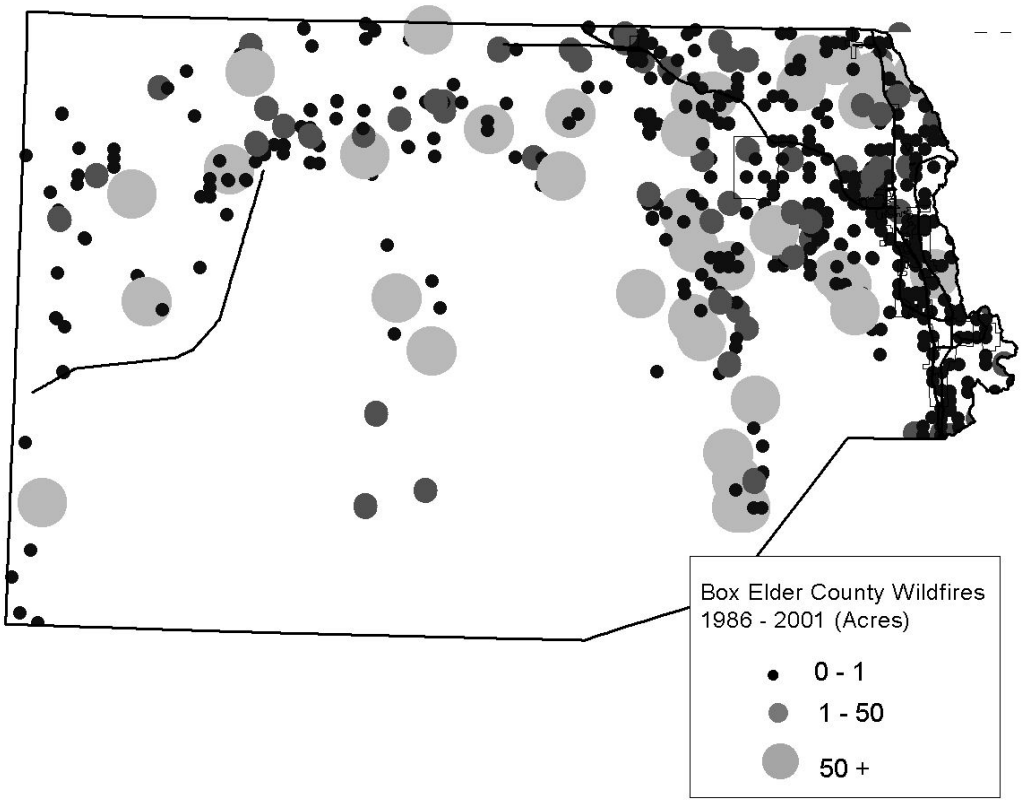
BOX ELDER COUNTY WILDFIRES

Background

The vast majority of Box Elder County has minimal threat from wildfire. Most of western Box Elder County is sage and scrub vegetation. In these areas when wildfires start they are relatively easy to contain and protect developed property. Where the highest risk occurs in Box Elder County is on the urban fringe and wildland interface primarily along the base of the Willard and Wellsville mountains. Some scattered second home developments are also at risk from wildfire. **See the "Wildfire Hazard" Map in the county annex map section.**

History of Wildfires in Box Elder County

Major fires in Box Elder County include the "Wildcat", "Fort Ranch", "Thiokol", "Pilot Peak", "Dry Canyon", "Morris Ranch", and "West Hills" fires. The following graphic illustrates the number and rough locations of wild fires in Box Elder County in the 15 year period from 1986 to 2001. In 1992 a large fire burned uncontained for over a week in the mountains above Perry City.



Box Elder County Wildfire Hazard Assessment
Hazard Profile

Frequency	Annually to some extent
Severity	Severe
Location	Dispersed throughout the whole county
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-6 hours
Probability of Future Occurrences	Very High (Based on data from 1986-2001, there is a 52% chance a fire of at least 1000 acres will occur every year)

A few subdivisions on the eastern edge of Brigham City are located immediately adjacent to wildfire prone areas.

Located in the unincorporated county north of **Deweyville Town** along the base of the Wellsville Mountains is located the Cedar Ridge Subdivision. Many of these homes are located in a high risk wildfire area.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-13: Box Elder County Wildfire Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Brigham City	562	157	$20,213,196	7	$6,000\$2,400
Honeyville City	13	5	$674,928		
Mantua Town	28	8	$989,561	1	$100\$342
Perry City	30	9	$1,266,446		
Willard City	34	17	$1,430,014		
Unincorporated	340	95	$13,871,710	6	$33,000\$2,057

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-14: Box Elder County Wildfires Other Facilities at Risk

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Bear River City			1.2miles/$57,521	
Deweyville Town			1.1miles 345Kv line/ $53,035 7.2miles 138Kv line/$354,125	
Honeyville City			1.4miles 345Kv line/$67,500 3.5miles 138Kv line/$67,769	
Unincorporated			3.8 miles 345Kv line\$183,213 1.9 miles 230Kv line\$91,694 24 miles 138Kv line\$1.1 million	2.28miles/$549,788

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

Assessing Vulnerability: Analyzing Development Trends

The areas that expose development to the most risk from wildfires are often the most desirable places to live. These places afford residents good views, access to public lands, open space and a connection with nature. Most jurisdictions have found it difficult to restrict, limit or modify development proposals for these areas.

In terms of future development trends Brigham City, Willard, South Willard and Mantua will likely see the most growth pressure in these fire prone areas. Brigham City recently proposed extending its eastern town boarder to U.S 91 north of Mantua Town. News reports indicate as many as 300 housing units may be proposed for the area. This area is all classified as high or extreme in terms of wildfire hazard.

Development that is being talked about in South Willard (east of U.S. 89) could put numerous homes at risk from wildfire depending on where it is sited.

As Brigham City, Willard, Honeyville and Mantua continue to grow; development pressure will likely increase on the margins of town and the trend will likely be to develop higher on the foothills. Some of this risk is moderated by the presence of U.S. Forest Service land that will set some bounds on this trend in certain areas.

BOX ELDER COUNTY LANDSLIDES

Background

Landslides are most common in Box Elder County at the base of the Willard Mountains from Perry south to the Weber County line. Landslides do not pose much of a problem for other parts of the county. **See the "Landslide Potential" Map in the county annex map section.**

History of Landslides in Box Elder County

Table IV-15: Box Elder County Landslide Areas	
Active Landslides (in Acres)	Historically Active Landslides 1847 to present (in Acres)
490	103,770

Debris flows associated with the 1923 flooding of Willard City were very destructive and destroyed a number of homes and building. Main Street Willard was covered in a thick layer of mud, rocks and debris. The force was strong enough to move large boulders (See cover photo).

In 1949 a five mile stretch of U.S 89 between South Willard and Utah Hot Springs was covered with mud, rocks and boulder.

In late May 1983 a large landslide occurred on the face of the mountain north of Willard near Facer Creek. Also in 1983-84 Three Mile Canyon near Perry City experienced a mud slide. As a result over $1 Million was spend constructing a detention basin and overflow facilities.

Box Elder County Landslide Hazard Assessment
Hazard Profile

Frequency	Annually to some extent
Severity	Sever
Location	Dispersed throughout the whole county
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-6 hours
Probability of Future Occurrences	Very High

The Perry to South Willard area along the base of the Willard Mountains has had ongoing problems with debris flows, landslides and flash flooding. A number of debris basins have been constructed as well as other debris flow management structures. Portions of the Ogden-Brigham Canal susceptible to debris flow blockage have been placed in culvert to avoid flooding.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-16: Box Elder County Landslide Risk Residential and Commercial (Active & Historically Active Landslides)					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Brigham City	131	25	$3,156,549		
Deweyville Town	52	19	$2,673,932		
Honeyville City	458	136	$15,697,737	3	$600/$1,028
Perry City	37	17	$1,462,448		
Willard City	525	185	$23,748,463	10	$1,500/$3,438
Unincorporated	377	117	$16,021,369		

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard. Data does not include areas susceptible to debris flows (no data available).

Table IV-17: Box Elder County Landslides Other Facilities at Risk (Active & Historically Active Landslides)				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Deweyville Town		0.6miles/$1,860,000	0.1miles/$4,821	
Honeyville City		4.3miles/$13,300,000	0.8miles 345Kv line/$38,571 1.1miles 138Kv line/$52,727	.33miles/$179,575
Willard City	Police/Fire Station, Willard School	4.5miles/$13,950,000	0.8miles/$38,347	
Unincorporated		19.1miles/$59,210,000	1.2miles 345Kv line/$57,857 6.9miles 138Kv line/$330,745	2.42miles/$583,547

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk. Data does not include areas susceptible to debris flows (no data available)

Table IV-18: Box Elder County Landslide Risk Residential and Commercial (Active Landslides Only)					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Perry City	9	3	$426,209		
Willard City	525	185	$23,748,463	10	$1,500/$3,438
Unincorporated	89	27	$3,366,168		

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)

** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-19: Box Elder County Landslides Other Facilities at Risk (Active Landslides Only)				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Willard City		.6 miles Interstate/ $18 million 3.5 miles two land/ $10.8 million	0.6 miles 138 Kv line/$28,760	
Unincorporated		.1 miles Interstate/ $3 million	.2 miles 138Kv line/$9,586	
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.** Data does not include areas susceptible to debris flows (no data available)				

Assessing Vulnerability: Analyzing Development Trends

Any development on alluvial fans in the South Willard area could be problematic.

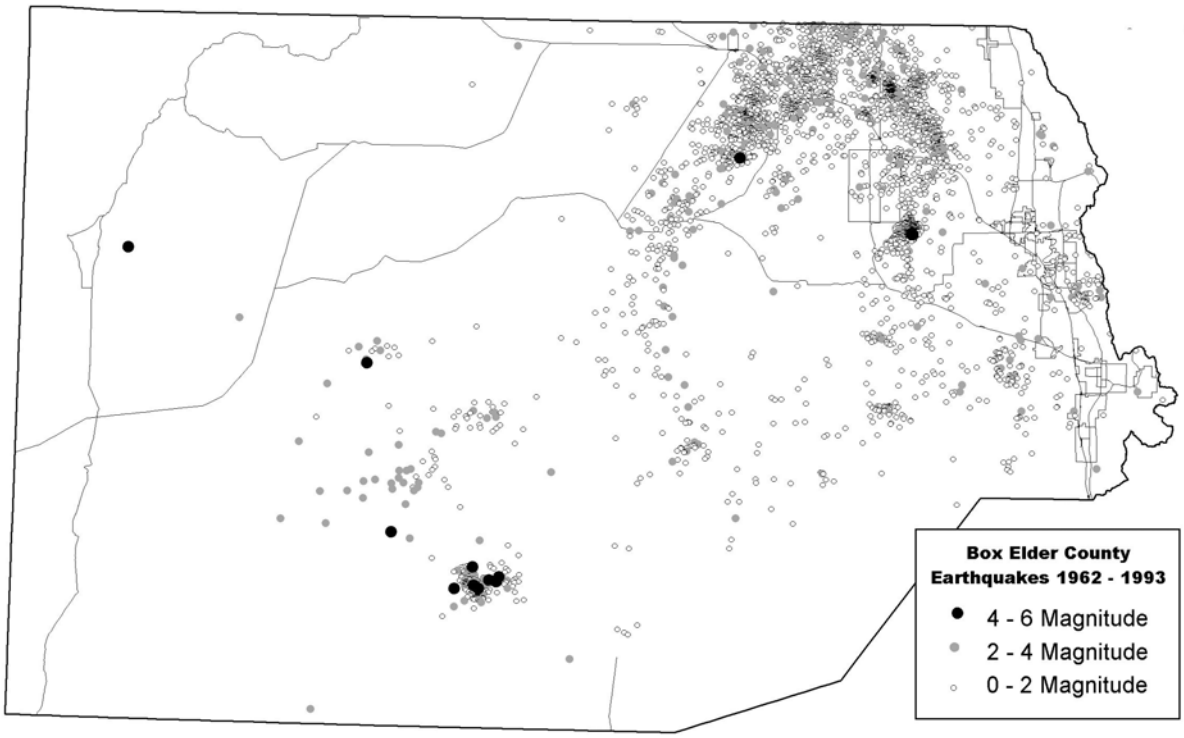
BOX ELDER COUNTY EARTHQUAKES

Background

The most populated portions of Box Elder County are located on the Intermountain Seismic Belt and the northern most segment of the Wasatch Fault. Earthquakes are common in Box Elder County, although no major earthquake resulting in significant property damage has occurred since European settlement. Geologic evidence establishes the possibility of a major earthquake in Box Elder County. **See the "Earthquake Fault Zone" and "Liquefaction Potential" Map in the county annex map section.**

History of Earthquakes in Box Elder County

The 1934 Hansel Valley Earthquake at 6.54 magnitude is widely held as the state's largest earthquake in modern recorded history (four aftershock earthquakes occurred ranging from 4.8 to 6.1 magnitude). The epicenter was in a largely unpopulated portion of the county and little or no property damage occurred. This earthquake resulted in surface fault rupture. Prior, in 1909 a 6.0 magnitude earthquake also occurred in the Hansel Valley.



Box Elder County Earthquake Hazard Assessment
Hazard Profile

Frequency	Low magnitude events occur frequently. Larger magnitude events are rare (although not necessarily on geologic time).
Severity	Potentially Catastrophic
Location	Entire County with highest frequency north of the Great Salt Lake. Surface fault ruptures are likely to occur in fault zones and liquefaction would impact most of the populated county.
Seasonal Pattern	None
Duration	A few minutes with potential aftershocks
Speed of Onset	No warning
Probability of Future Occurrences	Based on 1962-1993 data, there is a 50% chance every year of an earthquake of 4.0 magnitude or greater.

Much of the populated corridor in Box Elder County is located near the Wasatch Fault. According to Hecker (1992), the Wasatch Fault Zone is the longest and most active normal fault in the Utah. The Wasatch Fault extends from the south of Malad Idaho to western Sanpete County Utah, much along the populated Wasatch Front. Ten distinct segments have been identified along the fault that has similar characteristics.

Based on geologic evidence of the last 6000 years, of all the studied segments the Brigham City segment through most of Box Elder County is the most overdue for seismic release. Evidence suggests that it has been at least 3000 years since a significant release has occurred on the Brigham fault segment. All the other studied segments of the fault indicate faulting in the last 3000 years which suggests these segments have had release of seismic energy (Hecker, 1992).

Development in portions of **Brigham City, Perry, Honeyville and Willard** are located in areas that are susceptible to surface fault rupture in the event of a large earthquake.

Soil liquefaction presents the most widespread threat to **Box Elder County** inhabitants. Like most of the populated Wasatch Front, much of the population in Box Elder County is located on lake bed sediments from ancient Lake Bonneville. In addition areas with higher groundwater and more sandy soils present the highest risk. Problems related to soil liquefaction would impact a large percentage of the population in the event of a 5+ magnitude earthquake.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-20: Box Elder County Earthquake Risk (Liquefaction) Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Bear River City	750	233	$28,752,286	14	$7,600/$4,802
Brigham City	1,210	370	$44,449,661	90	$240,500/$30,876
Corinne City	619	206	$21,341,700	9	$13,000/$3,087
Deweyville Town	241	93	$13,167,183	2	$600/$686

Table IV-20: Box Elder County Earthquake Risk (Liquefaction) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Elwood Town	681	198	$26,823,488	7	$9,900/$2,401
Fielding Town	448	142	$15,765,197	8	$6,500/$2,744
Garland City	1,911	609	$31,668,000	34	$19,000/$11,664
Honeyville City	421	136	$17,335,932	16	$21,700/$5,489
Perry City	193	58	$8,688,271	1	$900/$343
Tremonton City	5,405	1,758	$193,749,291	241	$ 408,600/$82,679
Willard City	264	85	$10,460,115	9	$32,200/$3,087
Unincorporated	4,920	1,550	$186,181,315	133	$214,000/$45,628

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Box Elder County
(2002 State Tax Commission Report & Box Elder County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-21: Box Elder County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Bear River City	School	12.2miles/$37,820,000		
Brigham City	Discovery School	2.2miles Interstate/$66,000,000 17.2miles 2 lane/$53,320,000		7.06miles/$1,702,413
Corinne City	Fire Station	19.0miles/$58,900,000		4.23miles/$1,020,001
Deweyville Town		4.8miles/$14,880,000		4.06miles/$979,008
Elwood Town		3.6miles Interstate/$1.8,000,000 25.3miles/$78,430,000		3.32miles/$800,568
Fielding Town	Fire Station & School	8.0miles/$24,800,000		
Garland City	Middle School, Police Station, High School	1.27miles Interstate/$36,000,000 10.7miles 2 lane/$33,170,000		1.99miles/$479,859
Honeyville City	Fire Station	6.6miles Interstate/$198,000,000 17.4miles 2 lane/$53,940,000	2.8miles 345Kv line/$134,999 4.9miles 138Kv line/$233,877	7.01milles/$1,690,356
Howell Town				
Mantua Town				
Perry City		2.9miles Interstate/87,000,000 0.2miles 2 lane/$620,000	0.5miles 345Kv line/$24,107 1.0 miles 138Kv line/$47,934	3.74miles/$901,845
Tremonton City	North Park School, BRV Hospital, Fire/Police station, McKinley School	4.7miles Interstate/$41,000,000 27.7miles 2 lane/$85,700,000		3.88miles/$935,604
Willard City		4.37miles Interstae/$129,000,000	2.7miles 345Kv line/$130,178	4.76miles/$1,147,803

Table IV-21: Box Elder County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
		12.9miles 2 lane/$39,990,000	7.4miles 138Kv line/$354,711	
Unincorporated		29.6miles Interstate /$880,000,000 238miles 2 lane/$737,8000,000	17.9miles 345Kv line/$63,030 3.2miles 230Kv line/$154,432 46miles 138Kv line/$2,209,757	42.84miles/$10,330,223
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Table IV-22: Box Elder County Earthquake Risk (Fault Zone) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Brigham City	715	208	$23,770,185		
Honeyville City	30	10	$1,149,286		
Perry City	14	5	$726,861		
Unincorporated	39	11	$1,558,940		
Population and Residential Development estimates are derived using 2000 Census data *****2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Box Elder County (2002 State Tax Commission Report & Box Elder County Assessor's Office) **Note: Communities not listed have no residential or commercial property identified in the hazard.**					

Table IV-23: Box Elder County Earthquakes (Fault Zone) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Deweyville Town			0.1miles/$4,793	
Perry City				.74miles/$178,440
Unincorporated			0.1miles 345Kv line/$4,821 0.2miles 230Kv line/$9,662 0.9miles 138Kv line/$43,141	.87miles/$209,787
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Box Elder County HAZUS Analysis

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates can be used by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The results of the model ran for Box Elder County simulates a 2,500 year event with an earthquake magnitude of 7.0.

Table IV-23: Box Elder County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)

Timing	Sector	Level 1	Level 2	Level 3	Level 4
2 A.M	Commercial	2	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	5	2	0	0
	Residential	77	19	2	4
	Single Family	292	75	10	20
	Total	378	98	13	25
2 P.M.	Commercial	183	57	10	19
	Commuting	0	0	1	0
	Educational	111	34	6	11
	Hotels	0	0	0	0
	Industrial	39	11	2	4
	Residential	15	4	0	1
	Single Family	60	15	2	4
	Total	407	122	20	39
5 P.M.	Commercial	173	53	9	18
	Commuting	0	0	0	0
	Educational	8	2	0	1
	Hotels	0	0	0	0
	Industrial	24	7	1	2
	Residential	29	7	1	1
	Single Family	115	30	4	8
	Total	349	100	16	30

Severity Level 1: Injuries will require medical attention buy hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization buy are not considered life-threatening.
Severity Level 3: Injuries will require hospitalization and can become life threatening in not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

Table IV-24: Box Elder County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses	Wage	0.00	.63	9.21	.45	.41	10.70
	Capital-Related	0.00	.27	8.08	.26	.15	8.76
	Rental	12.66	5.33	5.02	.19	.19	23.40
	Relocation	1.14	.12	.23	.01	.06	1.57

Table IV-24: Box Elder County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
	Subtotal	13.81	6.35	22.54	.91	.81	44.43
Capital Stock Loses	Structural	63.54	8.31	15.66	2.71	3.02	93.23
	Non-structural	223.05	38.39	41.57	9.68	7.63	320.32
	Content	52.40	7.83	18.76	6.11	3.50	88.60
	Inventory	0.00	0.00	.72	.96	.10	1.79
	Subtotal	338.80	54.53	76.70	19.47	14.25	503.94
	Total	352.80	60.88	99.25	20.38	15.07	548.37

Table IV-25: Box Elder County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
Highway	Segments	1,731	0
	Bridges	195	42
	Subtotal	1,926	42
Railways	Segments	279	0
	Bridges	0	0
	Subtotal	279	0
Airport	Facilities	16	6
	Runways	91	0
	Subtotal	107	6
	Total	2,312	48

Table IV-26: Box Elder County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)				
Classification	Total	Least Moderate Damage > 50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	2	2	0	0
Schools	27	16	0	1
Police Stations	6	3	0	0
Fire Stations	6	5	0	0
On the day of the earthquake the model estimates that only 5% of the hospital beds in the county would be available for patient use. After 30 day 72% of the beds are predicted to be operational.				

Table IV-27: Box Elder County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		**Slight**		**Moderate**		**Extensive**		**Complete**	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	0	.03	1	.01	1	.01	0	.02	0	.02
Commercial	4	.26	8	.24	21	.46	20	1	16	1.6

Table IV-27: Box Elder County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Education	0	0	0	0	0	0	0	0	0	0
Government	0	.01	0	.01	1	.01	1	.03	0	.05
Industrial	1	.06	2	.05	4	.09	4	.23	3	.31
Religion	0	0	0	0	0	.01	0	.02	0	.02
Residential	50	3	150	4	339	7	326	18	216	22
Single Family	1,410	96	3,313	95	4,283	92	1,456	80	745	76
Total	1,465		3,474		4,649		1,808		980	

Assessing Vulnerability: Analyzing Development Trends

The development trend for many cities in Box Elder County has been to build further up in the foothills of the Wellsville and Willard Mountains. As cities get more “built-out” this trend will likely increase. This development will be exposed to risk associated with potentially unstable slopes or surface fault rupture in the event of an earthquake. New growth pressure in South Willard is of particular concern.

BOX ELDER COUNTY DAM FAILURE

Background

There are 261 regulated dams located in Box Elder County. Most of these dams are small detention ponds or livestock watering facilities and most pose a minimal threat to human safety or property.

Of the 261 regulated dams 250 are designated as “low hazard” by the State of Utah Division of Water Rights. As defined by state statue, low hazard dams are those dams which, if they fail, would cause minimal threat to human life, and economic losses would be minor or limited to damage sustained by the owner of the structure.

A total of 7 dams have been designated as “moderate hazard” by the State of Utah in Box Elder County. Moderate Hazard dams which, if they fail, have a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities.

The State of Utah has rated 4 dams in Box Elder County as “high hazard” which means that, if they fail, have a high probability of causing loss of human life or extensive economic loss, including damage to critical public utilities.

Dam failure inundation maps and emergency action plans for each of the high risk dams can be found on the Utah Division of Water Right’s website at: http://waterrights.utah.gov/cgi-bin/damview.exe?Startup.

History of Dam Failure in Box Elder County

No significant dam failures have occurred in Box Elder County.

Box Elder County Dam Failure Hazard Assessment
Hazard Profile

Frequency	Rare
Severity	Potentially Catastrophic
Location	Areas down stream of failed dam.
Seasonal Pattern	Anytime. Highest risk in spring during snowmelt.
Duration	A few hours
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Blue Creek Dam
The Blue Creek Dam is located one mile north of the town of Howell and has a hazard rating of high. The inundation area flows southward along blue creek, then just west of the development in Howell before ending at the Great Salt Lake basin.

Mantua Dam
The Mantua reservoir and dam have a high hazard rating. The inundation area covers the entire western side of the dam including significant amounts of the town of Mantua. Within the town, multiple homes and structures are at risk. The inundation continues westerly down Box Elder Creek filling the canyon bottom and covering highway 89/91, eventually leading through the center of Brigham City. Once again, significant numbers of people, homes and businesses are within the potential inundation area.

Three Mile Creek (debris and detention basin)
Three Mile Creek retention basin is located about 0.5 miles southwest of the city of Perry. The inundation area flows westerly from the dam towards the Great Salt Lake basin. Several structures as well as a section of highway 89/91 lie within the inundation area.

Cutler Dam
Cutler Dam and reservoir lie in extreme western Cache County and about four miles east northeast of Fielding in Box Elder County. This facility has a hazard rating of high. The inundation area follows the Bear River flood plain first southwesterly and then south past Deweyville, Elwood, Honeyville, Bear River City and finally Corrine City before ending at the Great Salt Lake. Since the inundation area remains, for the most part, within the flood plain, threats the population and homes appears to be minimum.

Assessing Vulnerability: Analyzing Development Trends

Any new downstream development that is located in the floodplain increases the exposure to risk in terms of human life and property. Given the relatively low probability of catastrophic dam failures, most jurisdictions are unwilling to regulate development in dam failure inundation areas.

BOX ELDER COUNTY HAZARD MITIGATION STRATIGIES

Hazard Mitigation Goals

The following goals were identified to direct the county's hazard mitigation strategies. These general goals were identified and developed based on the local official surveys (See appendix A), input from the Bear River District PDM Technical Planning Team and Steering Committee.

Goal # 1: Minimize potential impacts for future development

- **Develop, refine and improve the hazard data available to local level decision makers.**
- **As appropriate, develop and implement regulatory mechanisms to insure new development activities will not increase the risk to life or property.**
- **Build technical capacity for local elected and appointed officials.**
- **Empower citizens to make informed choices.**

Goal # 2: Minimize potential impacts for existing development

- **Improve emergency disaster response capabilities.**
- **Improve the disaster resistance of existing infrastructure and critical facilities.**
- **Educate and build capacity of citizens to undertake mitigation activities.**

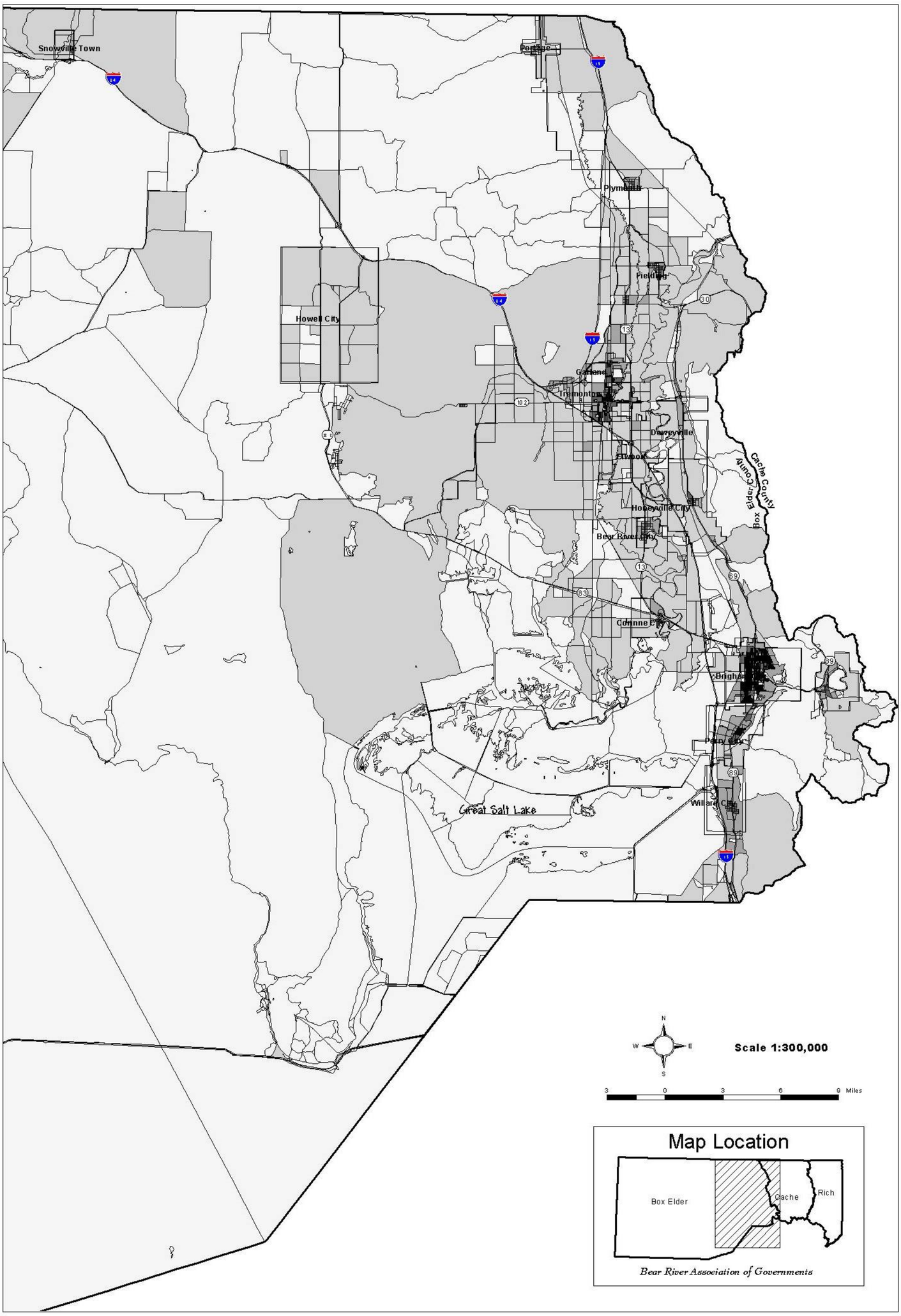
To accomplish these goals specific mitigation strategies were developed by participating jurisdictions. These goals were given assigned a priority of high, medium, or low by Bear River District PDM Technical Planning Team and Steering Committee. Priorities were give taking into account the following factors:

- Number of people protected by the project
- Technical feasibility
- Political support
- Environmental impacts
- Available funding source

A guiding factor in prioritizing mitigation was the though that mitigation should provide the greatest amount of good to the greatest amount of people when cost was taken into account. Prioritizing mitigation was difficult in this plan as each as Bear River is vulnerable to many different hazards. Each with its own characteristics. Thus, recurrence intervals, past events, damage estimates compiled during the assessing vulnerability section of this plan were also taken into account.

BOX ELDER COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
Multi-Hazard	**Goal 2**	**All Jurisdiction**	**Prepare for Severe Weather Events**	**Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)**	**Medium**	**2006**		**Minimal**	**NOAA**
Multi-hazard	**Goal 1 & 2**	**Brigham, Mantua**	**Protect critical infrastructure**	**Bury the 36" Penstock water line that carries culinary water, produces power and provide irrigation water to Brigham City.**	**High**	**2007**	**Local, FEMA**		
Multi-hazard	**Goal 1 & 2**	**Perry City**	**Improve emergency preparedness**	**CERTS training and equipment**	**High**	**2006**	**Local, FEMA**	**$3,000-$5,000**	**UDESHS, FEMA**
Multi-hazard	**Goal 1 & 2**	**Perry City**	**Protect critical infrastructure**	**Install electrical generators at culinary water wells.**	**High**	**2005**	**Local, FEMA**	**$20,000**	**UDESHS, FEMA**
Flooding	**Goal 1 & 2**	**Snowville, Plymouth and Tremonton**	**Mitigate impacts related to flooding.**	**Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.**	**High**	**2005**		**Minimal**	**UDESHS, ACOE**
Flooding	**Goal 1 & 2**	**Jurisdictions with identified flood hazards**	**Make better informed decisions.**	**Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.**	**Medium**	**2009**	**FEMA, UDESHS, Local**	**$2,500 to $65,000 each**	**Consultants, FEMA, UDESHS, Public Works**
Flooding	**Goal 1 & 2**	**Brigham City, Perry, Willard**	**Minimize flood risk from canal failure or overtopping**	**For those not already been studied, analyze and model the canals to determine deficiencies related to present and future demands (taking into account projected storm water increases based on projected development).**	**Medium**	**2007**	**Local, FEMA**	**$40,000**	**Consultants**
Flooding	**Goal 2**	**Perry, Willard**	**Minimize flooding along the base of the Willard Mountains (Perry south to Weber County Boundary).**	**Pearson Canyon drainage-extend storm water drain west of SR-89 to the east of the railroad tracks and eventually under the tracks to wetlands.**	**Medium**	**2005**	**Willard City, Willard Flood Improvement District, FEMA**	**$106,100**	
Flooding	**Goal 2**	**Willard**	**Minimize flooding along the base of the Willard Mountains (Perry south to Weber County Boundary).**	**Pearson Canyon drainage-dike the north channel east of the Ogden-Brigham Canal to divert water to the south branch. Deepen existing detention basin and low level outlet constructed.**	**Medium**	**2007**	**Willard City, Willard Flood Improvement District, FEMA**	**$126,000**	
Flooding	**Goal 2**	**Tremonton**	**Protect critical community facilities.**	**Berm around the west and north sides of the regional waste water treatment plan (similar to south and east sides). 840 feet, 3 feet high and 15 feet wide along Malad River.**	**Medium**	**2006**	**Tremonton, FEMA**	**$12,000**	
Flooding	**Goal 2**	**Honeyville**	**Educate citizens**	**Provide education and issue warnings when building permits are issued along the Bear River.**	**High**	**2004**	**Honeyville Town**	**Minimal**	
Flooding	**Goal 2**	**Honeyville**	**Educate citizens**	**Educate citizens and property owners along foot of Wellsville Mountains of areas of past flooding.**	**High**	**2004**	**Honeyville Town**	**Minimal**	
Wildfire	**Goal 2**	**Honeyville, Deweyville, Brigham City, Perry, Willard**	**Become "Firewise" communities.**	**Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).**	**High**	**2007**		**Minimal**	**BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.**
Wildfire	**Goal 2**	**Honeyville**	**Build citizen capacity**	**Educate and train property owners along the foot of the Wellsville Mountains about living with wildfire threats.**	**High**	**2006**	**Honeyville Town**	**Minimal**	**BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.**
Earthquake and Landslide	**Goal 1 & 2**	**All Jurisdictions**	**Make better informed decisions.**	**Improve the geologic hazard information and mapping for populated portions of the county.**	**Medium**	**2008**	**Utah Geologic Survey, Local**	**$65,000**	**Utah Geologic Survey, BRAG**
Earthquake and Landslide	**Goal 1**	**All Jurisdictions**	**Avoid placing new development at risk from geologic hazards.**	**Develop land use ordinances that require site specific geo-hazard studies be performed prior to development permitting in areas determined to be high risk related to earthquakes (especially for critical or high-occupancy buildings).**	**High**	**2006**		**Minimal**	**Utah Geologic Survey, BRAG, Utah League of Cities and Towns.**

PART IV-BOX ELDER COUNTY ANNEX HAZARD MAPPING



Box Elder County

Population Density

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries fand population density from US Census.

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads

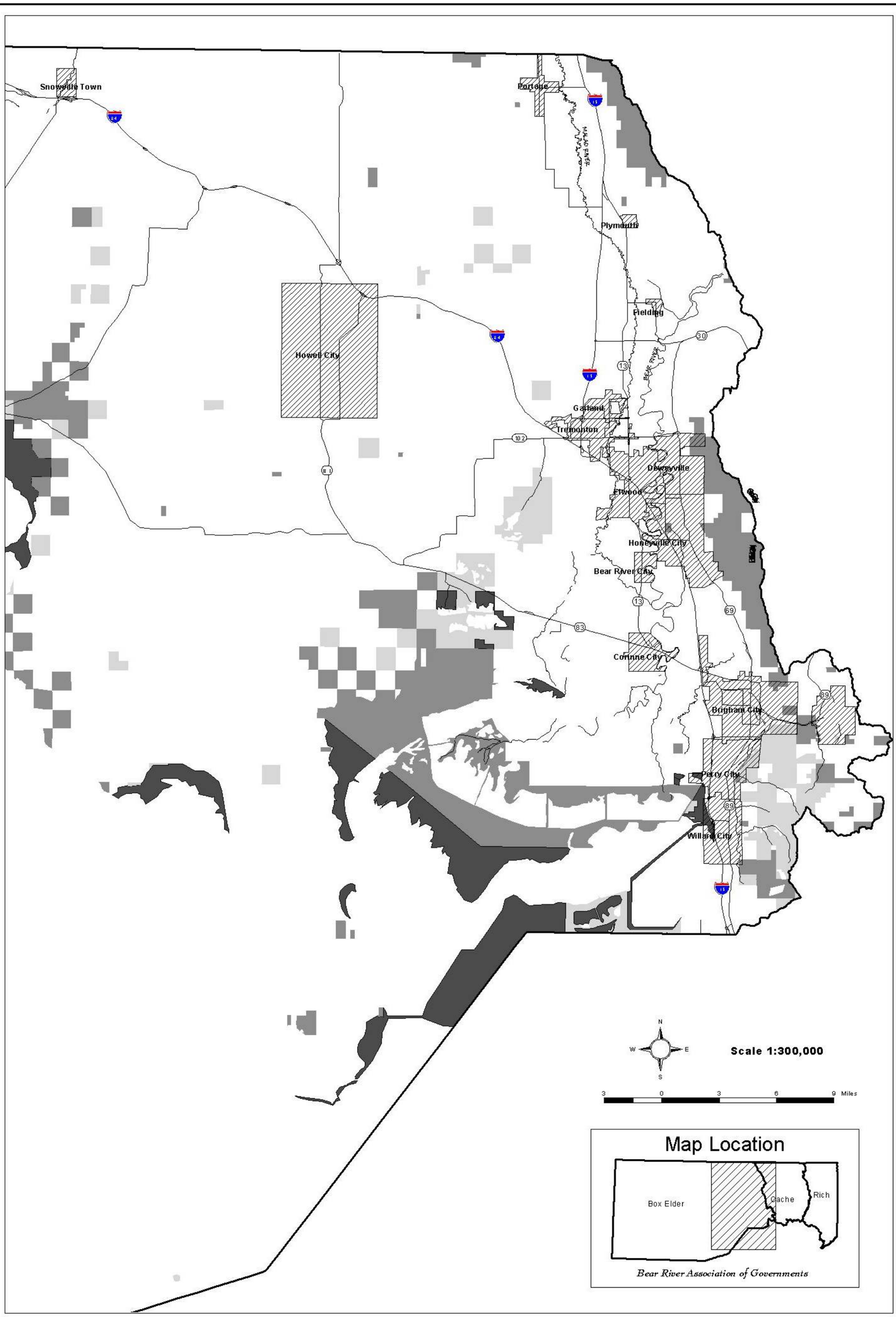
Rivers

Box Elder County

Population Density (Persons per acre)

- 0
- 0 - 0.3
- 0.301 - 2
- 2.001 - 6
- 6.001 - 1000

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Box Elder County

Land Ownership

Data Source: Municipalities, ownership, roads, rivers and lakes maintained by Utah AGRC. County Boundries from U.S. Bureau of the Census.

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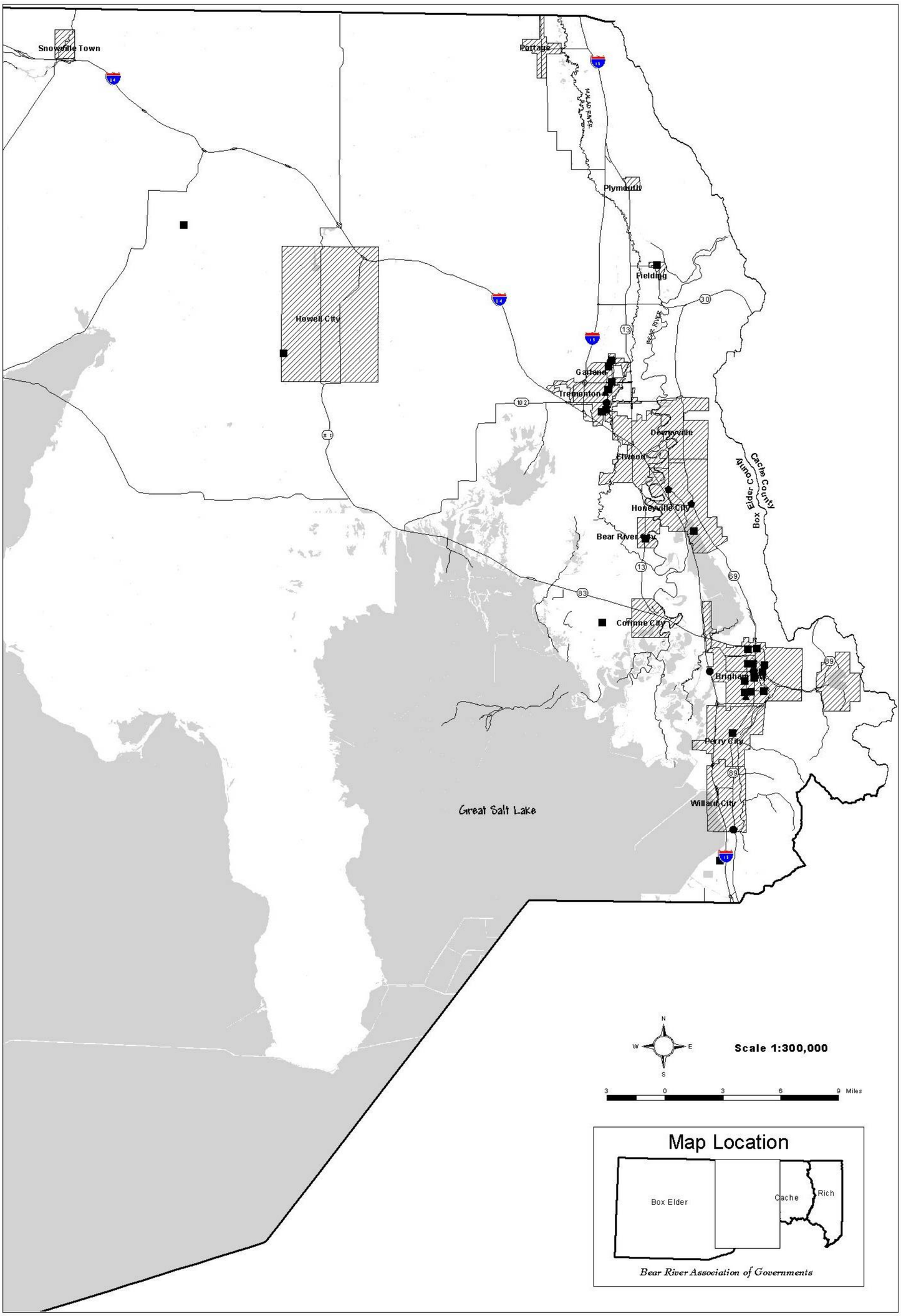
Roads
Rivers
Cache County
Municipalities

Land Ownership
Private
State Lands
Federal Lands
Sovereign Lands

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Box Elder County

Critical Facilities

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census.

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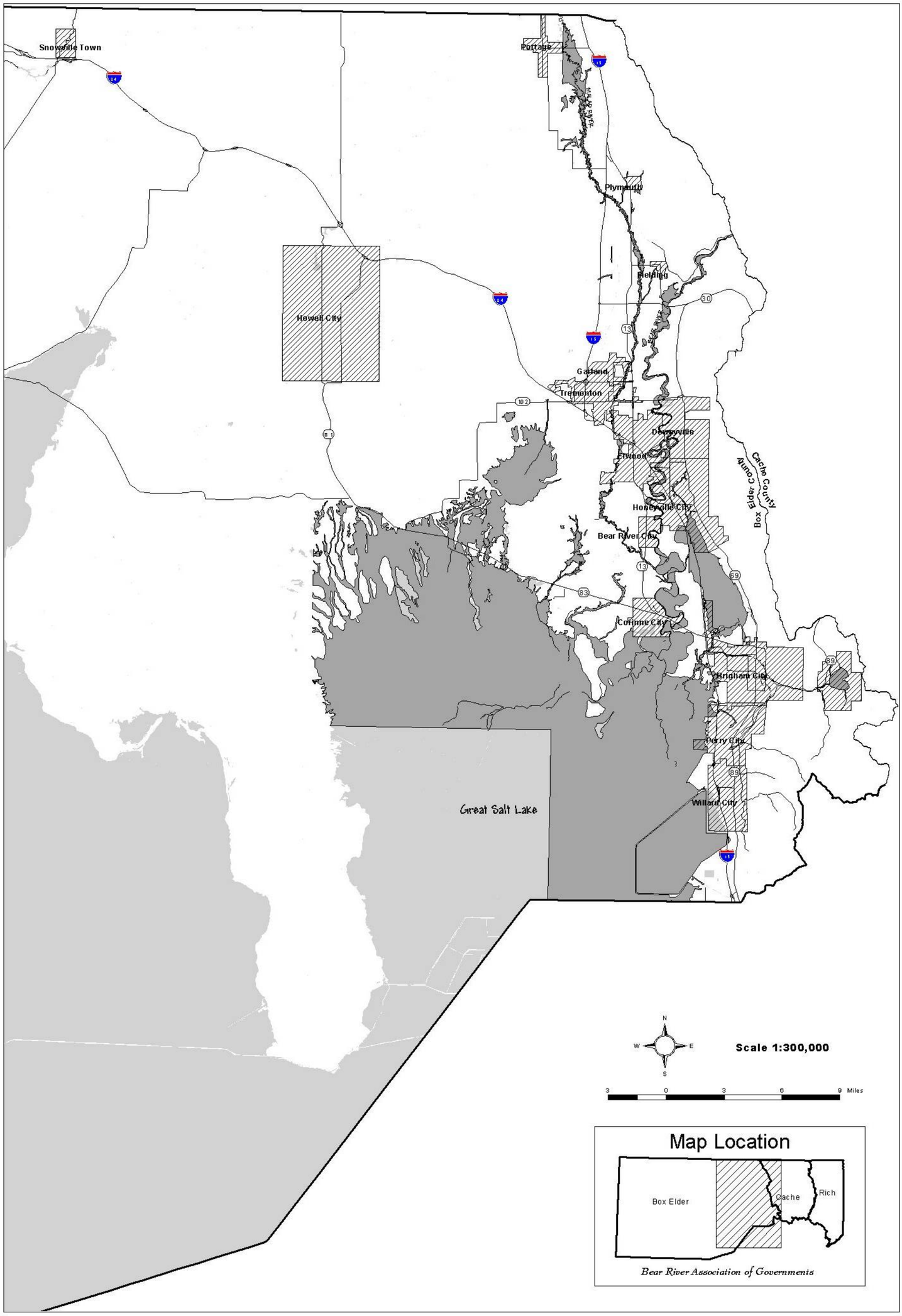
Roads
Rivers
Lakes
Municipalities
Police Station
School
Hospital
Fire Station
Box Elder County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Box Elder County

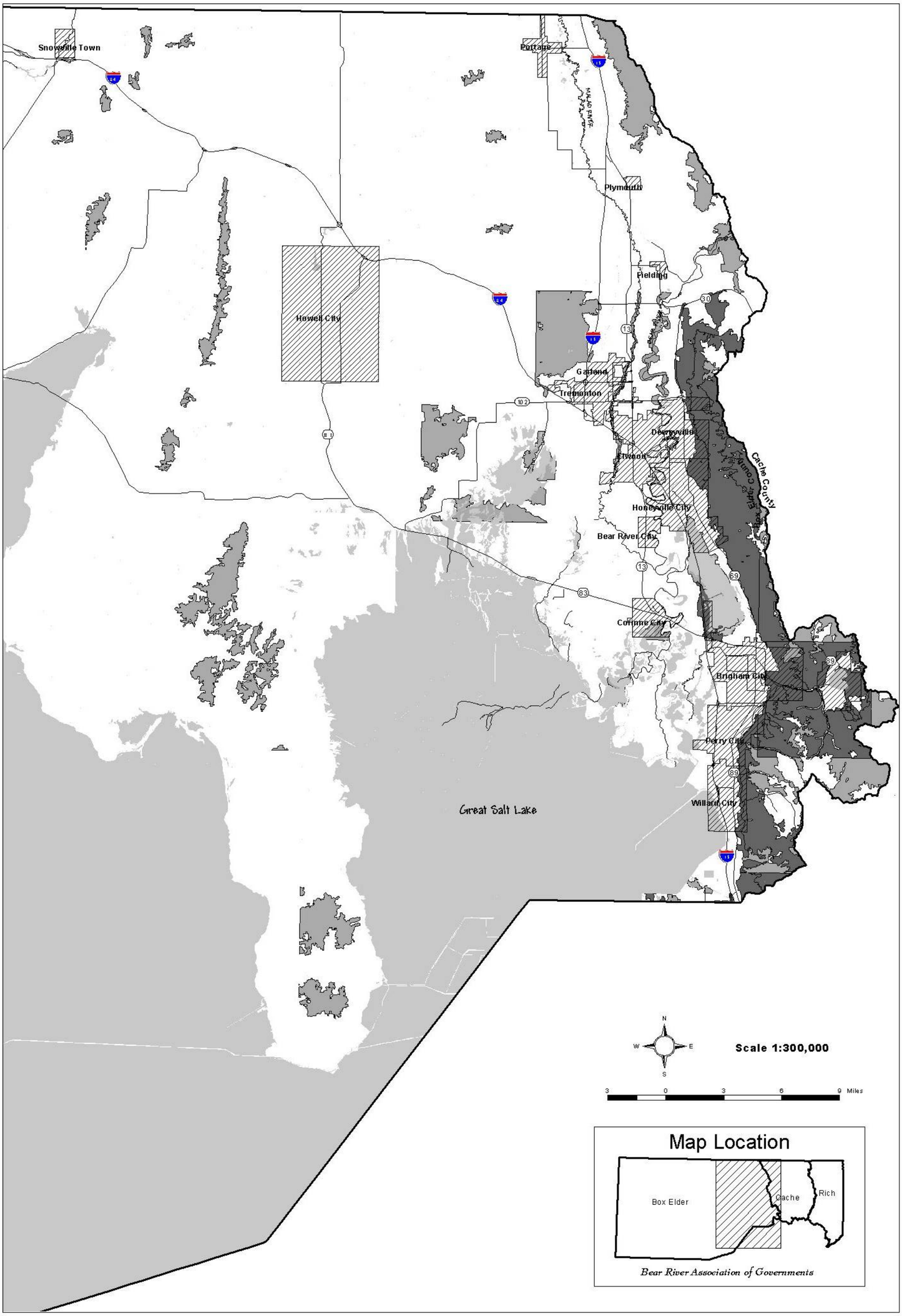
FEMA Flood Zone

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. FEMA Flood Zone digitized from paper FIRM maps.

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads		FEMA Flood Zone	
Rivers		Municipalities	
Lakes		Box Elder County	

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Box Elder County

Wildfire Hazard

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. Fire Classes from BLM Fire Hazard Analyisis.

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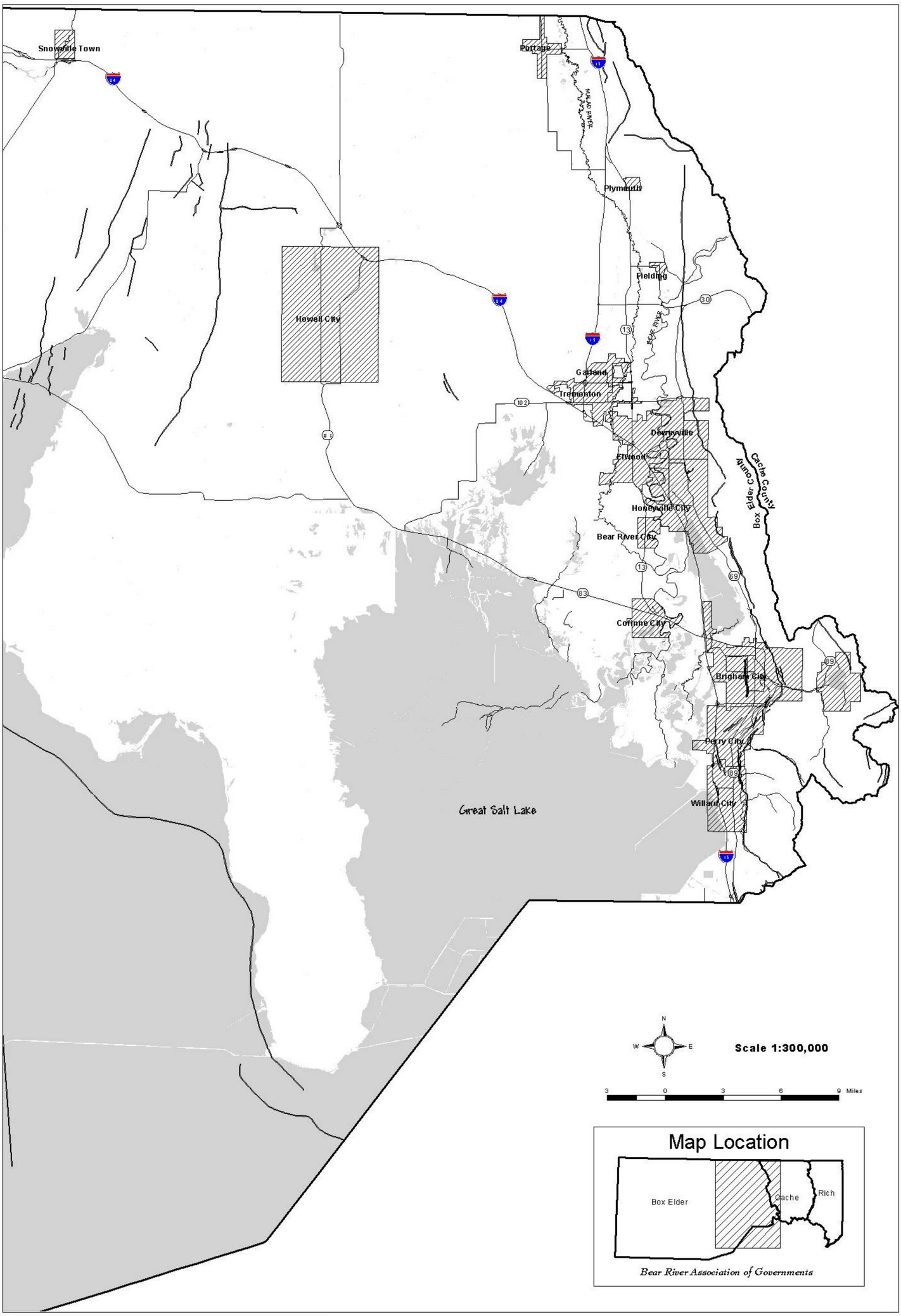
Roads
Rivers
Lakes
Municipalities
Moderate Fire Hazard
High and Extreme Fire Hazard
Box Elder County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

Landslide Missing



Box Elder County

Earthquake Fault Zone

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. Fault zones derived from "Quaternary Tectonics of Utah" (Hecker, Utah Geological Survey Bulletin 127, 1993)

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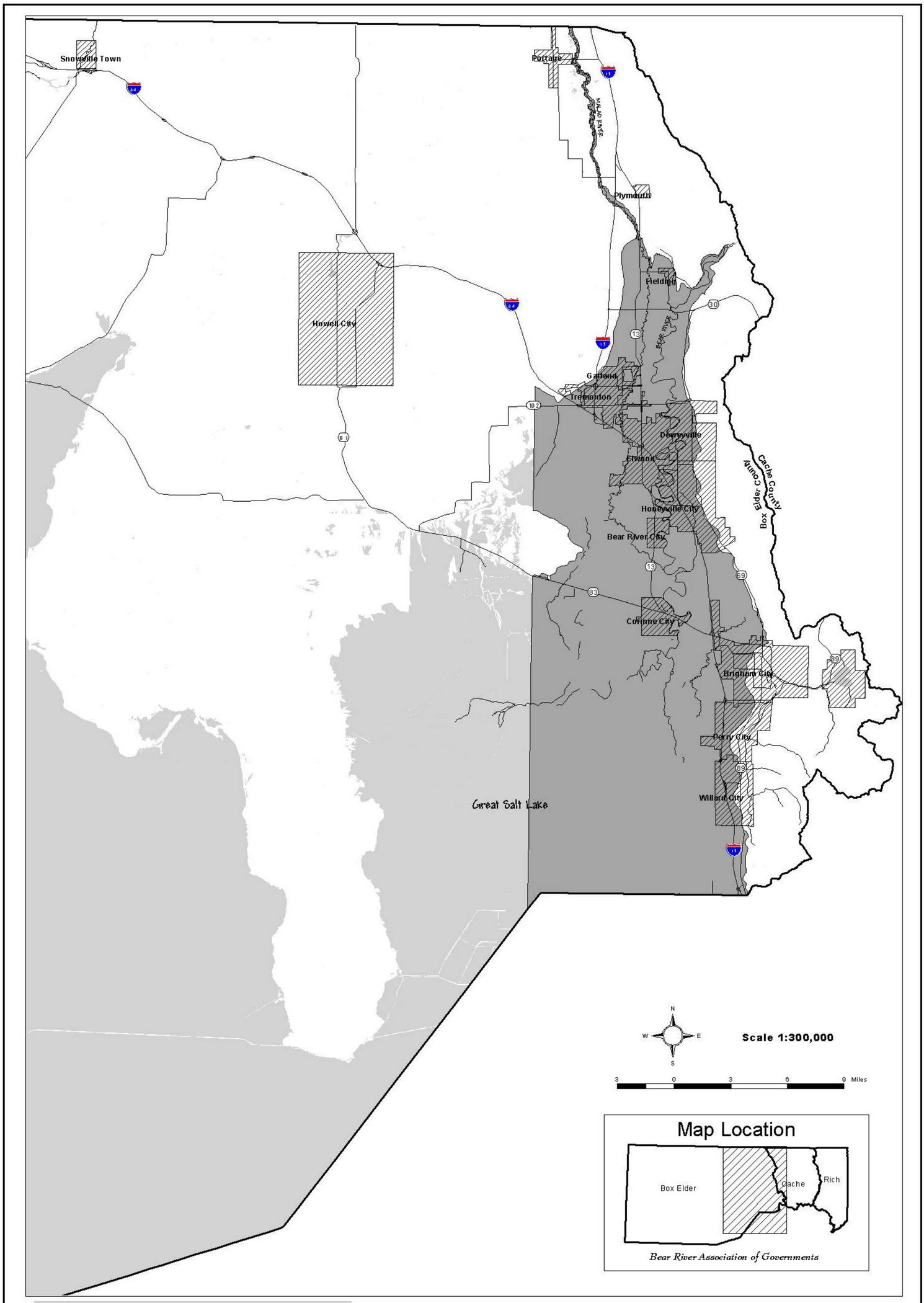
Roads
Rivers
Lakes
100' Fault Zone
Municipalities
Box Elder County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Box Elder County

Liquifaction Potential

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census.

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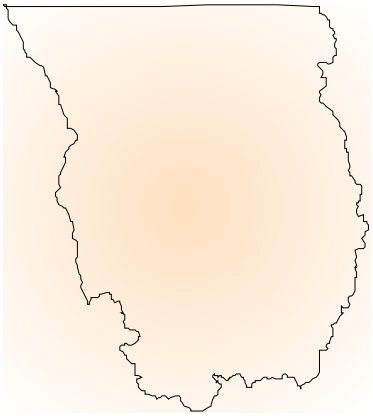
Roads		High Liquifaction	
Rivers		Municipalities	
Lakes		Box Elder County	

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

PART IV-CACHE COUNTY ANNEX RISK ASSESSMENT



General Background Information

Cache County is located in extreme Northern Utah and is bordered by Box Elder County to the west and Rich County on the east. The County, covering roughly 1,165 square miles of land, is nestled between the Bear River Mountain's to the east and the divide of the Wellsville Mountains on the west. Cache Valley, a fertile agricultural area characterized by hundreds of farms and dairies, extends to the foothills of these ranges.

Cache County gained its name from the fur trading days when trappers such as Jim Bridger and Eteinne Post trapped beaver along the Bear and Logan Rivers and "cached" their pelts in large holes that they dug throughout the area. Settlement of the area began around 1855 when Brigham Young sent Mormon families to establish settlements in the valley. Since the wild grass was ideal for grazing, twenty-three men and two women were sent to Cache Valley to begin a cattle ranch on the Blacksmith Fork River. It was named Elkhorn Ranch after the antler hanging over the main gate. The plans were for 3,000 cattle to remain in the valley during the summer, and then winter further south in warmer climates. Unfortunately, the winter snows fell early that year. In a desperate attempt to save the cattle from the cold, the ranchers drove them to Box Elder County in a raging blizzard. The snow drifts were four feet deep in the valley and even deeper in the mountains. One of the rancher's feet froze and only 420 cattle survived. Within two years these ranchers left Cache Valley.

The early settlers of Elkhorn Ranch and the later Maughan's Fort weren't the first people to live in Cache Valley. Shoshoni Indians hunted and fished in "Willow Valley," as it was first called for the great willow trees that lined the stream and river banks.

In the early 1900's the fertile soil in Cache Valley attracted further settlement and soon transformed the valley into a major agricultural center for farming and ranching. Today, agriculture is still a viable part of Cache County's economy as evidenced by numerous farms, ranches, and dairy operations along with cheese factories and beef and pork processing plants. Utah State University located in Logan City has long been a significant part of the valley's economy and continues to grow as a major research university and area employer. Recent economic development includes several light manufacturing firms that have increased employment opportunities and a growing tourism industry which takes advantage of the County's countless scenic and outdoor recreation opportunities. (See the “Population Density and “Land Ownership” map in the map section of the county annex)

Table IV-28: Cache County Participating PDM Jurisdictions			
Cache County	Amalga Town	Clarkston Town	Cornish Town
Hyde Park City	Hyrum City	Lewiston City	Logan City
Mendon City	Millville City	Newton Town	Nibley City
North Logan City	Paradise Town	Providence City	Richmond City
River Heights City	Smithfield City	Trenton Town	Wellsville City

CACHE COUNTY FLOODING

Background

Portions of Cache County are at threat from both riverine and flash flooding. The Cache Valley (the western part of Cache County where nearly all the county's population is located) is located in the Bear River Drainage basin. The Bear River flows through the valley. The two main tributaries of the Bear River located in Cache County are the Logan and Blacksmith Fork Rivers. The Logan River is the largest tributary of the Bear. Other tributaries of the Bear that generally enter the valley through canyons of the mountainous eastern part of the county are the Summit Creek, Little Bear, Spring Creek Cherry Creek, High Creek and the Cub River All of these steams and rivers, to some degree, have had some history of flooding.

Phase II of the National Pollutant Discharge Elimination System (NPDES) administered by EPA has requirements for communities to more carefully manage their storm water discharge. While driven more by water quality concerns, nonetheless this provides an important opportunity for communities to better manage their storm water systems. This is critically important because for many communities an ever increasing threat to residents comes from the potential for man-made canal failure flooding. As more development has occurred, existing irrigation canals have been increasingly relied on to accommodate storm water discharge. Irrigation officials are quick to point out that the canals were never designed for such use. Most canals have lower capacities and a narrowing channel the further you go down the canal. While this design makes sense for irrigation use, it is exactly the opposite of how you would design a canal to accommodate storm water discharge. The positions of many canals in Cache County also make them susceptible to blockage by debris or ice that can result in canal failure outflows. Cache County has had a couple of near misses in this regard.

In terms of potential damage to developed residential, commercial and industrial areas, the Logan & Blacksmith Fork Rivers poses the most significant threat for residents of Cache County. Both of these rivers drain large areas and have steep well defined stream channels. Flood level flows are produced when high temperatures occur during the early spring and accelerate the watershed snowmelt rate. Often this threat can be escalated when combined with early spring rains.

A number of dams are located on the Logan River in the canyon upstream of the City of Logan. Due to their relatively small size, they do little to moderate flood potential for downstream development.

The Bear River enters Cache County on the north near Preston Idaho. Winding through the valley it eventually enters the Cutler Reservoir. The risk from rising flood waters of the Bear River through Cache County is relatively minor. Land located in the Bear River flood plain has a high water table which makes development difficult. Most of adjacent land near the Bear is used for agricultural purposes. Farmers and ranchers have seemingly adapted their agricultural activities to mitigate the cyclical high flows effects of the Bear River. Much of the adjacent agricultural uses along the Bear are operated under lease agreements with Pacificorp who owns

most of Cutler Reservoir. **See the "FEMA Flood Zone" Map in the county annex map section.**

History of Flooding in Cache County

In terms of historical flooding impact on development, most events have been documented on streams and rivers that drain the mountainous eastern portion of Cache County and flow into western Cache Valley. Most of the significant flooding that has historically impacted developed land has occurred on the Logan and Blacksmith Fork Rivers. However, noteworthy flooding has occurred on some of the smaller streams and creeks that enter the valley near the towns of Providence, Smithfield and Richmond.

Table IV-29: Cache County Flood History 1847-2003

Location	Date	Description
Amalga	1980	No information available
Clarkston	1917	No information available
	Aug 1958	Crop damage, road damage
	Aug 1961	Crop & road damage, flooded homes
	1980, 1981	No information available
Hyde Park City	1993	Lower Canal failure, home flooded and property damage.
Logan	1882	No information available
	May 1907	Logan River flooding, basements of homes near river flooded. Most flooding in Logan's recorded history.
	May 1957	Agricultural flooding in lower fields
	May 1958	Crop and road damage
	July 1962	Crop damage
	Sept 1963	Road damage
	June 1964	Crop damage, 2 inches rain in 24 hours
	1969	No information available
	1971	Low lying farms flooded, stream banks eroded, basements flooded.
	1972, 1976	No information available
	1977	Dry Canyon Flooding
	1978, 1980, 1981	No information available
	Spring 1983	Several bridges destroyed, undercutting of embankments, Canyon Road Landslide, culverts and roads.
	Aug 1997	Dry Canyon flash flooding
	1998	Flooding on the Blacksmith Fork River backed up Spring Creek and property damage occurred.
Providence	Aug 1959	Cloudburst flooding of dozens of homes near Spring Creek.

Table IV-29: Cache County Flood History 1847-2003		
Location	Date	Description
Smithfield	June 1964	A number of homes flooded by Summit Creek after intense storm
FEMA Flood insurance study for Logan City, 2-17-81, Local Surveys (see appendix A) (Butler & Marsell, 1972), (Division of Comprehensive Emergency Management, 1981)		

Cache County Flood Hazard Assessment
Hazard Profile

Frequency	Some flooding occurs nearly every year in Cache County
Severity	Moderate
Location	Generally along rivers, streams and canals.
Seasonal Pattern	Spring flooding as a result of snowmelt. Mid-late summer cloudburst events.
Duration	A few hours or up to three weeks for snowmelt flooding
Speed of Onset	1-6 hours
Probability of Future Occurrences	High-for delineated flood plains there is a 1% chance of flooding in any given year.

Isolated flooding has been fairly common for many years. Damage from flooding has been relatively minor. The majority of flooding in Cache County has occurred on agricultural land.

Following a development pattern not unlike many Utah and western communities, many early European settlements in Cache County were located near the mouths of canyons. Early settlers located there for easy access to water that could be diverted for irrigation of crops and pastures as well as fertile soils well suited for agriculture. Richmond, Smithfield, Logan, Providence Millville and Hyrum are all located near the mouths of canyons that drain some portion of the adjacent Bear River Range. The Logan River has the largest drainage basin next to the Bear at 524 square miles. The Blacksmith Fork drainage basin is the next largest at roughly 287 square miles.

Analysis of areas of Cache County mapped by FEMA for communities that participate in the NFIP indicate some conflict related to existing development located in what has been determined to be the 100 year floodplain. Digitized floodplain maps for Cache County were overlaid on a layer of Digital Ortho Aerial Photographs as well as a 1996 data layer that delineates "developed" areas (Water Related Land use Study produced for the State of Utah Division of Water Resources). An August 2003 report Flood Hazard Identification Study: Bear River Association of Governments by the U.S. Army Corps of Engineers was also used to determine flood risk for communities that do not have FEMA Firm flood plain maps.

Hyde Park City has a number of existing homes located in the 100 year flood plain along the stream that drains Hyde Park Canyon. In addition, development near the Logan North field and Hyde Park Canals is at potential risk of flooding. The recently completed Cache County Storm Water Analysis report concluded that these canals through Hyde Park have deficient capacity to

carry predicted flows resulting from a 10 year storm event of 3 hour duration. The problem areas predicted by this model were where the canal intersects 200 South, Center Street and 300 North in Hyde Park City (JUB Engineering, 2003).

In terms of the relative hazard from flooding, older residential development along the Logan River in the lower portions of **Logan City** commonly referred to as the "Island" area represents one of the most significant threat in Cache County both in terms of potential loss of risk and property loss. A number of older homes are located in the 100 year floodplain of the Logan River. In addition a number of newer (post 1970) homes have been constructed near the river in the flood plain (along Sumac and Thrushwood Drives).

A number of homes in the Country Manor Subdivision along the Blacksmith Fork River are located in the 100 year floodplain. The Logan City Golf Course is also located in the 100 year floodplain. The golf course can accommodate flooding and flood water storage device and is designed to moderate flooding downstream.

A number of canals make their way through Logan City. Potential for failure is significant for all canals. If storm water management is not properly addressed, the risk to life and property near canals increases as more development puts further demands on systems beyond their designed capabilities. According to a canal company representative, the Northwest Field/Benson Canal experiences difficulty accommodating demand with any storm event that totals ½ inch of precipitation in one hour. The canal has a permitted flow rate of 40.3 cfs and a calculated capacity of 60 cfs. The canal has potential to pick up 363 cfs in predicted storm water flows when measured near the airport (City of Logan, 2001).

In May 1996 the Logan and Northern Canal failed above Crockett Avenue pump house. City officials were forced to divert flows down Crockett Avenue into the Logan River to prevent damage to adjacent residences (City of Logan, 2001).

A large portion of lower **Mendon Town** is mapped in the 100 year flood plain. Small streams that drain a portion of the eastern slope of the Wellsville Mountains flow through Mendon. Two steep drainages converge from Bird Canyon and Coldwater Canyon.

Perhaps a larger issue that poses a more acute flooding threat for Mendon inhabitants comes from the town's proximity to the Wellsville-Mendon Canal. Mendon is located on the lower stretches of the canal that begins at Hyrum Dam. The canal runs North-South uphill of Mendon Town. Site specific flood problems have occurred with this canal. Overtopping and bank erosion occurred in 1982. Flooding problems occurred when heavy rain fell on frozen ground.

The Lower Millville Providence Canal was demonstrated to have deficient capacities to accommodate a 10 year, 3 hour duration storm event as if flows though **Millville City** when it was modeled for the Cache County Storm Water Analysis report. Channel capacity was found to be deficient at 50 North, 150 North, 400 North and 2200 South in Millville City.

Likewise the Lower Millville Providence Canal produces similar issues as it flows though **Providence City**. The model suggest that capacity deficiency exist as the canal nears 500 South, 400 South, 200 South, 100 South and 100 North (JUB Engineering, 2003).

Residential development in **Smithfield City** along Summit Creek is also threatened by significant flooding along Summit Creek according to mapping (See Cache County Flood Plain Map). However, in post settlement history the impacts to Smithfield residence have been minimal from Summit Creek. During the 1983 flooding that impacted nearly the whole state; Smithfield did experience some rising flow in Summit Creek that were contained by sandbagging.

The Logan Northern Canal flows through much of Smithfield City. Although minimal property damage has occurred, the canal has some sections that have been problematic and vulnerable to bank overflow. Most of the problems are associated with debris accumulation and/or storm surge water levels. Problem areas include areas around 4th South and about 4th East, 1st South to Center Street and 50th East, 3rd to 4th North and 50th West. During the 1983 floods, a large debris flow almost reached the Logan, Hyde Park and Smithfield Canal. Had the canal be blocked significant flooding would have occurred.

The Cache County Storm Water Analysis Report concluded that the Logan, Hyde Park & Smithfield Canal as it passes though Smithfield City is deficient in capacity to accommodate a 10 year storm event of 3 hour duration. The report modeled such a storm event and analyzed drainage capacity of the canal. Potential problem areas were identified where the canal intersects 600 South, 400 South, 200 South, and 200 North in Smithfield (overtopping near 200 North would cause minor damage because it would flow onto the Smithfield Golf Course). Further the Logan Northern Canal was found deficient as it intersects 300 South, 200 East and Center Street in Smithfield City (JUB Engineering, 2003).

Lower portions of **Richmond City** are located in the 100 year flood plain. The flood threat comes from City Creek, a small tributary that drains a portion of the rather steep mountains to the east of Richmond City. Even though a large portion of the city is identified as in the 100 year flood plain, historically no significant flooding has occurred on City Creek. A large portion of the stream flow can be diverted into an irrigation canal above Richmond City. This may act to moderate the impacts of high stream flows.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-30: Cache County Flooding Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk	
		Units	Value	Units	Income*/Structures**
Amalga Town	Incomplete data-No flood plain map				
Clarkston Town	23	9	$836,787		
Cornish Town	Incomplete data-No flood plain map				
Hyde Park City	31	7	$1,044,463		
Logan City	160	54	$8,091,198	10	$47,800/$5,057

Table IV-30: Cache County Flooding Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk**	
		Units	**Value**	**Units**	**Income*/Structures****
Mendon City	75	22	$3,831,634	1	$1,900/$505
North Logan City	23	8	$1,151,007		
Providence City	7	4	$473,631		
Richmond City	104	34	$4,077,484		
River Heights City	Incomplete data-No flood plain map				
Smithfield City	590	150	$22,060,742	13	$10,300/$6,574
Trenton Town	Incomplete data-No flood plain map				
Wellsville City	100	30	$4,076,888	3	$2,300/$1,517
Unincorporated	913	277	$38,662,627	11	$5,900/$5,563

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.
No data was available to analyze the extent and magnitude of potential canal flooding

Table IV-31: Cache County Flooding Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Amalga Town		.1 miles\$310,000		
Clarkston Town		.2miles\$620,000		
Hyde Park City		.3miles\$930,000		
Lewiston City		.8miles\$2,480,000		.05miles/$12,056
Logan City		1.5miles\$4,650,000		.19miles/$45,815
Mendon City		1.1miles\$3,410,000		
Millville City		.1miles\$310,000		
North Logan City		.5miles\$1,550,000		
Richmond City		.9miles\$2,790,000		.05miles/$12,056
River Heights City				
Smithfield City		3.6miles\$11,160,000		.13miles/$31,347
Wellsville City	Willow Valley Middle	2.1miles\$6,510,000		.09miles/$21,702
Unincorporated		26 miles two lane roads/$82,150,000 .3 miles 4 lane highway/$1,650,000		.93miles/$224,255

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

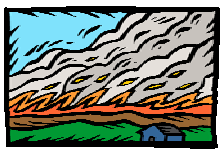
Assessing Vulnerability: Analyzing Development Trends

Many of the municipalities in Cache County do not have adequate ordinances or regulations in place to restrict development in flood prone areas. Development pressure in flood prone areas intensifies as more development occurs and new development is pushed to marginal areas. This is especially true with the cities in the Logan Urbanized Area.

Development is occurring near the numerous irrigation canals. This is to be expected. Canals cut though most communities and are difficult if not impossible to avoid. This is not necessarily a problem. Properly designed and utilized canals are not a flood risk necessarily. The problem is they were designed to transport irrigation water; not storm water. As development occurs in the sub basins near canals, the dramatically increased runoff generated by the added impervious surface area has to go somewhere. A great deal of this urban runoff ends up in the canals.

Existing storm water management systems in many cities rely on these canals to accommodate storm water flows. Many of these canal systems are at capacity for storms of near normal precipitation. Higher than normal storms will put demands on the canal systems that they cannot accommodate. Some problems have already occurred and many more are likely to happen if jurisdictions do not get a handle on alternative methods of storm water management. The most reasonable approach is to require all new development to accommodate its own storm water on-site.

In many circumstances the communities that are at risk from overtopping canals are not necessarily the ones creating the problem. Often canals will flow through one or more communities. It’s generally the one farthest downstream that sees the problem. The upstream communities may be the ones generating the most stormwater outflows into the canal but it’s the ones at the end of the system that is more likely to get flooded. The solution must include regional cooperation.



CACHE COUNTY WILDFIRES

Background

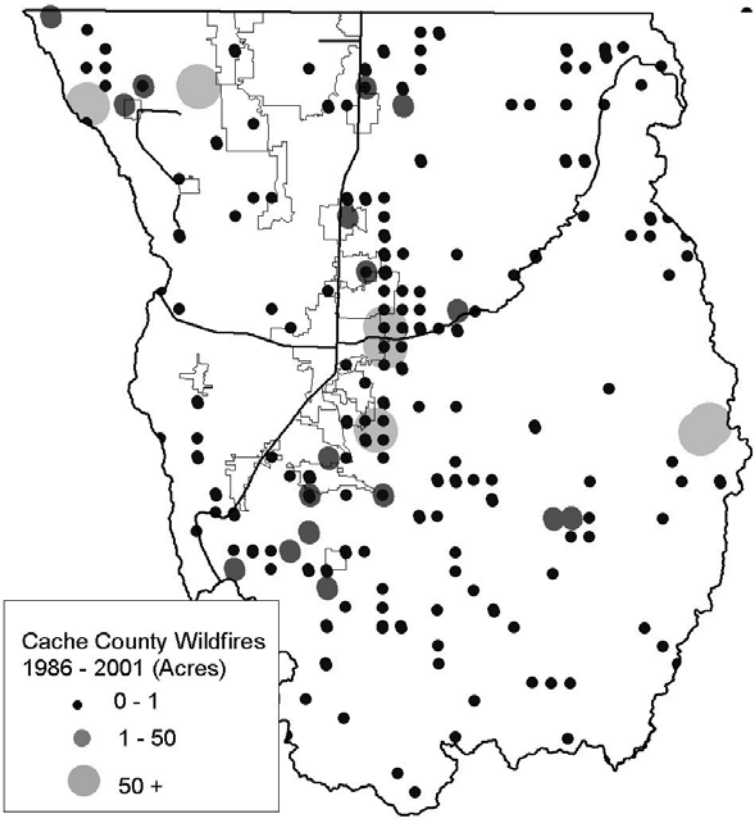
Wildfire has always had an impact on Cache County inhabitants. A few years ago many Logan City residents watched as wildfire crept down the hillside east of the city. Luckily little property damage resulted. To a certain extent, living with wildfires will always be a part living in Cache County.

Many of the communities in Cache County are located along the base of the Bear River Mountains in Cache Valley. Paradise, Millville, Providence, River Heights Logan, North Logan, Hyde Park City and Richmond all have urban interface or potential urban interface with wildfire high risk areas. Wellsville and Mendon on the east side of the valley have potential wildfire-urban conflict for development along the base of the Wellsville Mountains. **See the "Wildfire Hazard" Map in the county annex map section.**

In addition a number of cabins are located on private in-holdings or long term leases in the Cache National Forest.

History of Wildfires in Cache County

The following graphic illustrates the number and rough locations of wild fires in Cache County in the 15 year period from 1986 to 2001.



Cache County Wildfire Hazard Assessment
Hazard Profile

Frequency	Annually (to some extent)
Severity	Severe
Location	Mostly along the Bear River Mountains east of Cache Valley or the Wellsville Mountains west of Cache Valley.
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-12 hours
Probability of Future Occurrences	High (Based on data from 1986-2001, there is a 24% chance a fire of at least 1000 acres will occur every year)

Logan City is the most urbanized community in the district. Largely "built-out", a significant amount of recent development has occurred on the eastern side of the city. Much of this development is characterized as upscale and many homes are located on the urban-wild land interface. Electrical power lines for Logan City located on the eastern margin can start wild land fires due to electrical shorts.

In **Unincorporated Cache County**, the Scare Canyon and Hardware Park developments in South East Cache County have about 120 cabins and a large number of developable lots. About 38 cabins are located in Logan Canyon along U.S. 89 many in the Birch Glen area.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-32: Cache County Wildfire Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Logan City	172	50	$9,582,954	3	$2,500/$1,517
Millville City	217	53	$7,823,708	10	$7,000/$5,057
Providence City	15	5	$111,586		
Unincorporated	340 329	95 103 cabins	$13,871,710 $12,360,000		

Population and Residential Development estimates are derived using 2000 Census data
*2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Table IV-33: Cache County Wildfires Other Facilities at Risk

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
North Logan City			0.4miles/$19,177	
Unincorporated			1.9miles/$91,75	.93miles/$224,256

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

Assessing Vulnerability: Analyzing Development Trends

The areas that expose development to the most risk from wildfires are often the most desirable places to live. These places afford residents good views, access to public lands, open space and a connection with nature. Most jurisdictions have found it difficult to restrict, limit or modify development proposals for these areas.

The population of Cache County by 2050 is projected to nearly double. For communities to accommodate roughly 100,000 new residents, development pressures will certainly increase in fire prone areas. Increased encroachment on the wild land margins of communities will undoubtedly occur. It has already occurred in Logan City. North Logan and to some extent Hyde Park are beginning to trend this way as well.

CACHE COUNTY LANDSLIDES

Background

Landslide occurrences are common for portions of Cache County. The most frequent problems are associated with debris flows on alluvial fans in many of the canyon drainages. **See the "Landslide Potential" Map in the county annex map section.**

History of Landslides in Cache County

Table IV-34: Cache County Landslide Areas	
Active Landslides (in Acres)	Historically Active Landslides 1847 to present (in Acres)
160	97,731

During the wet years of 1982 & 1983 an abnormally high numbers of landslides occurred in Cache County. A rather large land mass slid into the Porcupine Reservoir upstream of the right abutment. A slide near Nibley Road east of Hyrum occurred in the back yard of a residential home. A slide on College Hill below Utah State University blocked the Logan and Northern Irrigation Canal causing some limited flooding. The road up Millville Canyon was displaced 4 feet by a slide. A debris flow from Dry Creek above Smithfield reached the Logan, Hyde Park and Smithfield Canal (south of 300 South).

Cache County Landslide Hazard Assessment
Hazard Profile

Frequency	Periodic
Severity	Moderate
Location	Generally located in areas with steeper slopes. Debris flows mostly occur at the mouth of canyon drainages.
Seasonal Pattern	Generally the worst in the wetter spring months.
Duration	Up to two weeks
Speed of Onset	No warning
Probability of Future Occurrences	High

Debris flows present a significant threat for development located in the mouths of the many steep canyons located in Cache County. The dynamics of this threat changes depending on the upslope drainage conditions. Wildfire that removes sediment stabilizing vegetation can dramatically increase the risk of debris flows. The other indirect threat comes from canal flooding caused by debris flow blockage.

Accurate spatial data is lacking that defines the extent of the debris flow threat in canyon areas. However areas of concern include the historic alluvial fans of Logan Canyon, Logan Dry Canyon (has been mitigated by a recently constructed debris basin), Green Canyon, Millville Canyon, Providence Canyon, Blacksmith Fork Canyon, Smithfield and Cherry Creek Canyons.

Some portions of the lower "Island" area in Logan are located near active landslide areas. Landslides on these Lake Bonneville sediments are fairly common.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-35: Cache County Landslide Risk Residential and Commercial (Active Landslides Only)

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Logan City	100	33	$5,464,538		
Unincorporated	3	1	$75,693		

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.
Data does not include areas susceptible to debris flows (no data available)

Table IV-36: Cache County Landslides Other Facilities at Risk (Active Landslides Only)

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Logan City		.3 miles/$930,000		

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

Table IV-37: Cache County Landslide Risk Residential and Commercial (Active & Historically Active Landslides)

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Hyrum City	47	10	$1,223,044		
Logan City	3,775	1,207	$125,675,961	9	$47,300/$4,551
Providence City	50	15	$3,174,217		
Unincorporated	286	75	$13,806,238	24	$20,200/$12,137

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.
Data does not include areas susceptible to debris flows (no data available)

Table IV-38: Cache County Landslides Other Facilities at Risk (Active & Historically Active Landslides)				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Hyrum City		1.2miles/$3,720,000		
Logan City		16.9miles/$52,390,000		
Millville City		0.1miles/$310,000		
North Logan City			0.1miles/$4,793	
Providence City		0.7miles/$2,170,000		
Trenton Town		0.2miles/$620,000		
Unincorporated		7.1miles/$2,201,000	0.1miles 345Kv line/$4,821 1.7miles 138Kv line/$81,488	.92miles./$221,844
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.** Data does not include areas susceptible to debris flows (no data available)				

Assessing Vulnerability: Analyzing Development Trends

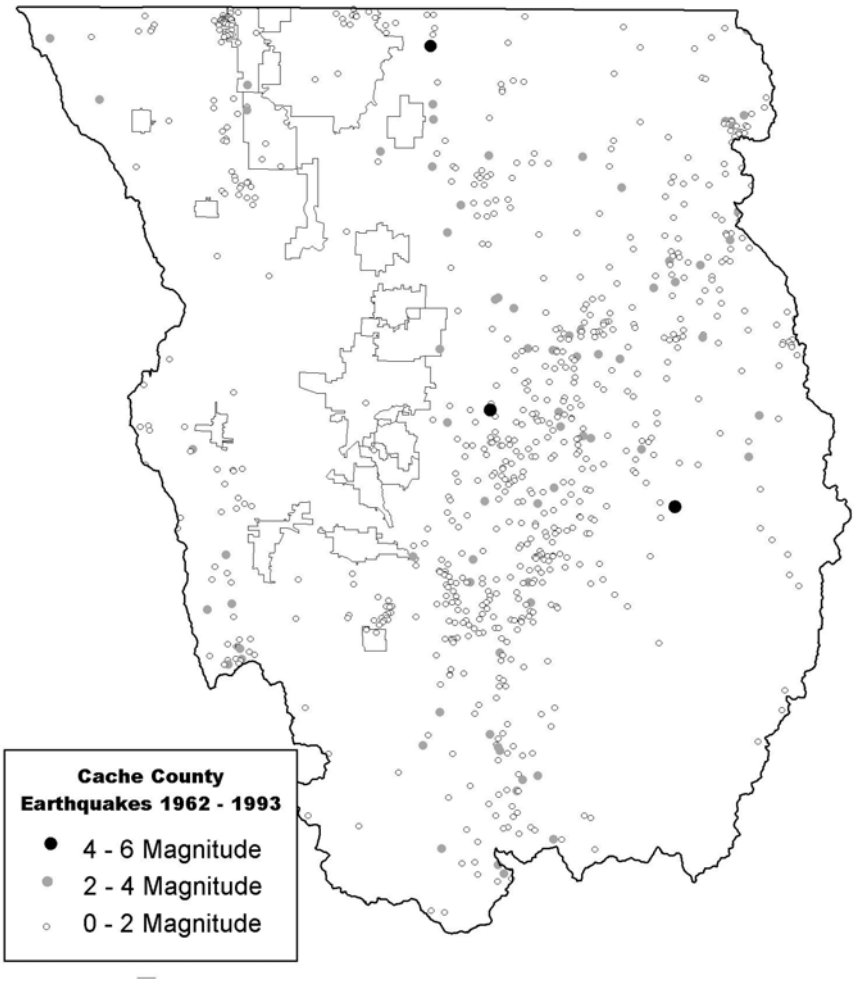
Increasing development occurring in the mouths of canyons along the Bear River Range should be of critical concern to local land use officials. Logan Canyon and Dry Canyon already have significant development. Increasing development pressure will be on Green Canyon above rapidly growing North Logan and to a lesser extent Providence and Millville Canyons.

CACHE COUNTY EARTHQUAKES

Background

Cache County is located in a seismically active region within the Intermountain Seismic Belt. The most damaging earthquake in Utah's post European settlement history occurred in near Richmond City in Cache County. In 1962 a M_L 5.7 earthquake occurred near Richmond that damaged nearly three-fourths of the homes in the town. Damage to homes and building occurred in many surrounding areas of Cache Valley (Christenson, 1992). Some geologic evidence suggest that an earthquake of magnitude seven plus has occurred in the recent geologic past on the west cache fault zone. **See the "Earthquake Fault Zone" and "Liquefaction Potential" Map in the county annex map section.**

History of Earthquakes in Cache County



Cache County Earthquake Hazard Assessment
Hazard Profile

Frequency	Low magnitude events occur frequently. Larger magnitude events are rare (although not necessarily on geologic scale).
Severity	Potentially Catastrophic
Location	Entire County with highest frequency in the Bear River Mountain Range. Surface fault ruptures are likely to occur in fault zones and liquefaction would impact large portions of the county.
Seasonal Pattern	None
Duration	A few minutes with potential aftershocks
Speed of Onset	No warning
Probability of Future Occurrences	Based on 1962-1993 data, there is a 29% chance every year of an earthquake of 3.0 magnitude or greater.

Three important fault zones have influence on Cache County. The East Cache Fault bounding the eastern portion of Cache Valley, the West Cache Fault bounding the western valley and the nearby Wasatch Fault. The majority of Cache County's population is located near the Eastern Cache Fault. Evidence points to the Temple Fork Fault as the most active in Cache County. Although miles away from the epicenter, this fault it thought to be associated with the 1962 Richmond Earthquake.

Areas in **Nibley**, western **Millville** and **Providence** and **River Heights** and southern **Logan City** have been identified with high liquefaction potential (see Cache County Liquefaction Map). In addition, much of the Bear River meander corridor has high liquefaction potential in the event of a Cache Valley earthquake (mostly un-developable river-bottom land).

Exposed risk to fault surface rupture exists in parts of upper Logan City, Millville, North Logan and Smithfield (See Cache County Fault Map).

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-39: Cache County Earthquake Risk (Liquefaction) Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Amalga Town	71	19	$2,404,998		
Logan City	6,905	2,553	$254,471,823	162	$765,500/$81,929
Nibley City	995	295	$42,194,645	6	$8,600/$3,034
Providence City	81	19	$1,997,362	9	$9,400/$4,551
River Heights City	59	26	$3,873,180	17	$21,300/$8,597
Trenton Town	5	3	$270,264		
Wellsville City	199	69	$9,682,994		
Unincorporated	936	333	$26,161,146	18	$221,600/$9,103

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)

Table IV-39: Cache County Earthquake Risk (Liquefaction) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor's Office) **Note: Communities not listed have no residential or commercial property identified in the hazard.**					

Table IV-40: Cache County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Amalga Town		3.3miles/$10,230,000	.198miles/$9,491	
Cornish Town		0.8miles/$2,480,000		.31miles/$74,752
Lewiston City		2.4miles/$7,440,000		1.87miles/$540,922
Logan City	Logan So. Campus, Riverside & Wilson School,	1.7miles of highway/$9,350,000 2708miles of 2 lane road/$86,180,000		
Millville City		1.9miles/$5,890,000		.68miles/$163,972
Nibley City	Nibley School	6.5miles/$20,150,000		.88miles/$212,199
Providence City		1.5miles/$4,340,000		
Trenton Town		1.1miles/$3,410,000		
Wellsville City		4.7miles/&14,570,000		.48miles/$115,745
Unincorporated		1.6miles of highway/$8,800,000 30.8 miles of 2 lane road/$95,480,000	.98miles/$46,975	1.22miles/$294,185
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Table IV-41: Cache County Earthquake Risk (Fault Zone) Residential and Commercial					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Logan City	43	18	$3,046,896		
North Logan City	27	6	$1,277,345		
Smithfield City	68	18	$2,634,398		
Trenton Town	9	3	$358,414		
Unincorporated	554	15	$2,578,287		
Population and Residential Development estimates are derived using 2000 Census data *****2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor's Office) **Note: Communities not listed have no residential or commercial property identified in the hazard.**					

Table IV-42: Cache County Earthquakes (Fault Zone) Other Facilities at Risk				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
North Logan City			0.1miles/$4,793	
Trenton Town				.17miles/$40,993
Unincorporated			0.1miles 345Kv line/$4,821 1.7miles 138Kv line/$81,488	.31miles/$74,752
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Note: A 2001 study titled "Seismic-Hazard Mapping of the Central Cache Valley, Utah-A Digital Pilot Project" by McCalpin and Solomon provide next generation analysis and mapping of earthquake hazard mapping for the Newton, Smithfield, Wellsville and Logan 7.5-minute USGS quadrangles. The information contained in this report is certainly considered more accurate and the delineations more defensible; however for consistency this information was not used in the hazard analysis of this plan.

Cache County HAZUS Analysis

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates can be used by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The results of the model ran for Cache County simulates a 2,500 year event with a earthquake magnitude of 7.0.

Table IV-43: Cache County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)					
Timing	Sector	Level 1	Level 2	Level 3	Level 4
2 A.M	Commercial	6	2	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	4	1	0	0
	Industrial	10	3	0	1
	Residential	199	50	6	12
	Single Family	386	96	13	25
	Total	605	152	20	39
2 P.M.	Commercial	372	111	18	36
	Commuting	0	0	0	0
	Educational	206	61	10	20
	Hotels	1	0	0	0

Table IV-43: Cache County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)					
Timing	Sector	Level 1	Level 2	Level 3	Level 4
	Industrial	74	22	4	7
	Residential	11	2	0	0
	Single Family	59	15	2	4
	Total	723	212	35	68
5 P.M.	Commercial	337	100	17	32
	Commuting	0	0	0	0
	Educational	58	17	3	6
	Hotels	1	0	0	0
	Industrial	46	14	2	4
	Residential	76	19	2	5
	Single Family	152	38	5	10
	Total	670	188	30	57

Severity Level 1: Injuries will require medical attention buy hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization buy are not considered life-threatening.
Severity Level 3: Injuries will require hospitalization and can become life threatening in not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

Table IV-44: Cache County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses	Wage	0	1.46	25.12	1.24	1.42	29.24
	Capital-Related	0	.62	22.29	.75	.55	24.21
	Rental	16.79	17.43	12.73	.69	.69	48.32
	Relocation	1.55	.38	.58	.05	.20	2.76
	Subtotal	18.33	19.88	60.72	2.72	2.86	104.52
Capital Stock Loses	Structural	83.89	22.53	36.91	8.25	6.19	157.76
	Non-structural	294.13	109.22	98.06	27.94	20.95	550.29
	Content	70.51	22.50	43.39	17.87	10.22	164.50
	Inventory	0	0	1.44	2.57	.17	4.18
	Subtotal	448.52	154.26	179.80	56.64	37.52	876.74
	Total	466.86	174.14	240.52	59.36	40.39	981.26

Table IV-45: Cache County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
Highway	Segments	1,052	0
	Bridges	27	4
	Subtotal	1079	4
Railways	Segments	79	0
	Bridges	0	0

Table IV-45: Cache County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
	Subtotal	79	0
Airport	Facilities	5	2
	Runways	91	0
	Subtotal	96	2
	Total		

Table IV-46: Cache County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)				
Classification	Total	Least Moderate Damage > 50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	1	0	0	1
Schools	32	4	0	0
Police Stations	4	0	0	0
Fire Stations	7	0	0	0
On the day of the earthquake the model estimates that only 100% of the hospital beds in the county would be available for patient use.				

Table IV-47: Cache County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		**Slight**		**Moderate**		**Extensive**		**Complete**	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	0	.01	0	.01	1	.01	0	.01	0	.02
Commercial	24	.69	42	.59	89	1	69	3	40	3
Education	1	.02	1	.01	2	.03	2	.07	1	.05
Government	0	.01	1	.01	1	.02	1	.04	1	.05
Industrial	4	.11	6	.08	14	.18	12	.45	7	.58
Religion	0	.01	1	.01	1	.02	1	.04	0	.04
Residential	279	8	624	9	899	12	602	23	291	25
Single Family	3,127	91	6,441	90	6,664	87	1,898	73	817	70
Total	3,435		7,116		7,672		2,585		1,158	

Assessing Vulnerability: Analyzing Development Trends

Development in Logan and North Logan has already encroached on areas that are susceptible to surface fault rupture on the Cache East Fault. Development pressure will increase for these towns as well as Providence, Millville and Richmond to build higher on the hillside and potentially build on active fault lines.

Some of the southwestern areas of Logan City have seen recent high growth. Much of this area has been identified as having high liquefaction potential in the event of a 5 plus earthquake.

Proposed annexation plans encompassing portions of the unincorporated College-Young Ward area also have identified problems with soils prone to liquefaction.

CACHE COUNTY DAM FAILURE

Background

There are 225 regulated dams located in Cache County. Most of these dams are small detention ponds, small agricultural reservoirs or livestock watering facilities and most pose a minimal threat to human safety or property.

Of the 225 regulated dams 215 are designated as “low hazard” by the State of Utah Division of Water Rights. As defined by state statue, low hazard dams are those dams which, if they fail, would cause minimal threat to human life, and economic losses would be minor or limited to damage sustained by the owner of the structure.

A total of 5 dams have been designated as “moderate hazard” by the State of Utah in Cache County. Moderate Hazard dams which, if they fail, have a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities.

The State of Utah has rated 5 dams in Cache County as “high hazard” which means that, if they fail, have a high probability of causing loss of human life or extensive economic loss, including damage to critical public utilities.

Dam failure inundation maps and emergency action plans for each of the high risk dams can be found on the Utah Division of Water Right’s website at: http://waterrights.utah.gov/cgi-bin/damview.exe?Startup.

History of Dam Failure in Cache County

No significant dam failures have occurred in Cache County.

Cache County Dam Failure Hazard Assessment
Hazard Profile

Frequency	Rare
Severity	Potentially Catastrophic
Location	Areas down stream of failed dam.
Seasonal Pattern	Anytime. Highest risk in spring during snowmelt.
Duration	A few hours
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Cutler Dam
Cutler Dam and reservoir lie in extreme western Cache County and about four miles east northeast of Fielding in Box Elder County. This facility has a hazard rating of high. The inundation area follows the Bear River flood plain first southwesterly and then south past Deweyville, Elwood, Honeyville, Bear River City and finally Corrine City before ending at the Great Salt Lake. Since the inundation area remains, for the most part, within the flood plain, threats the population and homes appears to be minimum.

Hyrum Dam
Hyrum Dam and Reservoir are located directly south of Hyrum City on the Little Bear River. The dam is rated as a high hazard facility and the inundation area flows westerly towards Wellsville five miles away, and then into Cutler Marsh.

Logan First Dam
This facility located near the mouth of Logan Canyon has a high hazard rating. The inundation area consists of most of the Island area, much of the landscape around the Logan River Golf Course and County Fairgrounds, and continuing west towards Cutler Reservoir. There is a significant population as well as large numbers of homes and businesses within the inundation area.

Porcupine Dam
Porcupine Dam is located about eight miles upriver from the town of Paradise on the east fork of the Little Bear River. The dam has a high hazard rating. There is no inundation map associated with this dam. This dam was recently drained and some reinforcement work performed.

Newton Dam
Newton dam was constructed by the Bureau of Reclamation on Clarkston Creek three miles north of the town of Newton. This facility has a high hazard rating. There is no inundation map associated with this dam.

Assessing Vulnerability: Analyzing Development Trends

Any new downstream development that is located in the floodplain increases the exposure to risk in terms of human life and property. Given the relatively low probability of catastrophic dam failures, most jurisdictions are unwilling to regulate development in dam failure inundation areas.

CACHE COUNTY HAZARD MITIGATION STRATIGIES

Hazard Mitigation Goals

The following goals were identified to direct the county's hazard mitigation strategies. These general goals were identified and developed based on the local official surveys (See appendix A), input from the Bear River District PDM Technical Planning Team and Steering Committee.

Goal # 1: Minimize potential impacts for future development

- **Develop, refine and improve the hazard data available to local level decision makers.**
- **As appropriate, develop and implement regulatory mechanisms to insure new development activities will not increase the risk to life or property.**
- **Build technical capacity for local elected and appointed officials.**
- **Empower citizens to make informed choices.**

Goal # 2: Minimize potential impacts for existing development

- **Improve emergency disaster response capabilities.**
- **Improve the disaster resistance of existing infrastructure and critical facilities.**
- **Educate and build capacity of citizens to undertake mitigation activities.**

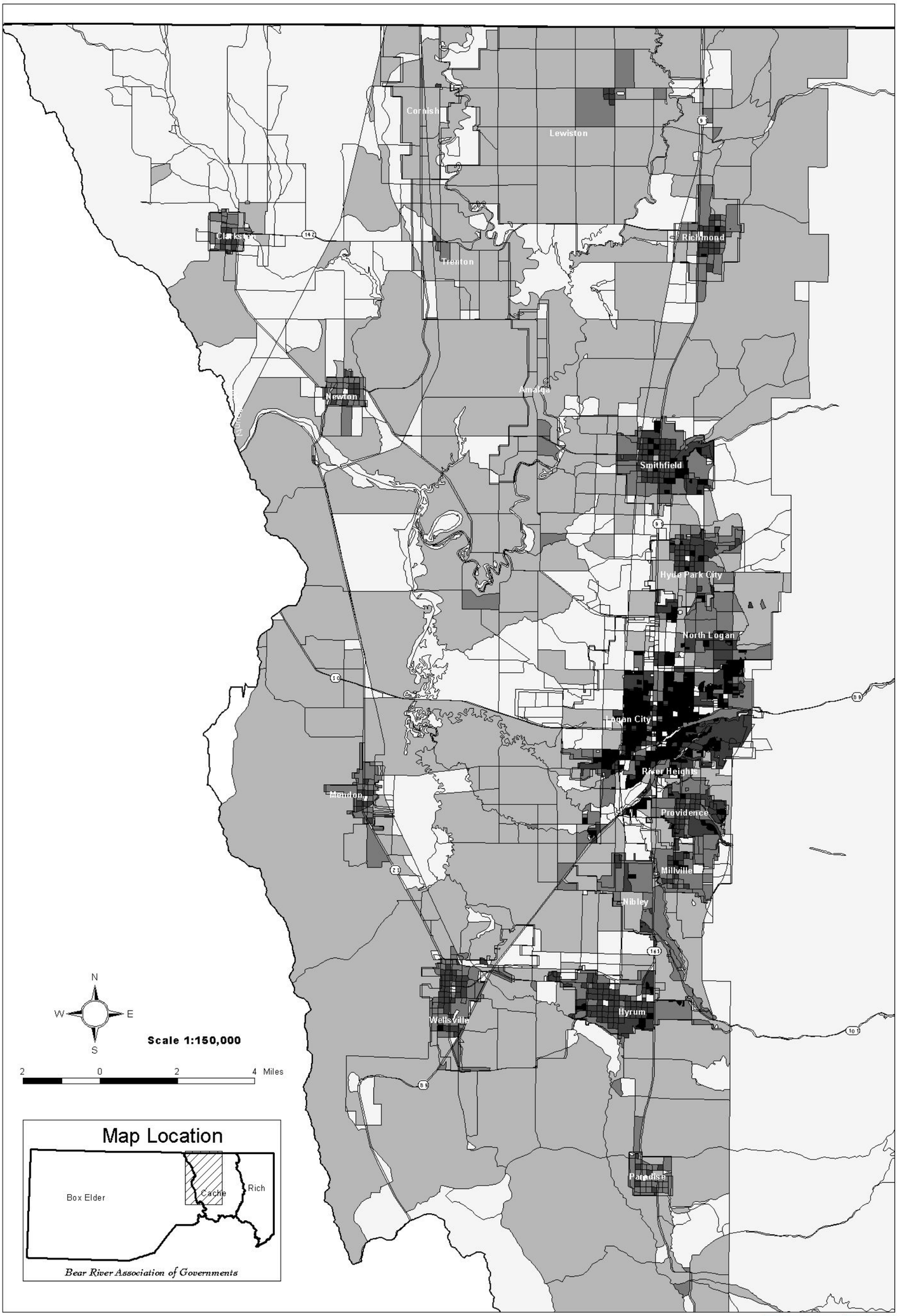
To accomplish these goals specific mitigation strategies were developed by participating jurisdictions. These goals were given assigned a priority of high, medium, or low by Bear River District PDM Technical Planning Team and Steering Committee. Priorities were give taking into account the following factors:

- Number of people protected by the project
- Technical feasibility
- Political support
- Environmental impacts
- Available funding source

A guiding factor in prioritizing mitigation was the though that mitigation should provide the greatest amount of good to the greatest amount of people when cost was taken into account. Prioritizing mitigation was difficult in this plan as each as Bear River is vulnerable to many different hazards. Each with its own characteristics. Thus, recurrence intervals, past events, damage estimates compiled during the assessing vulnerability section of this plan were also taken into account.

CACHE COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
Multi-Hazard	**Goal 2**	**All Jurisdiction**	**Prepare for Severe Weather Events**	**Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)**	**Medium**	**2006**		**Minimal**	**NOAA**
Multi-Hazard	**Goal 1 & 2**	**All Jurisdictions**	**Make critical infrastructure disaster resistant.**	**Provide for a redundant source of electrical power in Cache Valley.**	**High**	**2007**	**Pacificorp, Local, Logan City, Hyrum City**	**YTD**	**Cache Chamber of Commerce, UDESHS**
Flooding	**Goal 1 & 2**	**Unincorporated County, Nibley City**	**Reduce the threat of flooding from the Blacksmith Fork River**	**Dredge and widen the river channel, and build up river bank at 5200 South on the parallel to Hollow Road.**	**High**	**2006**	**Local, FEMA**	**$4,500**	
Flooding	**Goal 1 & 2**	**Amalga, Nibley, Paradise, Trenton**	**Mitigate impacts related to flooding.**	**Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.**	**High**	**2005**		**Minimal**	**UDESHS, ACOE**
Flooding	**Goal 1 & 2**	**Jurisdictions with identified flood hazards**	**Make better informed decisions.**	**Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.**	**Medium**	**2009**	**FEMA, UDESHS, Local**	**$2,500 to $65,000 each**	**Consultants, FEMA, UDESHS, Public Works**
Flooding	**Goal 1 & 2**	**All Jurisdictions with Canals**	**Minimize flood risk from canal failure or overtopping**	**For those that have not already been studied, analyze and model the canals to determine deficiencies related to present and future demands (taking into account projected storm water increases based on projected development).**	**Medium**	**2007**	**Local, FEMA**	**$95,000**	**Consultants**
Flooding	**Goal 1 & 2**	**All Jurisdictions**	**Minimize flood risk from storm water runoff.**	**Work toward requiring all new development to accommodate its own storm water discharge on-site. Develop ordinances and standards that require new development be designed to do on-site storm water retention.**	**Medium**	**2005**	**Local Funds, EPA, FEMA**	**$7,000 per jurisdiction**	**BRAG, EPA, Utah Association of Conservation Districts, FEMA, UDESHS**
Flooding	**Goal 2**	**Logan City**	**Improve Logan City's flood management capability.**	**Dredge 1st, 2nd & 3rd Dams. Mud and silt has built up over the years causing the settlement area to shrink.**	**Medium**	**2005**	**Local Funds, FEMA**	**Approx $120,000 per dam**	
Wildfire	**Goal 2**	**Paradise, Hyrum, Wellsville, Millville, Providence, Logan, North Logan, Hyde Park, Smithfield, Mendon and Richmond**	**Become "Firewise" communities.**	**Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).**	**High**	**2007**		**Minimal**	**BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.**
Earthquake and Landslide	**Goal 1 & 2**	**All Jurisdictions**	**Make better informed decisions.**	**Obtain better earthquake information for local level decision makers. This work has been done for the Newton, Wellsville, Logan and Smithfield 7.5 USGS quads. Complete similar work for the Clarkston, Richmond, Trenton and Paradise 7.5 minute quads. .**	**Medium**	**2008**	**Utah Geologic Survey, Local**	**$45,000**	**Utah Geologic Survey, BRAG**
Earthquake and Landslide	**Goal 1**	**All Jurisdictions**	**Avoid placing new development at risk from geologic hazards.**	**Develop land use ordinances that require site specific geo-hazard studies be performed prior to development permitting in areas determined to be high risk related to earthquakes (especially for critical or high-occupancy buildings).**	**High**	**2006**		**Minimal**	**Utah Geologic Survey, BRAG, Utah League of Cities and Towns.**

PART IV-CACHE COUNTY ANNEX HAZARD MAPPING



Cache County

Population Density

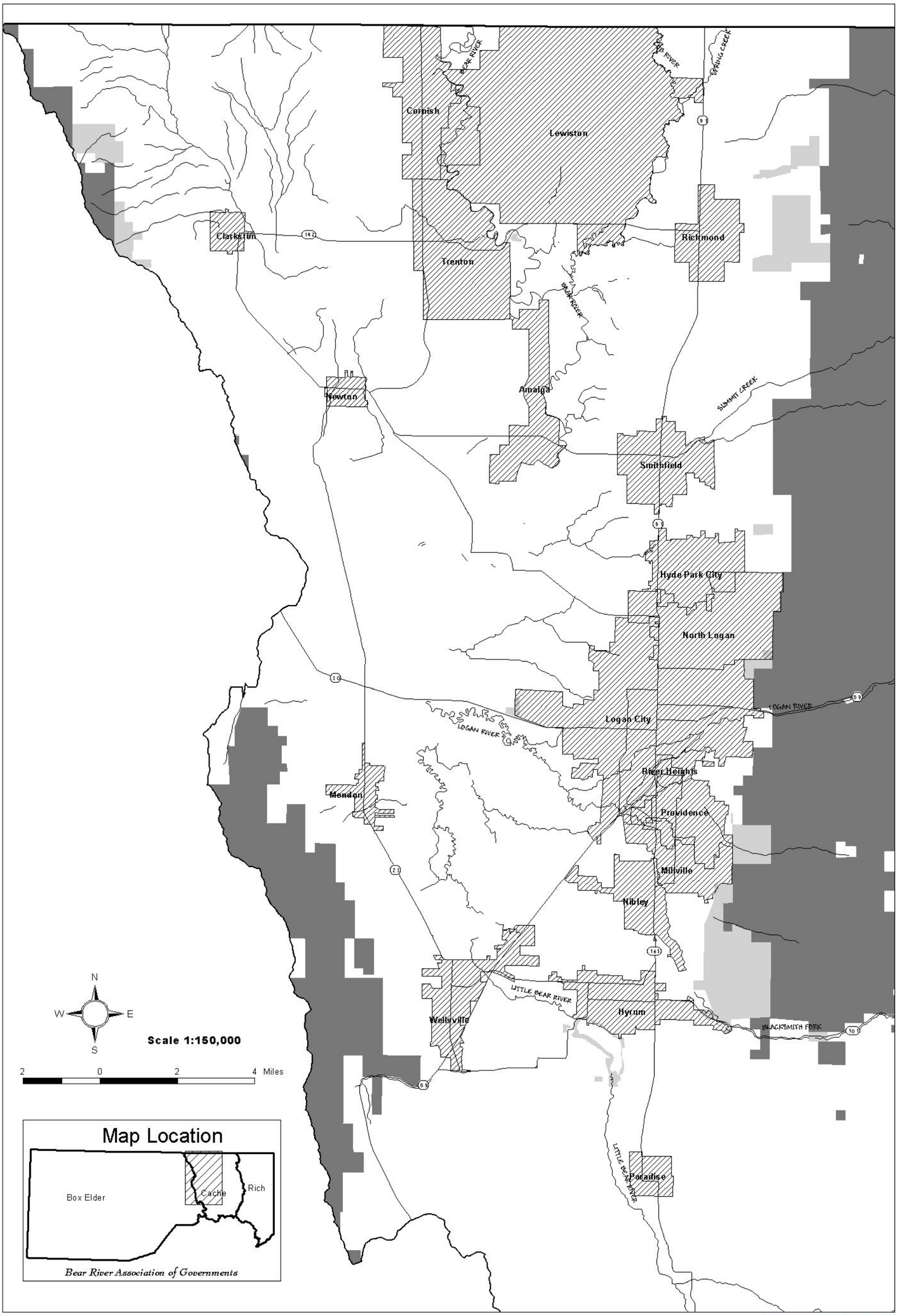
Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries and population density from US Census.

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads
Rivers
Cache County

Population Density (Persons per acre)
- 0
- 0 - 0.3
- 0.301 - 2
- 2.001 - 6
- 6.001 - 1000

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Cache County
Land Ownership

Data Source: Municipalities, ownership, roads, rivers and lakes maintained by Utah AGRC. County Boundries from U.S. Bureau of the Census.

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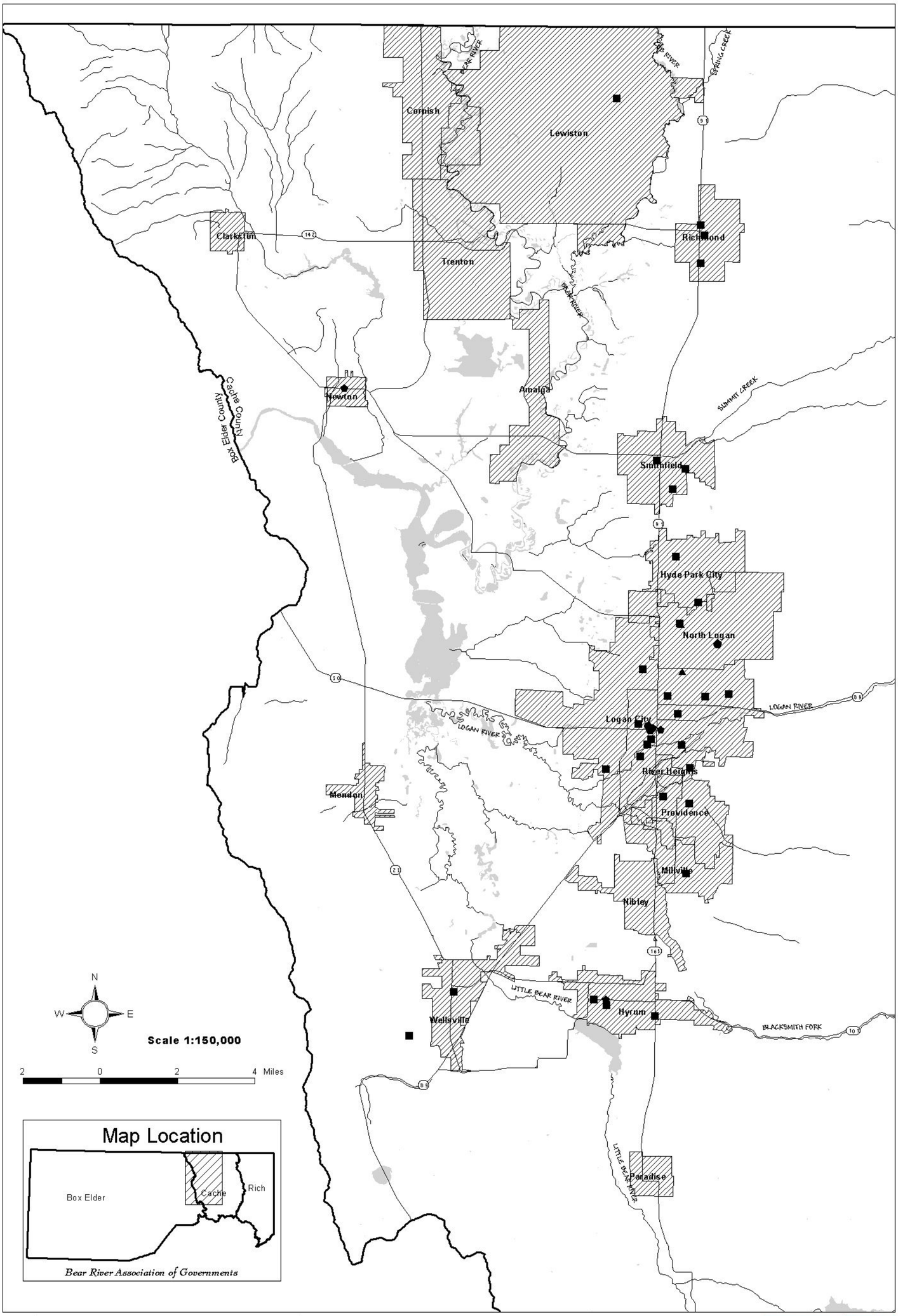
Roads
Rivers
Cache County
Municipalities

Land Ownership
Private
State Lands
Federal Lands
Sovereign Lands

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Cache County

Critical Facilities

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census.

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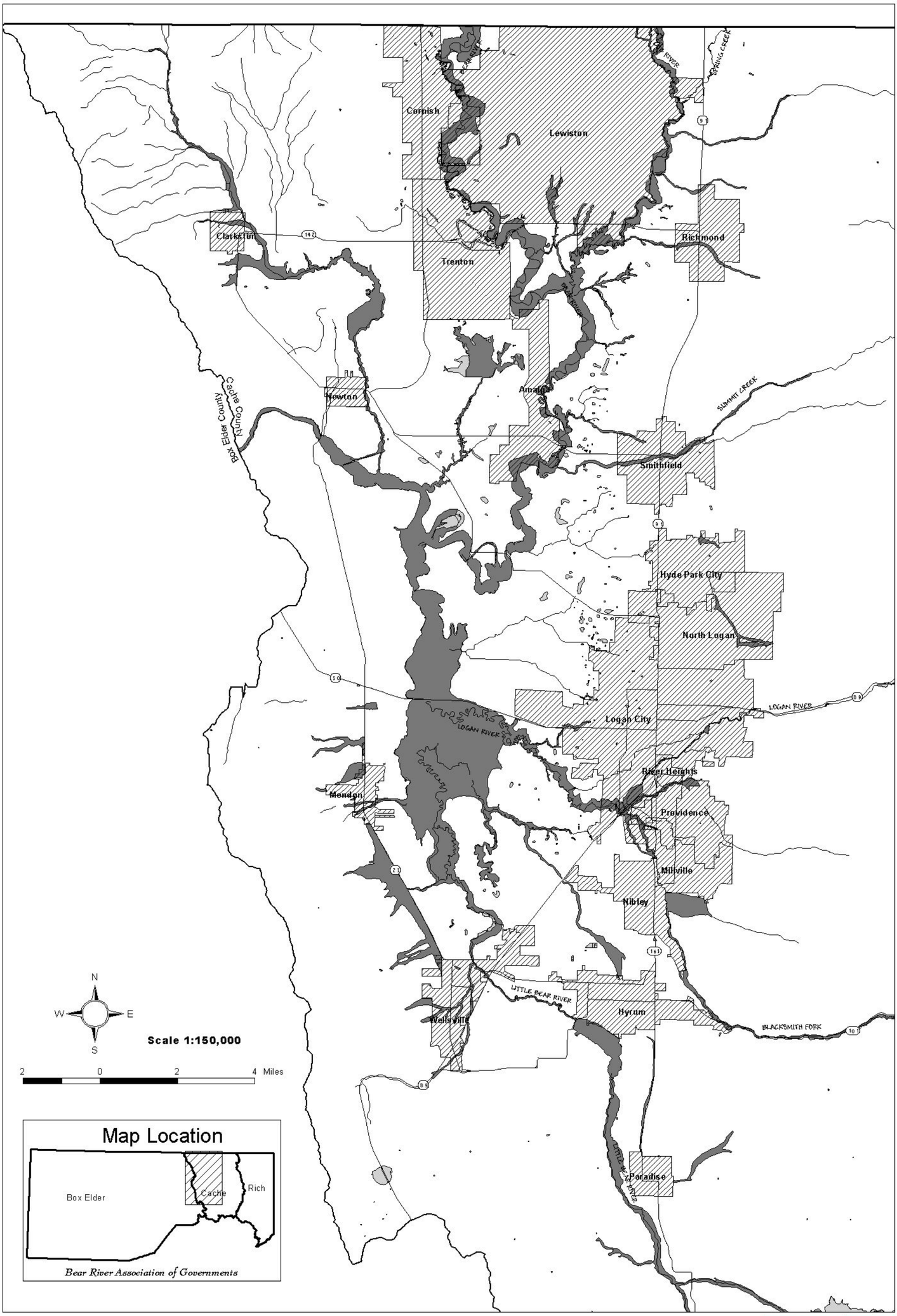
Roads
Rivers
Lakes
Municipalities
Police Station
School
Hospital
Fire Station
Cache County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Cache County

FEMA Flood Zone

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. FEMA flood zone digitized from paper FIRM maps.

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Roads
Rivers
Lakes
FEMA Flood Zone
Municipalities
Cache County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

Cache County

Wildfire Hazard

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. Fire classes from BLM Fire Hazard Analysis.

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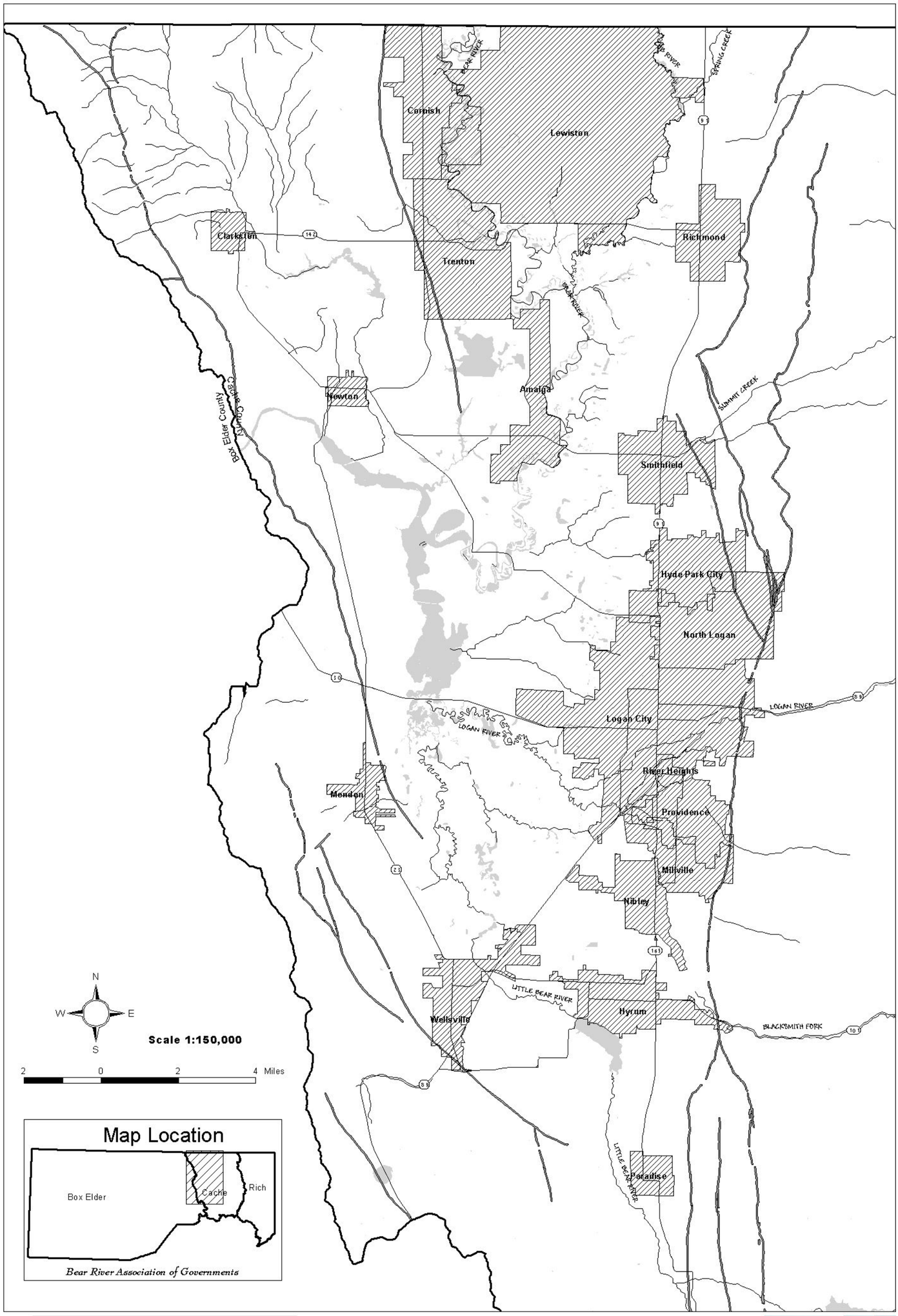
Roads
Rivers
Lakes
Municipalities
Moderate Fire Hazard
High and Extreme Fire Hazard
Cache County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

Landslide Missing



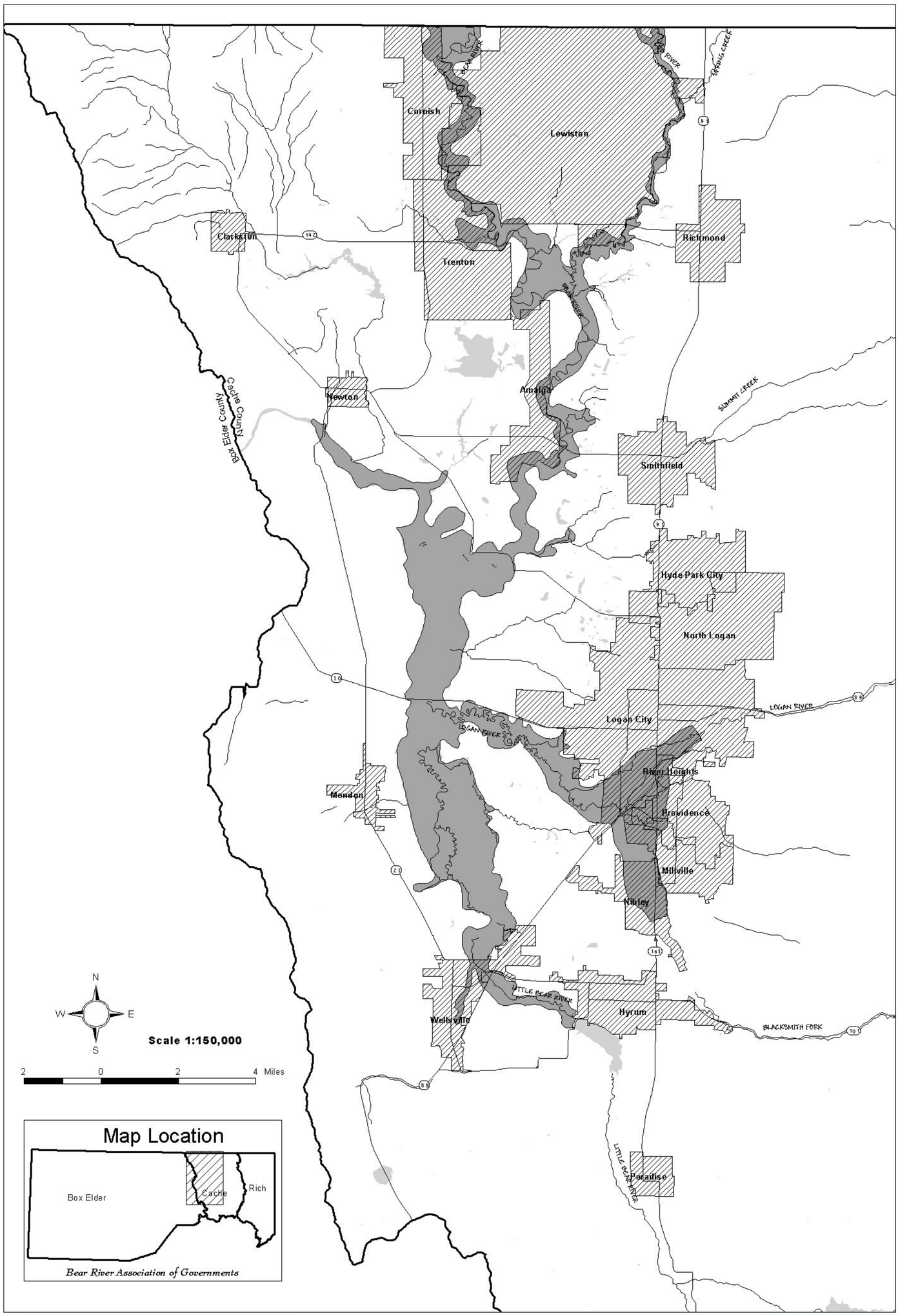
Cache County
Earthquake Fault Zone

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. Fault zones derived from "Quaternary Tectonics of Utah" (Hecker, Utah Geological Survey Bulletin 127, 1993)

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warrenties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads
Rivers
Lakes
100' Fault Zone
Municipalities
Cache County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Cache County
Liquifaction Potential

Roads
Rivers
Lakes
High Liquifaction
Municipalities
Cache County

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census.

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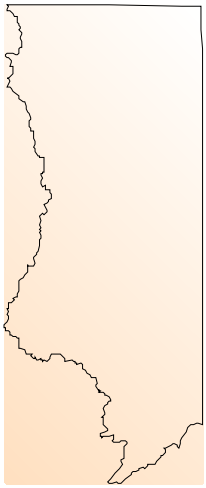
BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

PART IV-RICH COUNTY ANNEX RISK ASSESSMENT



GENERAL BACKGROUND INFORMATION

Rich County, located in the northeast corner of Utah occupies a land area of 1,034 square miles, extending from Wyoming on the east and Idaho on the north, with the southern portion of the Bear Lake extending into the County.

In 1863, members of the Church of Jesus Christ of Latter-day Saints (Mormons), under the leadership of Apostle Charles C. Rich, settled the northern portion of Bear Lake Valley in what is now Bear Lake County, Idaho. A year later, settlers began establishing themselves in the southern part of the valley in the vicinity of present day Meadowville, Utah (an unincorporated area), and at several other locations in Round Valley. The move into the southern Bear Lake Valley brought the settlers into conflict with Chief Washakie and his band of Shoshoni, who had historically used the area as an annual gathering place. Ongoing conflicts with these Native Americans continued until 1872 at which time Washakie and his people relocated to the Wind River reservation in Wyoming. Mormon settlers then freely expanded their settlements from Bear Lake Valley into neighboring Bear River Valley, establishing the site of Randolph in 1870, and Woodruff in 1871. In 1872 the federal government completed its survey of the area and established the exact location of the forty-second parallel, separating Idaho and Utah. After 1872 the Rich County seat was moved from Paris, (Idaho) to Randolph, Utah.

Rich County is comprised of two separate geographical regions: Bear Lake Valley and Bear River Valley. Nearly forty miles separate the communities of Woodruff and Garden City. The geographic isolation of the two valleys and the difficulty of travel between communities in each, resulted in the somewhat separate development of each. Randolph and Woodruff developed more similarities with the Wyoming communities within Bear River Valley than they did with the Bear Lake communities of Garden City and Laketown. Laketown and Garden City, had more in common with the Idaho communities of the Bear Lake Valley.

Most of Rich County is highland, but is well known for its lowlands which support productive farms and livestock. Of its 659,840 square miles, less than one acre in ten is devoted to crop production. Grazing on the other hand occupies one half of the County's acreage. Livestock and livestock products account for eighty percent of the County's income. There are also about 243 farms in Rich County which average 2,162 acres in size. Wild hay, alfalfa, barley and oats are the principle farm crops. Garden City, located within the County is known for its raspberries, with a raspberry festival held every August attracting hundreds of tourists throughout the region.

Rich County is also known for its recreation spots including the Wasatch National Forest, Bear Lake State Park, and Rendezvous Beach State Park. Bear Lake, once called the Sea of Silence, invites vacationers of all types to its beaches. In the summer, water skiing, sailing, swimming, fishing, and camping are popular activities, and in the winter months, snowmobiling, tubing, and ice fishing are popular.

Rich County has none of the industrial, educational or cultural assets of Box Elder or Cache Counties. Bear Lake has carried this sparsely populated county's economy for some time. This economic picture is rounded out by a number of cattle ranches and agricultural farms which make up the other half of the picture. Generally speaking, this area survives based on its service

community associated with summer and winter recreational seasons. A definite lack of diversity in its economy has led Rich County to a relatively flat growth rate, which in recent years has actually been negative. The recreational potential is still strong and the recreation needs of increasing numbers of Wasatch Front residents and Cache Valley residents will provide increased demand for the recreational assets found in Rich County. The County is also subject to dramatic seasonal population shifts due to "Snow birds", and an under-utilized winter season. (See the “Population Density and “Land Ownership” map in the map section of the county annex).

Table IV-48: Rich County Participating PDM Jurisdictions			
Rich County	Garden City	Laketown	Woodruff

RICH COUNTY FLOODING

Background

The flood risk for Rich County is minimal. The county is sparsely populated and the communities are generally not located near a flood source. The Bear River passes through Rich County in an area with some agricultural use. It flows primarily through rural areas with little or no development.

All of the four incorporated cities in Rich County have small streams that pass through the communities. These communities have historically experienced minimal impacts from flooding.

The southern half of Bear Lake is located in Rich County. A great deal of beach front development has occurred along the shores of Bear Lake. The rising lake level has rarely threatened lakeshore development but some flood of homes has occurred. Pacificorp operates a hydroelectric facility on the lake and has purchased some of the flood prone lakeshore properties to mitigate the impact of high lake level flooding.

History of Flooding in Rich County

Table IV-49: Rich County Flood History 1847-2003		
Location	Date	Description
Randolph	1955	Flooding caused the closure of the Highway.
	Spring 1983	Damage to roads, culverts & bridges. Some homes flooded and crop damage.
Woodruff	Spring 1983	Damage to roads, culverts & bridges. Some homes flooded and crop damage.
Local Surveys (see appendix A) (Butler & Marsell, 1972), (Division of Comprehensive Emergency Management, 1981)		

Rich County Flood Hazard Assessment
Hazard Profile

Frequency	Infrequent
Severity	Moderate
Location	Generally along rivers, streams and canals.
Seasonal Pattern	Spring flooding as a result of snowmelt. Mid-late summer cloudburst events.
Duration	A few hours or up to three weeks for snowmelt flooding
Speed of Onset	1-6 hours
Probability of Future Occurrences	Moderate-for delineated flood plains there is a 1% chance of flooding in any given year.

In Rich County, only Woodruff Town has a delineated flood plain.
An August 2003 report Flood Hazard Identification Study: Bear River Association of Governments by the U.S. Army Corps of Engineers was used to determine flood risk for communities that do not have FEMA Firm flood plain maps (See Appendix B for full report).

In **Unincorporated Rich County** what development does exist near the Bear River (isolated farmsteads) has potential flood risk and to some extent development around Bear Lake.

Portions of **Garden City** have some risk of flooding from the Garden City Canyon drainage and to a lesser extent the smaller drainages to the south and north.

Randolph City has some flood threat from the Little Creek drainage. The upstream Little Creek Reservoir may help moderate this risk.

Woodruff City has flood risk from the Genes Creek and Dry Creek drainages.

Assessing Vulnerability: Identifying Assets & Estimating Losses

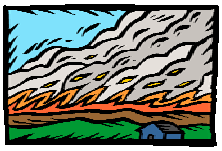
Very minimal property is at risk of flooding in Rich County. Even agricultural impacts are minimal when the Bear River flood because most the adjacent use is grazing land that can adapt to higher flows. With the exception of Woodruff Town, the lack of flood plain data makes it very difficult to pinpoint potential specific impact areas. However, based on local experience the potential impacts are negligible.

Woodruff Town is the only Rich County community that has a flood plain map. Base on GIS overlay analysis, approximately nineteen housing units or fifty persons are located in the 100 year flood plain. It is estimated that $1,425,397 in residential property is at risk.

Assessing Vulnerability: Analyzing Development Trends

Most of the growth in terms of new development is occurring in Garden City and to a lesser extent Laketown. Most of this new development is second home housing associated with the Bear Lake recreation area. A great deal of this development is on the hillsides above Garden City proper. Some risk of flooding is possible as this development encroaches on drainages.

New development on the Lakeshore could also increase the property at risk. However this risk is somewhat minimal.



RICH COUNTY WILDFIRES

Background

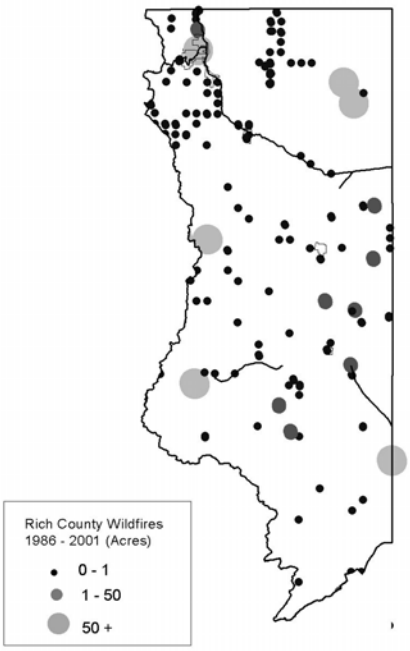
Wildfires occur with some frequency in Rich County. The vast majority occur in areas that are predominately sage and scrub vegetation on BLM owned land. Most fires rarely threaten human safety or property and are often allowed to burn. The primary conflict area in terms of threat to property as it related to wildfire are areas above Garden City town proper, in mostly secondary home developments associated with the Bear Lake Recreation area. Some of these homes are built in heavily timbered areas.

Portions of the Cache National Forest are located in western Rich County. Transitioning down slope from the forest into the Bear Lake Valley and Garden City a significant number of cabins are located in Garden City above the traditional town center. Some of these homes are built in heavy vegetation and timber. Many are surrounded by lower sage type vegetation.

These areas are at risk from wildfire originating in the Forest Service managed land to the west and also human caused fire through or below the development. Much of this development is bisected by U.S 89 as it makes its rather steep decent into Garden City from Cache County. Sparks caused by overheating brakes on heavy trucks have been known to start fires adjacent to the road. In the right conditions, these types of fires can quickly spread to portions of the Bridgerland development and others. **See the "Wildfire Hazard" Map in the county annex map section.**

History of Wildfires in Rich County

The following graphic illustrates the number and rough locations of wild fires in Rich County in the 15 year period from 1986 to 2001.



Rich County Wildfire Hazard Assessment
Hazard Profile

Frequency	Annually (to some extent)
Severity	Moderate
Location	Dispersed throughout the whole county
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-6 hours
Probability of Future Occurrences	High (Based on data from 1986-2001, there is a 24% chance a fire of at least 1000 acres will occur every year)

Located in **Garden City** above the historic town core are a number of mostly secondary homes located in areas at some risk from wildfire. Most of the developed land is characterized by rather steep slopes with limited access and inadequate water supplies. Most homes do not have defensible space around them. Many of these homes are built with flammable building materials and do not adhere to "firewise" construction techniques.

Adequate fire response is a problem for these areas. Garden City maintains an all volunteer fire department. Heavy tanker trucks would only be able to crawl up the steep road grade of U.S. 89 to respond to a fire. Although only a few miles away, response times for some areas can be over 30 minutes in drive time alone.

Representing one of the largest developments, the Bridgerland Village property owners have formed a community fire planning team and developed a community fire plan.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-50: Rich County Wildfire Risk Residential and Commercial

Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Garden City (Bridgerland Village)	331 Mostly Part Time	102 Cabins	$15,500,000		

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.

Assessing Vulnerability: Analyzing Development Trends

The secondary recreational home market is predicted to remain strong for areas around Bear Lake (Garden City & Laketown). New problems will occur as more homes are built in fire prone areas. Many parcels are currently subdivided and for sale in high fire risk areas.

A rather large second home development (100+ lots) is working its way through Rich County planning approval about 12 miles west of Woodruff town on the Monte Cristo road (Hwy 39). It's likely the county will require the provision of fire equipment on-site and trained emergency response personnel.

RICH COUNTY LANDSLIDES

Background

The potential for impacts related to landslides is minimal in Rich County. **See the "Landslide Potential" Map in the county annex map section.**

History of Landslides in Rich County

Table IV-51: Rich County Landslide Areas	
Active Landslides (in Acres)	Historically Active Landslides 1847 to present (in Acres)
0	69,196

The steeper slopes of the Bear River Mountains on the west side of the county as they descend into the Bear Lake Valley have indications of historical landslide activity. Much of this area is where summer cabins are located.

Rich County Landslide Hazard Assessment
Hazard Profile

Frequency	Infrequent
Severity	Moderate
Location	Mainly on Steeper slopes above Garden City in the Bear River Mountains.
Seasonal Pattern	Generally the worst in the wetter spring months.
Duration	Up to two weeks
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-52: Rich County Landslide Risk Residential and Commercial (Active & Historically Active Landslides)					
Jurisdiction Name	**Population**	**Residential Development at Risk**		**Commercial Development at Risk (x 1000)**	
		Units	**Value**	**Units**	**Income*/Structures****
Garden City	51	85	$9,309,625	2	$1,100/$294
Unincorporated	13	54	5,924,444		

Population and Residential Development estimates are derived using 2000 Census data
*****2002 estimated total sales revenue (Census)
** Based on average 2002 assessed commercial building value for Cache County
(2002 State Tax Commission Report & Cache County Assessor's Office)
Note: Communities not listed have no residential or commercial property identified in the hazard.
Data does not include areas susceptible to debris flows (no data available)

Table IV-53: Rich County Landslides Other Facilities at Risk (Active & Historically Active Landslides)				
Jurisdiction Name	**Critical Facilities**	**Roads**	**Power lines**	**Rail Lines**
Garden City		6.1miles/$18,910,000		
Unincorporated		12.2miles/$37,820,000	0.8miles/$38,608	
See Appendix D for data sources and cost factors. **Note: Jurisdictions not listed have no identified facilities at risk.**				

Assessing Vulnerability: Analyzing Development Trends

More construction on the steeper slopes above Garden City and south of Garden City could be problematic.

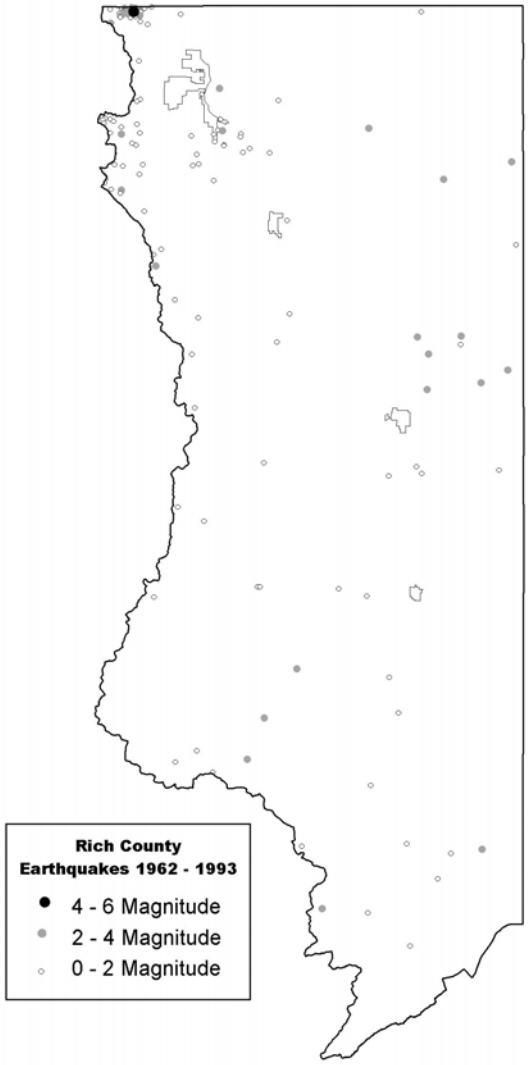
RICH COUNTY EARTHQUAKES

Background

Although not as seismically active as Box Elder and Cache Counties, Rich County does have recorded seismic activity. The predominate and most active faulting is the Bear Lake Fault on the east side of Bear Lake. **See the "Earthquake Fault Zone" Map in the county annex map section.**

History of Earthquakes in Rich County

On November 9, 1884 the Bear Lake Valley experienced an estimated 6.3 magnitude earthquake with the epicenter near Paris, Idaho followed by aftershocks of 2.3 magnitute. The earthquake was felt as far as Ogden.



Rich County Earthquake Hazard Assessment
Hazard Profile

Frequency	Occasional
Severity	Moderate
Location	Entire County with highest frequency in the Bear River Mountain Range. Surface fault ruptures are likely to occur in fault zones on the East Shore of Bear Lake.
Seasonal Pattern	None
Duration	A few minutes with potential aftershocks
Speed of Onset	No warning
Probability of Future Occurrences	Based on 1962-1993 data, there is a 10% chance every year of an earthquake of 3.0 magnitude or greater.

Kalliser indicates that the Bear Lake Fault is active with evidence of large earthquakes in the recent past. He reports a continuous like of scarplets in recent sediments on the east shore of the lake. In addition, the delta fans at the mouth of North and South Eden Canyons are displaced by faulting.

Some faulting has been reported by fathograms in the bottom of Bear Lake.

Assessing Vulnerability: Identifying Assets & Estimating Losses

The analysis did not document any impacts from liquefaction or fault zones to residential or commercial development in Rich County.

Table IV-54: Rich County Earthquakes (Fault Zone) Other Facilities at Risk

Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Laketown		0.2miles/$620,000		
Unincorporated		6.9miles/$21,390,000	0.1/$4,826	

See Appendix D for data sources and cost factors.
Note: Jurisdictions not listed have no identified facilities at risk.

Rich County HAZUS Analysis

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates can be used by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The results of the model ran for Rich County simulates a 2,500 year event with an earthquake magnitude of 7.0.

Table IV-55: Rich County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)					
Timing	Sector	Level 1	Level 2	Level 3	Level 4
2 A.M	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Residential	5	1	0	0
	Single Family	6	1	0	1
	Total	12	2	0	1
2 P.M.	Commercial	4	1	0	0
	Commuting	0	0	0	0
	Educational	3	1	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Residential	1	0	0	0
	Single Family	1	0	0	1
	Total	10	2	0	1
5 P.M.	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	2	0	0	0
	Single Family	2	1	0	1
	Total	9	2	0	1

Severity Level 1: Injuries will require medical attention buy hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization buy are not considered life-threatening.
Severity Level 3: Injuries will require hospitalization and can become life threatening in not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

Table IV-56: Rich County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses	Wage	0	.20	.27	.01	.01	.48
	Capital-Related	0	.08	.24	0	0	.34
	Rental	.90	.61	.16	0	0	1.66
	Relocation	.08	.02	.01	0	0	.11
	Subtotal	.98	.91	.68	.01	.01	2.59
Capital	Structural	4.38	1.57	.46	.06	.07	6.55

Table IV-56: Rich County Building-Related Economic Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Stock Loses	Non-structural	15.38	5.93	1.08	.18	.11	22.69
	Content	3.83	1.07	.48	.10	.07	5.54
	Inventory	0	0	.02	.02	0	.04
	Subtotal	23.59	8.57	2.04	.36	.26	34.82
	Total	24.57	9.48		.37	.27	37.41

Table IV-57: Rich County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
Highway	Segments	398	0
	Bridges	5	0
	Subtotal	403	0
Railways	Segments	0	0
	Bridges	0	0
	Subtotal	0	0
Airport	Facilities	0	0
	Runways	0	0
	Subtotal	0	0
	Total	403	0

Table IV-58: Rich County Transportation System Loss Estimates in $ Millions (HAZUS Model 7.0 Magnitude Earthquake)				
Classification	Total	Least Moderate Damage > 50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	0	0	0	0
Schools	3	0	0	0
Police Stations	2	0	0	0
Fire Stations	3	0	0	0

Table IV-59: Rich County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		**Slight**		**Moderate**		**Extensive**		**Complete**	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	.10	1	.1	1	.2	0	.31
Education	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0

Table IV-59: Rich County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Residential	25	6.3	74	12	181	30	163	62	57	62
Single Family	385	93.7	539	87.9	410	69.9	98	37.8	36	38
Total	410		614		592		261		93	

Assessing Vulnerability: Analyzing Development Trends

New lakeshore development on the east shore will be located near the Bear Lake Fault.

RICH COUNTY DAM FAILURE

Background

There are 525 regulated dams located in Rich County. Most of these dams are small detention ponds, small agricultural reservoirs or livestock watering facilities and most pose a minimal threat to human safety or property.

Of the 525 regulated dams 518 are designated as “low hazard” by the State of Utah Division of Water Rights. As defined by state statue, low hazard dams are those dams which, if they fail, would cause minimal threat to human life, and economic losses would be minor or limited to damage sustained by the owner of the structure.

A total of 5 dams have been designated as “moderate hazard” by the State of Utah in Rich County. Moderate Hazard dams which, if they fail, have a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities.

The State of Utah has rated 2 dams in Rich County as “high hazard” which means that, if they fail, have a high probability of causing loss of human life or extensive economic loss, including damage to critical public utilities.

Dam failure inundation maps and emergency action plans for each of the high risk dams can be found on the Utah Division of Water Right’s website at: http://waterrights.utah.gov/cgi-bin/damview.exe?Startup.

History of Dam Failure in Rich County

No significant dam failures have occurred in Rich County.

Rich County Dam Failure Hazard Assessment
Hazard Profile

Frequency	Rare
Severity	Potentially Catastrophic
Location	Areas down stream of failed dam.
Seasonal Pattern	Anytime. Highest risk in spring during snowmelt.
Duration	A few hours
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Woodruff Creek Dam

The Woodruff Creek Dam is a high hazard rating facility which lies nine miles east and upstream from the town of Woodruff. The inundation area follows Woodruff Creek covering the valley

bottom as it moves downhill. Once out of the canyon, the inundation area widens significantly, covering the entire town of Woodruff before ending at the Bear River.

Assessing Vulnerability: Analyzing Development Trends

Any new downstream development that is located in the floodplain increases the exposure to risk in terms of human life and property. Given the relatively low probability of catastrophic dam failures, most jurisdictions are unwilling to regulate development in dam failure inundation areas.

RICH COUNTY HAZARD MITIGATION STRATIGIES

Hazard Mitigation Goals

The following goals were identified to direct the county's hazard mitigation strategies. These general goals were identified and developed based on the local official surveys (See appendix A), input from the Bear River District PDM Technical Planning Team and Steering Committee.

Goal # 1: Minimize potential impacts for future development

- **Develop, refine and improve the hazard data available to local level decision makers.**
- **As appropriate, develop and implement regulatory mechanisms to insure new development activities will not increase the risk to life or property.**
- **Build technical capacity for local elected and appointed officials.**
- **Empower citizens to make informed choices.**

Goal # 2: Minimize potential impacts for existing development

- **Improve emergency disaster response capabilities.**
- **Improve the disaster resistance of existing infrastructure and critical facilities.**
- **Educate and build capacity of citizens to undertake mitigation activities.**

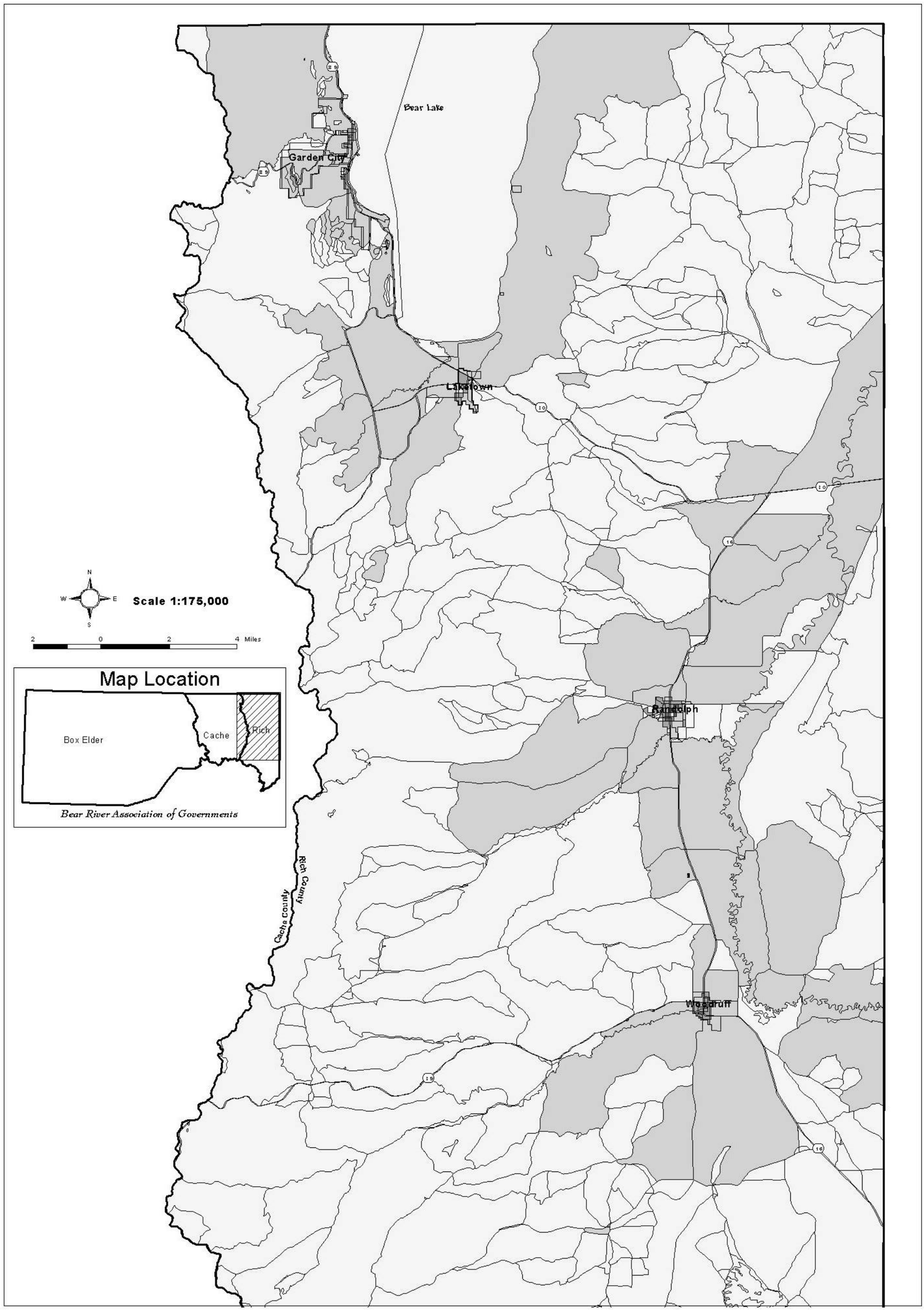
To accomplish these goals specific mitigation strategies were developed by participating jurisdictions. These goals were given assigned a priority of high, medium, or low by Bear River District PDM Technical Planning Team and Steering Committee. Priorities were give taking into account the following factors:

- Number of people protected by the project
- Technical feasibility
- Political support
- Environmental impacts
- Available funding source

A guiding factor in prioritizing mitigation was the though that mitigation should provide the greatest amount of good to the greatest amount of people when cost was taken into account. Prioritizing mitigation was difficult in this plan as each as Bear River is vulnerable to many different hazards. Each with its own characteristics. Thus, recurrence intervals, past events, damage estimates compiled during the assessing vulnerability section of this plan were also taken into account.

RICH COUNTY NATURAL HAZARD MITIGATION PROJECTS Bear River District Pre-Disaster Mitigation Plan 2004									
Hazard	**Goal**	**Jurisdiction(s)**	**Objective**	**Project Description**	**Priority**	**Timeframe**	**Potential Funding**	**Estimated Cost**	**Resources**
Multi-Hazard	**Goal 2**	**All Jurisdiction**	**Prepare for Severe Weather Events**	**Become a National Weather Service "Storm Ready" Community (http://www.stormready.noaa.gov/)**	**Medium**	**2006**		**Minimal**	**NOAA**
Flooding	**Goal 1 & 2**	**Woodruff, Laketown**	**Mitigate impacts related to flooding.**	**Initiate participation in the National Flood Insurance Program (NFIP) to enable home owners to purchase flood insurance.**	**High**	**2005**		**Minimal**	**UDESHS, ACOE**
Flooding	**Goal 1 & 2**	**Jurisdictions with identified flood hazards**	**Make better informed decisions.**	**Develop a floodplain map for communities that do not have one. Refine, update and improve existing flood plain mapping.**	**Medium**	**2009**	**FEMA, UDESHS, Local**	**$2,500 to $65,000 each**	**Consultants, FEMA, UDESHS, Public Works**
Wildfire	**Goal 2**	**Garden City, Unincorporated Rich County**	**Become "Firewise" communities.**	**Enact ordinance and planning procedures to insure development in fire prone areas are done wisely. Provisions for multiple access routes, firebreaks, wide roads and adequate water sources should be included. Standards for homes should be enforced that require defensible space and fire wise building materials and designs (see www.firewise.org).**	**High**	**2007**		**Minimal**	**BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.**
Wildfire	**Goal 2**	**Garden City, Unincorporated Rich County**	**Build citizen capacity**	**Educate and train property owners in Wildland/Urban interface areas on how to protect their property from wildfire.**	**High**	**2006**	**Local**	**Minimal**	**BRAG, Utah Division of State Lands, Fire and Forestry, Utah League of Cities and Towns.**

PART IV-RICH COUNTY ANNEX HAZARD MAPPING



Rich County
Population Density

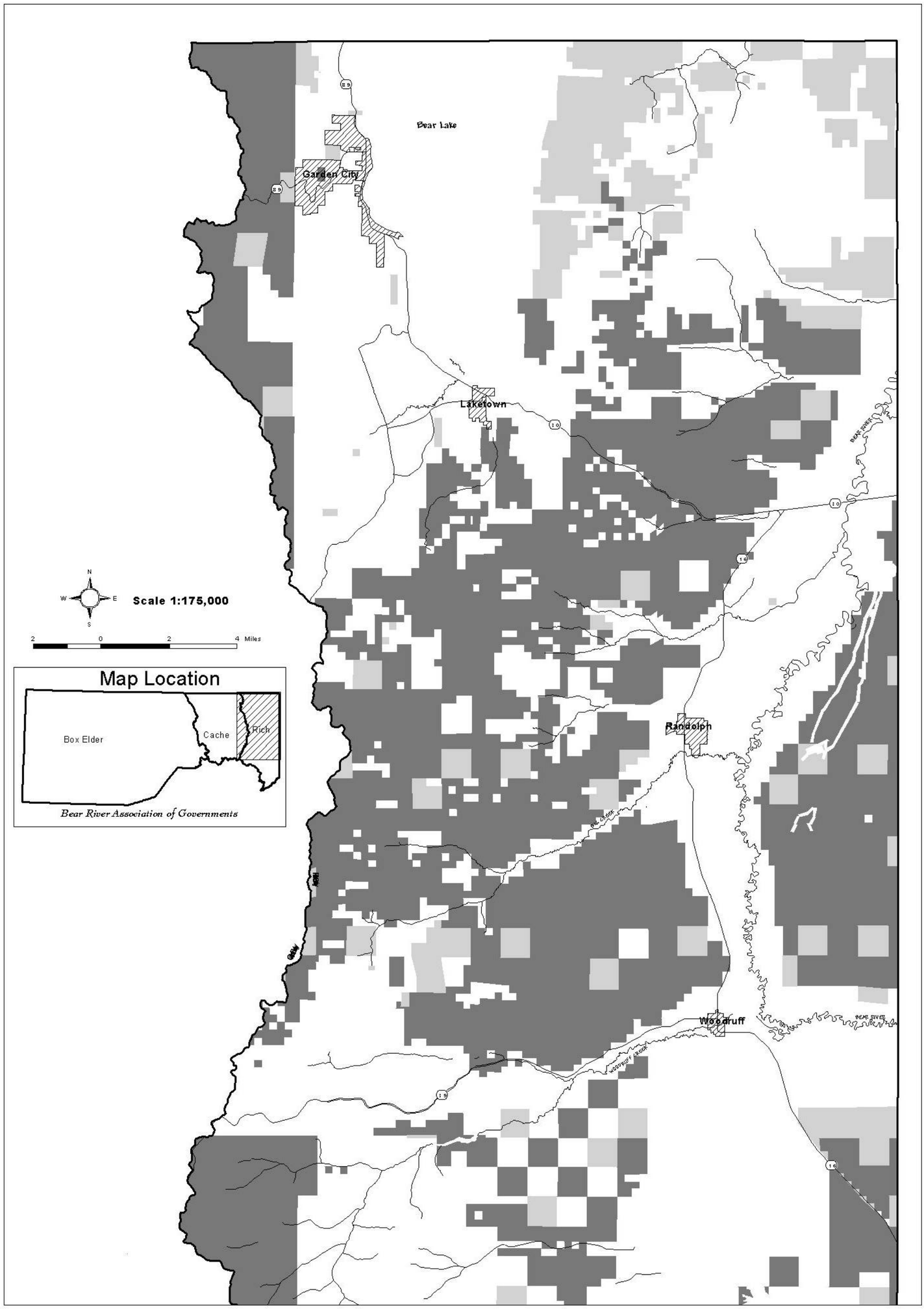
Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County boundries and population density from US Census.

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but it is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or portrayal accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads
Rivers
Rich County

Population Density (Persons per acre)
0
0 - 0.3
0.301 - 2
2.001 - 6
6.001 - 1000

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Rich County
Land Ownership

Data Source: Municipalities, ownership, roads, rivers and lakes maintained by Utah AGRC. County Boundries from U.S. Bureau of the Census.

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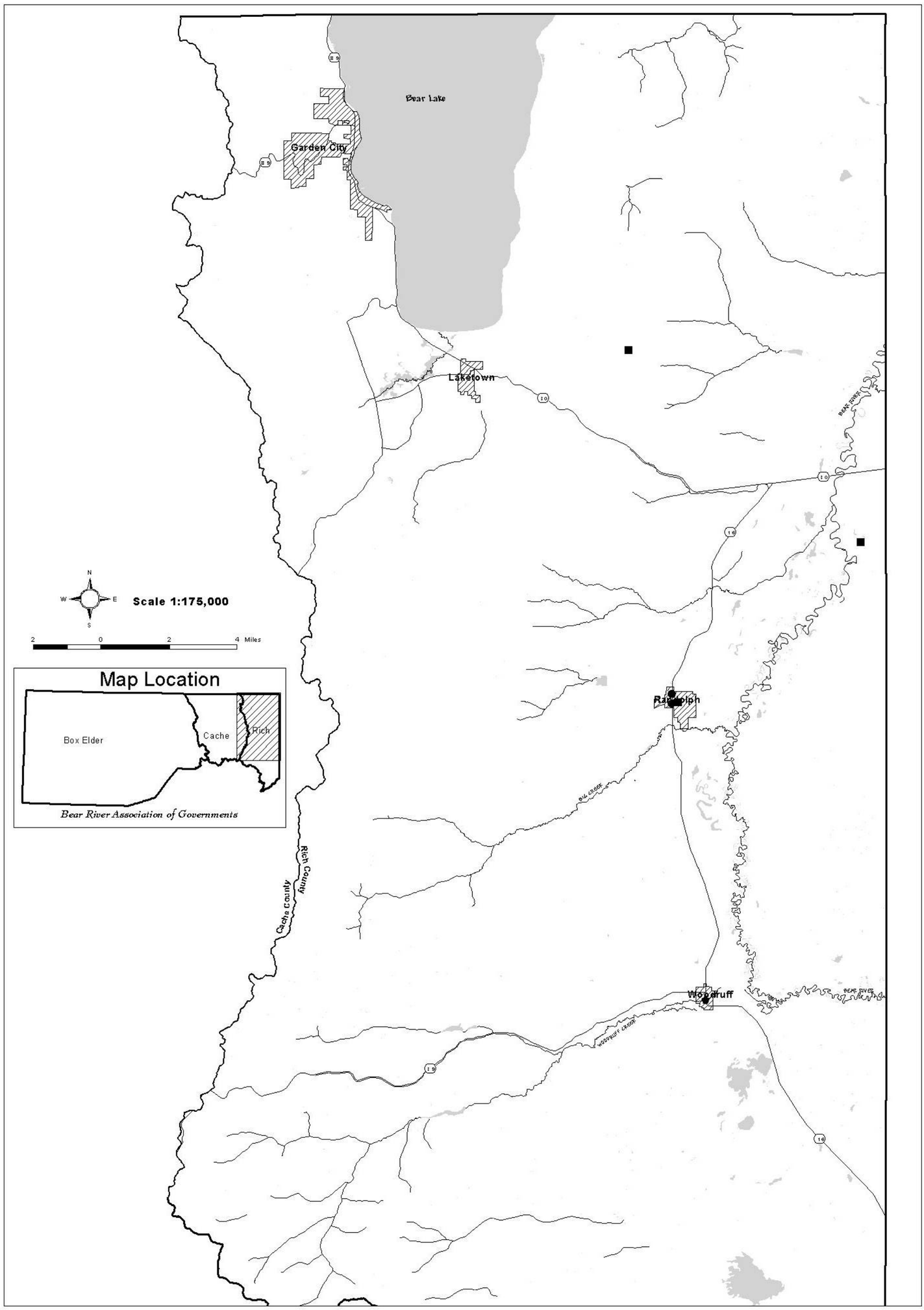
Roads
Rivers
Cache County
Municipalities

Land Ownership
Private
State Lands
Federal Lands
Sovereign Lands

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Rich County

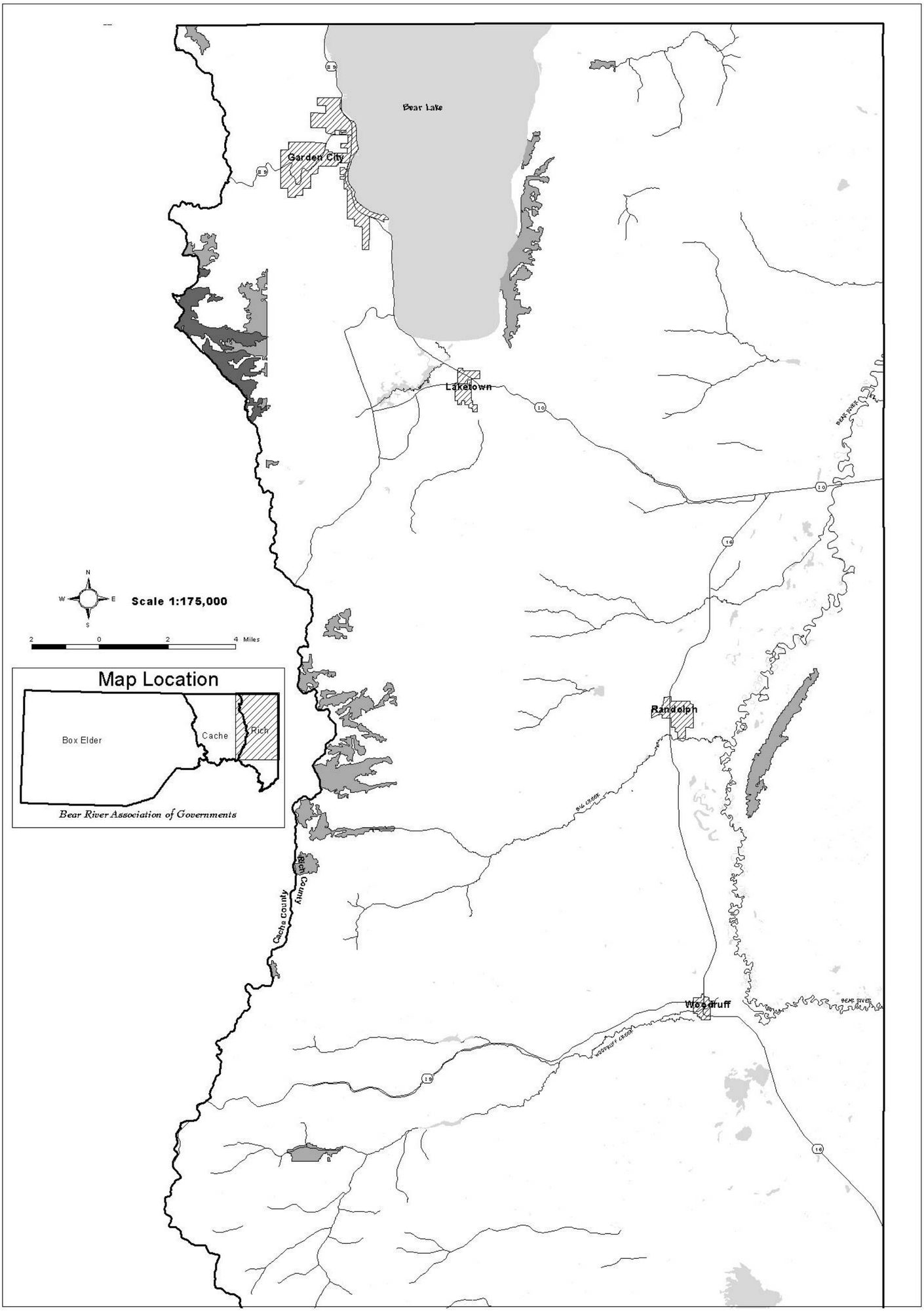
Critical Facilities

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census.

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads
Rivers
Lakes
Municipalities
Police Station
School
Hospital
Fire Station
Rich County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich



Rich County

Wildfire Hazard

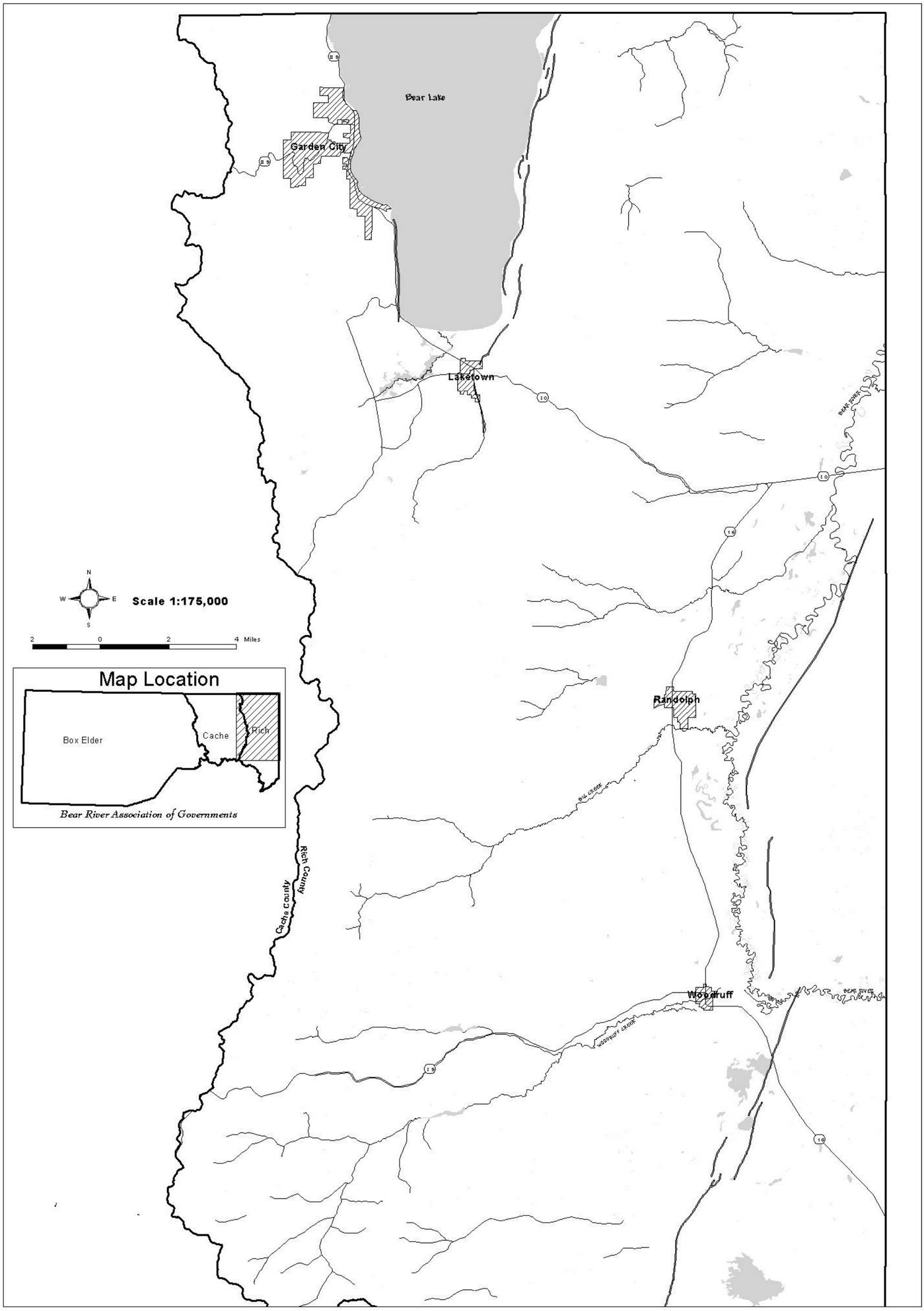
Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County boundries from US Census. Fire classes from BLM Firee Hazard Analysis

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from various sources may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads	Moderate Fire Hazard
Rivers	High and Extreme Fire Hazard
Lakes	
Municipalities	Rich County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

Landslide Missing



Rich County

Earthquake Fault Zone

Data Source: Municipalities, roads, rivers and lakes maintained by Utah AGRC. County Boundries from US Census. Fault zones derived from "Quaternary Tectonics of Utah" (Hecker, Utah Geological Survey Bulletin 127, 1993)

The information on this map was derived from digital databases from BRAG GIS. Care was taken in the creation of this map but is provided "as is." BRAG cannot accept any responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Although information from a land survey may have been used in the creation of this product, in no way does this product represent a Land Survey. Users are cautioned to field verify information in this product before making any decisions.

Roads
Rivers
Lakes
100' Fault Zone
Municipalities
Rich County

BRAG
Bear River Association of Governments
Box Elder
Cache
Rich

PART V: CAPABILITY ASSESSMENT

INTRODUCTION

What follows is a description of the organizational, technical and political capacity of the Bear River Region to implement hazard mitigation strategies and goals. The best plan in the world will do nothing to improve hazard mitigation efforts in the region without sufficient implementation capacity and capability; particularly local level capacity (town, city and county government). The purpose of this section is to analyze gaps and potential capability weaknesses for local level jurisdictions in the region.

LOCAL ORGANIZATIONAL AND TECHNICAL CAPABILITY

Only a handful of communities in the Bear River region have full time professional staff of any kind. In many cases a limited tax base means that hiring full time professional staff in the smaller cities and towns is financially unobtainable. Often these smaller communities rely on local volunteers or elected and appointed officials to perform many of the tasks normally handled by professional staff. It's not uncommon to have a volunteer city council persons or planning commissioner assigned the task of emergency management, grant writing or long range planning. Professional staff at BRAG (and each of the three counties to some degree) help provide some technical and planning assistance to these smaller communities. This regional assistance is often limited by staffing capacity and funding. As funding allows, some communities are able to contract for professional services from private consultants.

Only Logan City and Brigham City have staffs that are, for the most part, dedicated full time to emergency management related tasks. While Box Elder, Cache and Rich Counties have emergency managers, all of these individuals have other responsibilities in addition to core emergency management functions.

Table V-1: State and Regional Hazard Mitigation Resources
Bear River District

Agency/Group	Description
Utah Div. of Emergency Services and Homeland Security	Training, technical assistance and funding.
Utah League of Cities and Towns	Training, technical assistance and planning assistance
Utah Geologic Survey	Technical assistance, plan review
Bear River Association of Governments	Technical assistance, plan review, GIS and Community Development Block Grants.
Bear River Health Department	Emergency preparedness and response. Homeland security planning.
Cache Chapter of the American Red Cross	Training, emergency preparedness and response.
Utah Association of Conservation Districts	Technical assistance and planning assistance.

Table V-2: Local Level Hazard Mitigation Capability Bear River District		
Jurisdiction	**Professional Staffing (e.g. City Manger, Engineer, Planner)**	**Technical Capacity (In House)**
BOX ELDER COUNTY	County Emergency Management Coordinator (partial time), County Planner, Public Works, Building Inspector	GIS Staffing and equipment
Bear River City	Volunteer\contracted consultant	None
Brigham City	Full time Emergency Manager, Planning Department, Public Works	GIS Staffing and equipment
Corinne City	Part time City Manager	None
Deweyville Town	Volunteer\contracted consultant	None
Elwood Town	Volunteer\contracted consultant	None
Fielding Town	Volunteer\contracted consultant	None
Garland City	Volunteer\contracted consultant	None
Honeyville City	Volunteer\contracted consultant	None
Howell Town	Volunteer\contracted consultant	None
Mantua Town	Volunteer\contracted consultant	None
Perry City	Volunteer\contracted consultant	None
Plymouth Town	Volunteer\contracted consultant	None
Portage Town	Volunteer\contracted consultant	None
Snowville Town	Volunteer\contracted consultant	None
Tremonton City	City Manager, City Engineer	CAD capability
Willard City	Part Time Planning Administrator	Some GIS Capability
CACHE COUNTY	Countywide Planner, Emergency Manager	GIS Capability and staffing
Amalga Town	Volunteer\contracted consultant	None
Clarkston Town	Volunteer\contracted consultant	None
Cornish Town	Volunteer\contracted consultant	None
Hyde Park City	Volunteer Emergency Manager	Some GIS Capability
Hyrum City	Zoning Administrator\City Manager, City Engineer	Some GIS Capability
Lewiston City	Volunteer\contracted consultant	None
Logan City	Emergency Management Department, Planning Department, City Engineers & Public Works.	Advanced GIS capability with customized application to Emergency Management.
Mendon City	Volunteer\contracted consultant	None
Millville City	Part Time Planner	None
Newton Town	Volunteer\contracted consultant	None
Nibley City	City Manager/Planner	None
North Logan City	City Manager/Engineer, Planner	Some GIS Capability
Paradise Town	Volunteer\contracted consultant	None
Providence City	City Manager	None
Richmond City	Part Time City Manager	None
River Heights City	Volunteer\contracted consultant	None
Smithfield City	City Manager\Engineer	Some GIS Capability
Trenton Town	Volunteer\contracted consultant	None

Table V-2: Local Level Hazard Mitigation Capability Bear River District		
Jurisdiction	**Professional Staffing (e.g. City Manger, Engineer, Planner)**	**Technical Capacity (In House)**
Wellsville City	City Manager	None
RICH COUNTY	Countywide Planner (Bear Lake Regional Commission), Part-time Emergency Manager	Significant GIS capability
Garden City	Volunteer\contracted consultant	None
Laketown	Volunteer\contracted consultant	None
Randolph City	Volunteer\contracted consultant	None
Woodruff Town	Volunteer\contracted consultant	None

POLICY AND PROGRAM CAPABILITY

Of the thirty nine municipalities in the Bear River Region, thirty one have an adopted General Plan as required by state code. Although many communities have recently updated their General Plan, many are very outdated and have not been revised in years. Generally speaking, if these plans address natural hazards at all, it is usually limited to flood related hazards.

All of the thirty nine municipalities have an adopted zoning ordinance. Again, often these ordinances are outdated and often are not consistent with the jurisdiction's General Plan. Most zoning ordnances do not address natural hazards in any way. A few communities have a "sensitive area" or "hazard area" overlay zone. All communities issue building permits and enforce local building codes. Often this service is contracted for with the county.

Many of the smaller communities lack emergency response plans.

Of thirty nine municipalities and three counties, twenty four are participating in the National Flood Insurance Program (NFIP).

Authority

Federal: Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidentially declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

The Disaster Mitigation Act of 2000 was signed into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards, risks and vulnerabilities in that plan.

State: The State of Utah derives it's authority under the Emergency Management Act of 1981 (Utah Code 53-2, 63-5) as well as the Governor's Emergency Operations Directive and Executive Order of the Governor 11.

Association of Governments: The Association of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

Local: Utah Code, Title 17, Chapter 27 is the County Land Use Development and Management Act that grants authority to counties. Utah Code, Title 10 Chapter 9 grants similar authority to municipalities.

PART VI: PLAN MAINTENENCE

PLAN MAINTANENCE PROCEDURE

Monitoring, Evaluating and Updating the Plan

Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for the Bear River Region are kept current and that local mitigation efforts are being carried out.

Annual Reporting Procedures

The Plan shall be reviewed annually, as required by the BRAG Governing Board, or as situations dictate such as following a disaster declaration. The second quarter of each year the BRAG Community Development Department Staff will review the plan and ensure the following:

1. The Executive Director and the Governing Board will receive an annual report and/or presentation on the implementation status of the Plan.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan.

If the BRAG Governing Board determines that a modification of the Plan is warranted, the Board may initiate a plan amendment.

Revisions and Updates

Periodic revisions and updates of the Plan are required to ensure that the goals and objectives for the Bear River Region are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review

Every five years the plan will be reviewed and a complete update will be initiated. All information in the plan will be evaluated for completeness and accuracy based on new information or data sources. New property development activities will be added to the plan and evaluated for impacts. New or improved sources of hazard related data will also be included.

The goals, objectives and mitigation strategies will be readdress and amended as necessary based on new information, additional experience and the implementation progress of the plan. The approach to this plan update effort will be essentially the same as used for the original plan development.

Plan Amendments

Plan amendments will be considered by the BRAG Governing Board during the plan's annual review to take place the second quarter of each year. All affected local jurisdictions (cities, towns and counties) will be required to hold a public hearing and adopt the recommended amendment by resolution prior to consideration by the BRAG board.

IMPLEMENTATION THROUGH EXISTING PROGRAMS

Integration with Local Planning

This plan is only useful to the extent its recommendations and mitigation strategies are integrated into local level decision making, programs, regulations and resource allocation priorities. The jurisdiction's Comprehensive Plan and supporting regulatory ordinances are where many of the plan's recommendations would be implemented locally. Capital improvement planning and programming is where most jurisdictions address the resource allocation and funding issues (this process generally coincides with the jurisdiction's budget approval process).

In the preparation of this plan it soon became very evident that, for most elected and appointed officials in the Bear River District, there is a strong desire to improve the jurisdiction's handling of natural hazard related issues. Many expressed a level of concern together with recognition that their jurisdiction is not appropriately dealing with natural hazard issues and may be unknowingly placing people and property at risk. For many cities and towns, particularly the smaller ones, lack of motivation is not the issue. Knowing what to do and how to move forward is.

Integration of the recommendations of this plan with local level planning and land use decision making will most effectively be accomplished by education, training and effective technical assistance. Enhanced communication and collaboration with other cities, towns and counties in the region will help move the plan into the implementation phase.

Specifically, BRAG proposes to move the implementation phase forward by:

1) Establishing, coordinating and hosting county hazard mitigation working groups that would meet at least quarterly.
2) Develop and host a natural hazard mitigation implementation workshop for the region within three months of local adoption of the plan.
3) Provide on-going technical assistance to cities and towns.

Potential Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The Bear River jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the Plan identifies the primary Federal and State grant programs for Bear River jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program Agency: Federal Emergency Management Agency
Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property. The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal. FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities: State and local hazard mitigation planning Technical assistance (e.g. risk assessments, project development) Mitigation Projects Acquisition or relocation of vulnerable properties Hazard retrofits Minor structural hazard control or protection projects Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program Agency: Federal Emergency Management Agency
FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP. FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program Agency: Federal Emergency Management Agency
The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration. To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each

disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

*Roads, bridges & culverts
*Draining & irrigation channels
*Schools, city halls & other buildings
*Water, power & sanitary systems
*Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

*Universities and other schools
*Hospitals & clinics
*Volunteer fire & ambulance
*Power cooperatives & other utilities
*Custodial care & retirement facilities
*Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants Agency: US Department of Housing and Urban Development
The community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants fro post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

Local

Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

Non-Governmental

Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

CONTINUED PUBLIC INVOLVEMENT

During interim periods between the five year re-write, efforts will be continued to encourage and facilitate public involvement and input. The plan will be available for public view and comment at local libraries and city offices, the BRAG office, and on the internet (http://www.brag.dst.ut.us/develop-hazard%20mit.htm). Comments will always be received whether orally, written or by e-mail.

All ongoing workshops and trainings will be open to the public and appropriately noticed. Ongoing press releases and interviews will help disseminate information to the general public and encourage participation.

As implementation of the mitigation strategies continues in each local jurisdiction, the primary means of public involvement will be the jurisdiction's own public comment and hearing process. State law as it applies to municipalities and counties requires this as a minimum for many of the proposed implementation measures. Effort will be made to encourage cities, towns and counties to go beyond the minimum required to receive public input and engage stakeholders.

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APPENDIX A: LOCAL GOVERNMENT SURVEY SUMMARY

BRIGHAM CITY

20 North Main Brigham City, UT
435-734-2001
Survey completed by: Jim buchanan

Participation in NFIP?
Don't know

Existing or Potential Natural Hazards

Drought	Soil Subsidence
Landslide	Earthquake
Wildfire	Winds
Dam Failure	Severe Weather
Flooding	

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
A lot

Building Codes Used in Community?
Ibc 2000

Fire Insurance Rating
5

Natural Hazard Maps, Documents, Ordinances or Plans.
a lot not sure

Contact Person
Jim Buchanan
PH # 734-2001-2401
Email jbuchanan@favorites.com

Bear River City

Survey completed by: Carol Andreasen
PO Box 160 Bear River, UT 84301
435-279-9047

Participation in NFIP?
No

Existing or Potential Natural Hazards

Earthquake	Wildfire
Drought	

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
?

Building Codes Used in Community?
UBC

Fire Insurance Rating
?

Natural Hazard Maps, Documents, Ordinances, or Plans.

Earth Quake Training Manual and Materials.
Box Elder County Emergency Preparedness Plan for Hazardous Materials.

Contact Person
?

Box Elder County

Survey completed by: Denton H. Beecher
01 South Main Street, Brigham City, UT 84302
435-734-3386

Participation in NFIP?
Yes

Existing or Potential Natural Hazards

Drought	Earthquake
Flooding	Wildfire
Landslide	Dam Failure
Soil Subsidence	Winter Storms
High Winds	Insect infestation
Hail Storms	

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Drought
Earthquake

Building Codes Used in Community?
UBC

Fire Insurance Rating
Unknown

Natural Hazard Maps, Documents,Ordinances, or Plans.
Poor Quality Earth quake maps
Cutler Dam maps

Contact Person
Denton Beecher
435-734-3386

Fielding Town

Survey completed by: Mayor Jim Garn
Box 104 Fielding, UT 84311
435-458-3374

Participation in NFIP?
Don't know

Existing or Potential Natural Hazards

Earthquake	Drought
Flooding	Soil Subsidence

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Disaster Plan

Building Codes Used in Community?
Box Elder County Codes

Fire Insurance Rating
unknown

Natural Hazard Maps, Documents,Ordinances, or Plans.
None

Contact Person
Mayor Jim Garn
435-458-3374

Hyde Park City

Survey completed by: David M. Kooyman
113 East Center St. Hyde Park City, UT 84318
435-563-6507
Hydepark@xmission.com

Participation in NFIP?
Don't know

Existing or Potential Natural Hazards
Flooding
Earthquake

Completed Natural Hazard Mitigation Projects.

Water system improvements 1995, Hyde Park City placed
the new water tank away from earth quake fault lines.

Needed Natural Hazard Mitigation Projects?
Not aware of any mitigation needs

Building Codes Used in Community?
ICBO Uniform Building Code 1997
IFCI Uniform Fire Code 1997

Fire Insurance Rating
unknown

Natural Hazard Maps, Documents,Ordinances, or Plans.
Floodplain map provided by FEMA

Contact Person
Mayor David Kooyman
435-563-6507 City
435-563-3364Home

Hyrum City

Survey completed by: D. Brent Jensen
83 West Main Hyrum, UT 84319
435-245-6033

Existing or Potential Natural Hazards

Drought	Flooding
Earthquake	Dam Failure

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Moveable joints in waterlines crossing Faults

Building Codes Used in Community?
Uniform

Fire Insurance Rating

ISO 5

Natural Hazard Maps, Documents, Ordinances, or Plans.
None

Contact Person
D. Brent Jensen
435-245-6033

Lewiston

Survey completed by: Mark Blair
PO Box 67 Lewiston, UT 84320
435-258-2141
bliardocm@aol.com

Participation in NFIP?
Yes

Existing or Potential Natural Hazards

Drought	Earthquake
Flooding	Power outage
Hazardous Material	
Winter Conditions	

Completed Natural Hazard Mitigation Projects.
Emergency Management Plan

Needed Natural Hazard Mitigation Projects?
Identifying Hazardous material

Building Codes Used in Community?
State Code and our Own

Fire Insurance Rating
?

Natural Hazard Maps, Documents, Ordinances, or Plans.
Emergency Management Plan, lists hazards

Contact Person
Mark Blair
435-258-2141

City Of Logan

Survey completed by: Scott Douglas
255 North Main Logan, UT 84321
435-716-9670
sdouglas@loganutah.org

Participation in NFIP?
Yes

Existing or Potential Natural Hazards

Drought	Earthquake
Flooding	Landslide
Wildfire	Dam Failure
Soil Subsidence	Winter Storms

Building Codes Used in Community?
IRC
IBC
2000 International Code

Fire Insurance Rating
3

Completed Natural Hazard Mitigation Projects.

Dredging of river by Country Manor
Replacement of rr tressles on 1700 South
Flood retention ponds up dry canyon
Wildfire trail along mountains on east side
Insulators on power lines along foothills
River gauge on BlackSmith Fork River
Snotel site up Logan Canyon
Crockett Dam Renovation
(Projects completed from 1997-2002)

Needed Natural Hazard Mitigation Projects?
First priority- Dredging of First, Second, and Thrid Dams
Second priority- Second power source to the valley
Third priority- More flood mitigation including canal work
Fourth priority- Upgrade water sources
Fifth priority- Zoning ordinances for flood and earthquake ares

Natural Hazard Maps, Documents, Ordinances, or Plans.
City Disaster Plan, each department has specific area plans
GIS mapping of all utilities
FEMA Flood plain maps and earthquake fault line maps

Contact Person

Scott Eli Douglas
435-716-9670

Newton Town

Survey completed by: Mayor Floyd Salisbury
PO Box 146 Newton, UT 84327
435-563-6976

Participation in NFIP?
No

Existing or Potential Natural Hazards
Drought Flooding
Dam Failure

Completed Natural Hazard Mitigation Projects.
Dam overflow project, Cost $5,000,000 completed 15 -20 years ago

Needed Natural Hazard Mitigation Projects?
?

Building Codes Used in Community?
Utah Uniform Building Code

Fire Insurance Rating
6

Natural Hazard Maps, Documents, Ordinances, or Plans.
Flood Plain Map

Contact Person
Reed Jenkins
435-563-5532

Paradise Town

Survey completed by: Lee Atwood
11 West 8900 South Paradise, UT 84328
435-245-6737

Participation in NFIP?
?

Existing or Potential Natural Hazards
Earthquake Wildfire
Flooding dams and canals
Drought

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
?

Building Codes Used in Community?
UBC Cache County Contract

Fire Insurance Rating
7

Natural Hazard Maps, Documents, Ordinances, or Plans.
Maps on Flood Plain

Contact Person
?

Perry City

Survey completed by: Judy W. Bylsma
3005 South 1200 West Perry, UT 84302
435-723-6461
perrycty@vii.com

Participation in NFIP?
Yes

Existing or Potential Natural Hazards
Earthquake Wildfire
Flooding Drought
Landslide

Completed Natural Hazard Mitigation Projects.
Large Culverts and flood control devices installed in 3 Perry Canyons to wetlands west of I-15 to mitigate spring run-off (Flood Waters)

Needed Natural Hazard Mitigation Projects?
Complete storm drain system to mitigate storm run-off and flooding

Building Codes Used in Community?
International Building Code

Fire Insurance Rating
5

Natural Hazard Maps, Documents, Ordinances, or Plans.
Foothill ordinance

Contact Person
Edward J. Skrobiszewski
435-723-6461

Town of Portage

Survey completed by: Mayor Keith Wadman
Po Box 4 Portage, UT 84331
435-866-2108

Participation in NFIP?
No

Existing or Potential Natural Hazards
Drought Earthquake
Flooding Wildfire

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Wildfire
Flooding
Earthquake
Drought

Building Codes Used in Community?
Box Elder County Codes

Fire Insurance Rating
Standard

Natural Hazard Maps, Documents, Ordinances, or Plans.
None

Contact Person
Mayor Keith Wadman
435-866-2108 or 435-866-9110

Richmond City

Survey completed by: Kip Panter & Marlow Adkins
6 West Main Richmond, UT 84333
435-258-2092
richmondcity@pcu.net

Participation in NFIP?
Yes

Existing or Potential Natural Hazards
Earthquake Flooding
Wildfire Drought
Wind

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
None

Building Codes Used in Community?
State of Utah Code
Contract inspection with Cache County

Natural Hazard Maps, Documents, Ordinances, or Plans.
General Plan identifies areas impacted by major Earthquake faults and potential flooding areas. Soil types have also been identified.

Contact Person
L. Alan Higham
435-258-2009

River Heights City

Survey completed by: Debbie Rees
520 South 500 East River Heights, UT 84321
435-752-2646

Participation in NFIP?
Don't Know

Existing or Potential Natural Hazards
Drought Earthquake
Flooding

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Unknown

Building Codes Used in Community?
?

Fire Insurance Rating
N/A

Natural Hazard Maps, Documents, Ordinances, or Plans.
None

Contact Person
Deebie Rees
435-753-9073

Snowville Town

PO Box 734 Snowville, UT 84336
435-872-8501

Participation in NFIP?
No

Existing or Potential Natural Hazards
Drought Earthquake
Flooding Wildfire

Completed Natural Hazard Mitigation Projects.
None

Needed Natural Hazard Mitigation Projects?
Drought
Earthquake

Building Codes Used in Community?
Commercial
Residential

Fire Insurance Rating
?

Natural Hazard Maps, Documents, Ordinances, or Plans.
None

Contact Person
Gary Frandsen
435-872-8274

Tremonton City

Survey completed by: S. Warren Hodges, Rich Woodworth, and Steve Bench
102 South Tremonton, UT 84337
435-257-3131
police@tremontoncity.com

Participation in NFIP?
No

Existing or Potential Natural Hazards
Earthquake Drought
Winter Storms Flooding
Landslide Dam Failure (impact utilities)
Soil
Subsidence Tornado
Wind Damage (non-cyclonic)

Completed Natural Hazard Mitigation Projects.
Natural Hazards addressed by uniform codes
i.e., earthquake, snow load, structural considerations, and material suitability

Needed Natural Hazard Mitigation Projects?
?

Building Codes Used in Community?
2000 International Codes

Fire Insurance Rating
6

Natural Hazard Maps, Documents,

Ordinances, or Plans.
Hillside development
Sensitive Area (SA) Malad River
Development Ordinances
Land Excavation- Special Requirements
Soils

Contact Person
S. Warren Hodges Blair Westgard, Fire Chief
435-257-3131 435-230-0775

Willard City

Survey completed by: Leland Jacobson
PO Box 593 Willard, UT 84340
435-734-9881
willard@xmission.com

Participation in NFIP?
Yes

Existing or Potential Natural Hazards
Drought Earthquake
Flooding Landslide
Wetlands
Soil Subsidence

Completed Natural Hazard Mitigation Projects.
Flood mitigation on alluvial fan- ongoing
Debris Basin- Major effort about
1939

Needed Natural Hazard Mitigation Projects?
Continued work on flood control projects
Storm drainage needed

Building Codes Used in Community?
2000 International Codes

Fire Insurance Rating
?

Natural Hazard Maps, Documents,
Ordinances, or Plans.
Sensitive Area Ordinance 12-200/ part of
Zoning Ordinance

Contact Person
Lynne Buland
435-734-9209

APPENDIX B: U.S. ARMY CORPS OF ENGINEERS: FLOOD HAZARD IDENTIFICATION STUDY FOR THE BEAR RIVER DISTRICT

Flood Hazard Identification Study

Bear River Association of Governments

By:
United States Army Corps of Engineers
Utah Division of Emergency Services and Homeland Security

August 20, 2003

Introduction

The US Army Corps of Engineers Sacramento District completed this flood hazard identification study through a contract with the seven Associations of Governments. Funding was provided under the USACE Planning Assistance to States Program (Section 22). The intent of the study is to aid in detailing natural hazards associated with fluvial process for entities within each AOG currently unmapped as part of the National Flood Insurance Program or mapped as D zone areas.

Acknowledgements

The following agencies aided in preparation, interpretation, and completion of this flood hazard investigation study.

Utah Associations of Governments
Bear River Association of Governments
Sacramento District Corps of Engineers
Utah Division of Emergency Services and Homeland Security

Scope of Work

This study will evaluate and identify areas with a high flood hazard and identify potential mitigation solutions. The areas evaluated in this study include the three unincorporated counties of Box Elder, Cache, and Rich. Municipalities within the three counties were studied if they met the following criteria:

1. Jurisdiction has not been mapped by FEMA,
2. Jurisdiction mapped by FEMA as a Zone D, area of undetermined flood hazard.

Fluvial hazards within the cities and towns of: Bear River, Deweyville, Elwood, Fielding, Garland, Howell, Plymouth, Portage, Snowville, and Tremonton were studied.

Description of the Study Area

This study includes the northern most counties of Utah, Box Elder, Cache, and Rich counties. The three counties are contained within two major physiographic provinces the Basin and Range province with comprises the majority of western Box Elder County, and the Middle Rocky Mountain Province. Vegetation corresponds with moisture, which increases with elevation. Thus, valleys and low land areas have desert brushes and grasses, which turn to pinyon-juniper and coniferous forests as elevation increases.

Population in the Bear River Association is predominately aligned along mountain fronts near interstates, with the majority of western Box Elder County sparsely populated. The agricultural sector still plays a large part in the economy of the study area, as does Utah State University located in Logan.

With the exception of the Raft River Mountains (tributary to the Snake River), the entire study area is drained by the Bear River, into the Great Salt Lake, a remnant of ancient Lake Bonneville. Major tributaries of the Bear River include: Malad River, Sheep Creek, Saleratus Creek, The little Bear, and Blacks Fork. Outside of the 1983 flooding event damage due to flooding in the study area has been quite limited, primarily damaging crops and agricultural infrastructure.

Discussion, Data, and Observations

Data presented in this study are from the following sources:

Box Elder County Emergency Operations Plan
Cache County Emergency Operations Plan
Rich County Emergency Operations Plan
Bear River Basin: Planning for the Future December 2002
US Army Corps of Engineers Wasatch Front and Central Utah Study July 1984 Volumes I and II
US Army Corps of Engineers Reconnaissance Report Bear River Basin Investigation February 1989

In addition to incorporating existing studies and plans completed in the area, this flood hazard study also contains information from technical experts familiar with the study area. The mitigation projects are purely suggested actions, which based on past experience, will reduce or eliminate the identified fluvial hazard. These mitigation recommendations in no way represent the only measure to attain fluvial mitigation. In many cases the proposed or best solution is simply avoidance. This method of mitigation is implemented through the use of zoning, and represents in most cases the lowest cost mitigation measure.

Need For Additional Research
Additional research should be conducted resulting in better maps for communities currently mapped as a FEMA Zone D, unmapped communities, and communities with outdated Flood Insurance Rate Maps. Communities would benefit from knowing peak flows and stages on tributaries of concern.

Disclaimer
The information provided in this study was developed from a number of sources including:
Past USACE studies done within the region and drainage basins,
Personal knowledge,
Limited onsite visits,
Map interpolations,
Current GIS work.

Even though care was taken to ensure a measure of correctness and field checks were preformed on the information and data gathered, it is important to note this flood hazard study is presented “as is”. The United States Army Corps of Engineers, Division of Emergency Service and Homeland Security, or any other agency assisting in completion of this study cannot accept any responsibilities for errors, omissions, or accuracy. There are no warranties, which accompany this product. Users are cautioned to field verify information provided in this product before making any decisions. In no way does the mapping presented in this study take the place of a regulatory FEMA Flood Insurance Rate Map (FIRM), or replace any flood hazard identification product developed by FEMA / National Flood Insurance Program (NFIP).

How Communities Where Ranked
The communities within this study were ranked based on a committee’s evaluation. The evaluation committee consisted of the:
Utah State Floodplain Program Manager
Utah State Hazard Mitigation Officer,

Natural Hazard Mitigation Planner,
U.S. Army Corps of Engineers,
State Earthquake Program Manager.

This committee researched each of the twenty-nine counties and all 269 incorporated areas within the State of Utah. Each jurisdiction was assigned one of five ratings: Very High, High, Moderate, Low, or Not Rated. These ratings in no way reflect actual flood threat. The ratings were assigned based on the following variables:
Perceived flood threat based on topography, past flooding occurrences, and experience of committee members.
Participation in the National Flood Insurance Program (NFIP).
Past studies included, but not limited to, regulatory FEMA/NFIP Flood Insurance Studies (FIS), other flood studies, and reconnaissance reports.
Population growth within the jurisdiction.
If the community is mapped by FEMA/National Flood Insurance Program NFIP), and type of map which identifies high, moderate and low flood threats

Ratings were used to set the scope of work for each community within this study. **Information on excluded communities was added were available.**

A Word about Wildfires
Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk associated with alluvial fans is always of concern. Post fire revegetation and stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

A Word About Dams
Dams are a critical support function for water managers in the State and can also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 67 dams within Bear River AOG of those 12 have received a high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years.

Box Elder County
Blue Creek
Mutton Hollow Debris Basin

Three Mile Creek Debris Basin
Cutler
Mantua
Cache County
Tony Grove Lake Dam
Hyrum
Logan First Dam
Porcupine
Newton
Rich County
Birch Creek No. 2
Woodruff Creek

Bear Lake a prominent recreation area is near the mid-point of the Bear River. Historically, the Bear River did not naturally flow into Bear Lake. In 1902 a predecessor of Utah Power and Light constructed inlet and outlet canals in an effort to divert Bear River Water into the lake for later release during the agricultural growing season. River modifications have created an active storage capacity of 1,452,000 acre-feet in Bear Lake and the ability to control the flow of the river.

Box Elder County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Box Elder	Unincorporated	8023		490005 - 9/1/87(L)	Bear River and Tributaries
Box Elder	Bear River City	750	B4	Not Participating	Bear River and Tributaries
Box Elder	Brigham City	17411	B4	490006 - 8/17/81	
Box Elder	Corrine	621	B4	490197 - 7/15/80(M)	
Box Elder	Deweyville	278	B4	Not Participating	Bear River and Tributaries
Box Elder	Elwood	678	B4	**Not Participating**	Bear River and Tributaries
Box Elder	Fielding	448	B4	**Not Participating**	Bear River and Tributaries
Box Elder	**Garland**	1943	B4	**Not Participating**	Bear River and Tributaries
Box Elder	Honeyville	1214	B4	490008 - 7/29/80(M)	
Box Elder	Howell	221	B4	Not Participating	NSFHA-Eligible
Box Elder	Mantua	791	C4	490009 - 7/8/80(M)	
Box Elder	Perry	2383	C4	490010 - 5/20/80(M)	
Box Elder	Plymouth	328	C4	Not Participating	Bear River and Tributaries
Box Elder	**Portage**	257	B4	**Not Participating**	Bear River and Tributaries
Box Elder	**Snowville**	177	B3	**Not Participating**	Deep Creek Tributaries
Box Elder	**Tremonton**	5592	B4	**Not Participating**	Bear River and Tributaries
Box Elder	Willard	1630	C4	490011A - 7/1/87(L)	

* D = Detailed Study Report and Map Prepared.

Box Elder County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	August 6, 1947	Brigham City	Limited damage	

Box Elder		Willard	to fruit orchards and US 91	
Flood Box Elder	May 17, 1949	Perry	50 farms damaged, several thousand dollars in damage to farms, orchards, and roads.	Source Mt. Baldy area
Flood Box Elder	August 10, 1952	Willard	$100,000 in damage to orchards due to hail, US 91 covered with mud	
Flood Box Elder	June 14, 1960	Brigham City	Crop damage	Heavy rains large hail.
Flood Box Elder	August 8, 1968	Howell	Flooding and damage to farmland	Source Blue Creek
Flood Box Elder	June 24, 1969	Brigham City	Business establishments flooded on Main Street.	
Flood Box Elder	Spring 1983	Brigham City,	Basement damage, foundation walls, and homes. Waste treatment plant in Box Elder Creek threatened.	Total PA requests of $146,596 for Box Elder County. Ground water and many slides.
		Garland	Dike along river eroded and floodwaters damaged community water supply pump house.	Source Bear River
		Honeyville	High ground water causing flooding	
		Willard	Several homes were inundated	Source Willard and Facer Creeks.
Flood Box Elder	Spring 1984	Entire County	Overland flows carried debris onto private	Damage total $331,442.00

			lands, and filled Willard, Facer, and Barker Debris Basins. Flows eroded pavement, washed out road shoulders, and culverts.	

(All dollar values given are for year of disaster)

Unincorporated Box Elder County

Box Elder County Flood Mitigation Goals -
Goal 1 Reduce Risk of Potential Flooding

Unincorporated Box Elder County – Problem Identification: This county has just under 20 percent of its residents living in the unincorporated county – many in the areas surrounding Brigham City and Tremonton. Box Elder also appears to be the county with the smallest percentage of communities participating in the NFIP – most likely because the flood threats are, for the most part, only minor to moderate - several being NSFHA-Eligible. The Bear and Malad Rivers and their tributaries represent the major flood threats to development.

Objective: Minimize future flood damage in the unincorporated County

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent
(100 ft minimum setback; greater adjacent to the Bear River) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Bear River City – Problem Identification: This community does not participate in the NFIP. As its name implies, the Bear River runs through it – posing a significant flood threat. A tributary to the Malad River also runs along the west side of the community.

Objective: Minimize future flood damage in Bear River City.

Alternative Action: Given the relatively few number of existing structures, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Deweyville – Problem Identification: This small community does not participate in the NFIP. It is at risk from flooding of not only the Bear River (the bank is apparently the town boundary) but also from not less than half dozen east side drainages. Most of the community appears to be at risk but the developed areas appear to be most threatened by the east side drainages as there is apparently little development near the Bear River.

Objective: Minimize future flood damage in Deweyville.

Alternative Action: Given the relatively few number of existing structures, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Elwood – Problem Identification: This community does not participate in the NFIP. As with Bear River City, it faces a significant threat from the Bear River on the east and the Malad River on the west. Much of the original development appears to be sited along Highway 191, approximately the same distance away from the two rivers making relatively safe from the flood threat of either. New development; however, has come increasingly closer to both rivers, increasing the overall flood threat.

Objective: Minimize future flood damage in Elwood.

Alternative Action: Given the relatively few number of existing structures at risk, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Fielding – Problem Identification: Northeast of Garland, this community does not participate in the NFIP. However, it appears that it is far enough away and high enough above the Bear and Malad Rivers to be NSFHA-Eligible.

Objective: Minimize future flood damage in Fielding.

Action: Identify Fielding as a NSFHA-eligible community (pending evaluation of flood history and evidence of past flooding).

Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Garland – Problem Identification: Just north of Tremonton, Garland does not participate in the NFIP. As there are apparently no rivers, creeks, or streams running through the town, it appears to have little flood threat and would be NSFHA-Eligible.

Objective: Minimize future flood damage in Garland.

Action: Identify Garland as a NSFHA-eligible community (pending evaluation of flood history and evidence of past flooding).

Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Howell – Problem Identification: This small community does not participate in the NFIP. It does not appear to have a significant flood threat due in large measure to the upstream Blue Creek Reservoir. Therefore, Howell appears to be a NSFHA-Eligible community.

Objective: Minimize future flood damage in Howell.

Action: Identify Howell as a NSFHA-eligible community (pending evaluation of flood history and evidence of past flooding).

Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Plymouth – Problem Identification: This community does not participate in the NFIP. Most of the town appears vulnerable to flooding from the 2 rather large drainages to the northeast whose creeks pass through town.

Objective: Minimize future flood damage in Plymouth.

Alternative Action: One project that would reduce the existing flood threat would be an overflow channel along the east-west road (about ½ mile north of town) from Bishop Canyon, picking up the other two drainages, then under Highway 191 to the drainage adjacent to the city cemetery (which drains to the Bear River).

Timeframe:
Funding:
Estimated Cost: About $200k for excavation and culverts (assuming the road itself (and the culverts through it) do not need modification.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Portage – Problem Identification: This community does not participate in the NFIP. It is primarily threatened from 2 creeks to the west – Portage Canyon and an unnamed drainage to the north. The main Portage Canyon channel appears to skirt the town to the southwest while the unnamed drainage does a very similar thing on the northwest. The residual threat to developments in Portage appears to be very minimal.

Objective: Minimize future flood damage in Portage.

Action: Since the flood threat for this community is so minor, A potential project could consist of zoning of the flood prone areas to insure that all new developments are sited as

far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:

Funding:

Estimated Cost: minimal.

Staff:

Snowville – Problem Identification: This the smallest incorporated community in the county with under 200 residents. It does not participate in the NFIP. There appears to be a substantial threat to most all the community from several relatively large Deep Creek tributary drainages to the east. (Rose Ranch Reservoir is downstream of the community so it cannot provide flood protection.)

Objective: Minimize future flood damage in Snowville.

Alternative Action: Given the relatively few number of existing structures at risk, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:

Funding:

Estimated Cost: $10k - $30k for the average home to flood proof.

Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:

Funding:

Estimated Cost: minimal.

Staff:

Tremonton – Problem Identification: Although Tremonton is the second largest community in Box Elder County; it does not participate in the NFIP. There is; however, a significant flood threat from the Malad River that flows right through the east side of town. The limited detail floodplains identified on the adjacent county map reflect what should be considered a minimal flood hazard area. In all likelihood, actual flooding would be much greater than that shown on the limited detail map. Original development in Tremonton seems to be sited a reasonable distance away from the river. It appears however, that newer development is encroaching into the floodplain.

Objective: Minimize future flood damage in Tremonton.

Alternative Action: Given the relatively few number of existing structures at risk, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:

Funding:

Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Cache County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Cache	Unincorporated	5766		490012 - 2/1/87(L)	Bear River and Tributaries
Cache	Amalga	427	B4	490013 - NITP	
Cache	Clarkston	688	B4	490014 - 8/19/80(M)	
Cache	Cornish	259	B4	Not Participating	Bear River and Tributaries
Cache	Hyde Park	2955	B5	490016 - 7/29/80(M)	
Cache	Hyrum	6316	B5	490017 - 4/8/80(M)	
Cache	Lewiston	1877	B5	490018 - 7/29/80(M)	
Cache	Logan	42670	B5	490019 - 9/28/84	
Cache	Mendon	898	B4	490020 - 7/22/80(M)	
Cache	Millville	1507	B5	490021 - 10/22/76	
Cache	Newton	699	B4	490022 - 7/22/80(M)	
Cache	Nibley	2045	B5	490023A - NITP	
Cache	North Logan	6163	B5	490024 - 3/18/86(M)	
Cache	Paradise	759	B5	490025 - NITP	
Cache	Providence	4377	B5	490226 - (NSFHA)	
Cache	Richmond	2051	B5	4900027 - 8/12/80(M)	
Cache	River Heights	1496	B5	Not Participating	**NSFHA-eligible**
Cache	Smithfield	7261	B5	490029 - 3/18/86(M)	
Cache	**Trenton**	449	B4	Not Participating	Bear River & Ransom Hollow
Cache	Wellsville	2728	B4	490031 - 7/29/80(M)	

* D = Detailed Study Report and Map Prepared.

Cache County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Cache	May 30, 1958	Logan	Damage to crops due to hail and high winds. Water caused road damage	
Flood Cache	August 22, 1958	Clarkston	Limited damage to homes. Highways and roads covered with water	
Flood Cache	August 18, 1959	Providence	Dozens of homes damaged. Flooding caused rock and mudslides in Logan Canyon	
Flood Cache	June 6, 1964	Smithfield	Intense storm flooded a number of homes within town.	Source Summit Creek

(All dollar values given are for year of disaster)

Unincorporated Cache County

Cache County Flood Mitigation Goals -
Goal 1 Reduce Risk of Potential Flooding

Unincorporated Cache County – Problem Identification: Only 6 percent of the county's population is in the unincorporated county, primarily in the Cache Valley surrounding Logan. Clearly, the major flood threat is to those properties adjacent to the Bear River and its tributaries. Reservoirs include Hyrum and Newton.

Objective: Minimize future flood damage in the unincorporated County.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent
(100 ft minimum setback; greater adjacent to the Bear River) as well as not allowing development on alluvial fans. New development near canals should also be discouraged,

as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Cornish – Problem Identification: Cornish lies in northwest Cache County just south of the Idaho border. It is the smallest community in Cache County and does not participate in the NFIP. It appears that there is a moderate flood threat to the low-lying areas on the east side of town adjacent to the Bear River. There is a lesser threat from the drainages coming out of the hills west of town, which are blocked by the north-south West Cache Canal.

Objective: Minimize future flood damage in Cornish.

Alternative Action: Given the relatively few number of existing structures at risk, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

River Heights – Problem Identification: This community, just south of Logan, does not participate in the NFIP. It appears that although the northern boundary is adjacent to the Logan River, the community is on a bluff overlooking the river. The only potential threats are from Dry Canyon to the northeast and from the unnamed drainages east of town. (The City of Logan has constructed a detention basin on Dry Canyon - east of River Heights). Based on the topographic map, it appears that the unnamed drainages some distance east of town, would tend to flow southwest toward the Spring Creek drainage south of River Heights proper. Based on the incorporated boundary on the county NFIP map, River Heights appears to be a NSFHA-Eligible community.

Objective: Minimize future flood damage in River Heights.

Action: Identify River Heights as a NSFHA-eligible community (pending evaluation of flood history and evidence of past flooding).

Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Trenton – Problem Identification: This community does not participate in the NFIP. It appears vulnerable to flooding on the east side of town from the Bear River and to a lesser extent from Ransom Hollow Creek through town (because it is a hollow).

Objective: Minimize future flood damage in Trenton.

Alternative Action: Given the relatively few number of existing structures at risk, flood proofing may be a viable alternative – especially for those structures with a history of being flooded.
Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Rich County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Rich	Unincorporated	739		Not Participating	
Rich	Garden City	357	B5	**Not Participating**	
Rich	Laketown	188	B5	490099 - (NSFHA)	
Rich	Randolph	483	B6	**Not Participating**	
Rich	Woodruff	194	C6	490101 - 7/22/80(M)	

Rich County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Rich Presidential	Spring 1983	Randolph and Woodruff	Damage to roads, culverts bridges, basements, and farmlands.	Source Bear Lake, Dean Ditch, and Woodruff Creek, PA cost $37,161

(All dollar values given are for year of disaster)

Unincorporated Rich County

Rich County Flood Mitigation Goals -
Goal 1 Reduce Risk of Potential Flooding

Unincorporated Rich County – Problem Identification: As one of the smallest counties in terms of population, Rich County does not participate in the NFIP. Although over 1/3 of the county's population is in the unincorporated county, primarily in the areas adjacent to Garden City and Laketown on Bear Lake. Clearly, the major flood threat in the unincorporated county is to those properties adjacent to the Bear River and Bear Lake. Less significant threats also exist along Woodruff and other smaller creeks throughout the county. Bear Lake is by far the largest water body in the county.

Objective: Minimize future flood damage in the unincorporated County.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent
(100 ft minimum setback; greater adjacent to the Bear River) as well as not allowing development on alluvial fans. New development near canals should also be discouraged,

as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Garden City – Problem Identification: This community does not participate in the NFIP. The major flood threat to this community is from Garden City Canyon and to a lesser extent, the drainages to the south and north.

Objective: Minimize future flood damage in Garden City.

Alternative Action: A structural mitigation project for this community could be a deflector levee on the west side of town near the city limit – a distance of about 8,000 ft.
Timeframe:
Funding:
Estimated Cost: The preliminary cost for the levee project would be about $400,000.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.
Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Randolph – Problem Identification: The largest community in Rich County, it does not participate in the NFIP. The main flood threat appears to be from Little Creek and adjacent drainages to the west. Based on the topographic map, there is a reservoir about 2 miles west of Randolph on Little Creek that could provide some incidental flood protection.

Objective: Minimize future flood damage in Randolph.

Alternative Action: A structural mitigation project for this community could be an overflow channel on the north side of town near the city limit – a distance of about a mile.
Timeframe:
Funding:
Estimated Cost: The preliminary cost for the levee project would be about $250k to $500k depending on the channel and culvert sizes.
Staff:

Alternative Action: An alternate project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:

Funding:

Estimated Cost: minimal.

Staff:

APPENDIX C: COORDINATION, COLLABORATION AND PUBLIC INPUT

Natural Hazard Mitigation Planning

Bear River District Fact Sheet

What is Hazard Mitigation?

"Hazard Mitigation" means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural and human-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities. Mitigation is the responsibility of individuals, private businesses and industries, state, local and federal governments.

What is the Disaster Mitigation Act of 2000?

These new regulations administered by the Federal Emergency Management Agency (FEMA), require that each county, city or town have an approved Natural Hazard Mitigation Plan in order to be eligible for post-disaster financial assistance in the event of a presidential disaster declaration as well as other ongoing FEMA hazard mitigation grants.

What is Required of My Community?

Counties, cities and towns are not mandated according to this new Federal Law to have approved mitigation plans; the program is voluntary. Congress indicates, however, that communities which do not have FEMA-approved mitigation plans will not qualify for certain kinds of federal disaster assistance.

The State of Utah's Department of Public Safety, Division of Comprehensive Emergency Management has chosen to utilize a regional planning approach to accomplish local mitigation planning goals in Utah. BRAG will complete the regional plan that will include consideration of all of the participating counties, cities and towns. FEMA will accept "regional mitigation plans as local plans, provided the counties, cities and towns provide input to the planning process and sign-off on the plans." Specifically, your participation will consist of passing a resolution of participation, appointing a local contact to represent your interests and provide information, and finally, adopt the plan before November 1, 2003.

What Are the Benefits For My Community?

- Insuring your community has full access to post-disaster federal funding.
- Potentially reduce the loss of life, property, essential services, critical facilities and economic hardship.
- Potentially reduce short-term and long-term recovery and reconstruction costs.
- Increase cooperation and communication within the community through the planning process.
- BRAG will take the lead, and with your cooperation, essentially complete the plan for you.

FOR MOR INFORMATION CONTACT JEFF GILBERT (435) 752-7242 jeffg@brag.dst.ut.us

B R A G

Bear River Association of Governments

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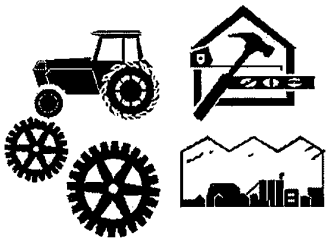
Logan, Utah 84321
(435) 752-7242

Natural Hazard Mitigation Planning

~ COMMUNITY AND ECONOMIC DEVELOPMENT ~



CDBG
Agricultural Preservation
Bear River Heritage Area
Planning Assistance
Bonneville Shoreline Trail
Business Services/Financing
Demographics

Natural Hazard Mitigation Planning Overview

Draft Bear River District Pre-disaster Mitigation Plan

Related Links:

Hazard Mitigation Plan-State of Utah

Hazard Planning Guidebook

FEMA DMA 2000 Resources

Strategies to mitigate impacts of Natural Hazards

For Information regarding this web site, contact webmaster@brag.dst.ut.us

B R A G

Bear River Association of Governments

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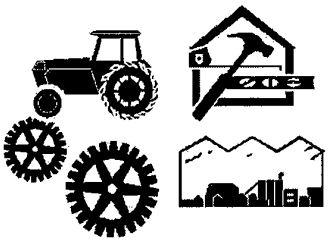
Logan, Utah 84321
(435) 752-7242

Draft Bear River Pre-Disaster Mitigation Plan

~ COMMUNITY AND ECONOMIC DEVELOPMENT ~



CDBG
Agricultural Preservation
Bear River Heritage Area
Planning Assistance
Bonneville Shoreline Trail
Business Services/Financing
Demographics

E-mail your comments, concerns & questions
jeffg@brag.dst.ut.us

Part I Plan Pre-requisites

Part II Planning Process

Part III General Regional Data

Part IV Risk Assessment

- **Hazard Identification & Definitions**
- **Region Annex -Agricultural Related Hazards**
- **Box Elder County Annex-Flood, Wildfire, Landslide, Earthquake & Dam failure**
  - **Box Elder County Hazard Maps: Population density, ownership, critical facilities, flood, wildfire, landslide, liquefaction, faults**
- **Cache County Annex-Flood, Wildfire, Landslide, Earthquake & Dam failure**
  - **Cache County Hazard Maps: Population density, ownership, critical facilities, flood, wildfire, landslide, liquefaction, faults**
- **Rich County Annex-Flood, Wildfire, Landslide, Earthq & Dam failure**
  - **Rich County Hazard Maps: Population density, ownership, critical facilities, wildfire, faults**

Part V Capability Assessment

Part VI Plan Maintenance

Prevention top priority in BRAG disaster plan

By Joe Rowley
staff writer

How much does it cost to clean up after a flood, earthquake or mud slide? Apparently, way too much.

The Bear River Association of Governments, or BRAG, along with regional and local groups across the nation, is working on a plan that should slow the rapidly rising costs of natural disaster relief. It comes from a federal initiative that finally makes sense, BRAG Community Development Director Jeff Gilbert said.

Over the past 20 years, the costs of cleaning up and rebuilding after natural disasters has been increasing significantly, BRAG Executive Director Roger Jones said. The federal government and private insurance companies have been footing increasingly higher bills, and the government finally decided to do something about it, he said.

> "It's common sense stuff that hasn't received a concerted effort nationwide."
>
> **– Roger Jones**
> **BRAG executive director**

To fix the problem, the Federal Emergency Management Agency, or FEMA, and Congress passed new regulations in 2000 that require cities to put more effort into planning with a focus on avoiding natural disasters. For example, rather than paying for the cleanup after a weak bridge gets washed out from a flood, communities ought to go to the lesser expense of identifying and fixing the problem bridge ahead of time, Jones said.

"It's common sense stuff that hasn't received a concerted effort nationwide," Jones said.

Some local officials already know about many of the possible hazards that could befall Cache County residents, Gilbert said. Logan and other cities have put into place emergency response plans, which by definition anticipate potential situations.

"We're really quite geared up for emergency response," Gilbert said.

The hazard mitigation plan takes it further than that, though.

The federal initiative applies to communities nationwide. To make it easier on communities in Utah, state officials decided to allow regional associations to develop one plan that would incorporate the needs of all their individual cities. BRAG started working in November on a plan that would apply to 39 cities in Cache, Rich and Box Elder counties, Gilbert said.

Once the plan is completed, each city merely has to adopt an ordinance accepting the plan to comply with the FEMA requirements. The plan is due to the state by November, Jones said.

BRAG recently asked mayors in the Bear River area to inventory any problem areas in their communities.

"Who knows what's going on in the cities better than the people who live there?" Gilbert said.

Gilbert will then compile all of the information gathered from the individual cities and add it to information from the U.S. Geological Survey, Sheriffs' offices and Utah State University special collections. Using that information, FEMA officials will be able to map the data and see a larger, more complex and integrated picture. The BRAG plan may even pinpoint hazards that the individual community leaders didn't know about, Gilbert and Jones said.

Many of the issues that apply to

See PRIORITY on A12

Priority

Continued from A3

Cache County involve floodplains. The emergency plan, called hazard mitigation, should become a city planning guide to help officials avoid building in potential flood areas, or at least take steps to minimize the damage of a potential flood. It doesn't "have any teeth," that bind cities into specific action, though, Gilbert said.

With the plan in place, communities will be eligible for more relief aid from the federal government when and if the President declares a disaster area. If a city has identified the steps that could be taken to avoid future problems, it will be able to use relief money more efficiently and FEMA will be more generous with the aid, Gilbert said.

Utah has been blessed with few occasions for Presidential disaster-area declarations, Gilbert said. However, the state is full of fault lines.

"I guess you could say we're one big shake away from needing this," he said.

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
MEETING WITH TRI-COUNTY EMERGENCY MANAGEMENT OFFICIALS
SEPTEMBER 12, 2002 @ BRAG ATTENDANCE LIST

Name	Title	Representing
Bruce Leonard	Public Works Director	Brigham City Corp. (Box Elder)
Jim Buchanan	Emergency Management Dir.	Brigham City Corp. (Box Elder)
Roger Jones	Director	BRAG
Paul Fulgham	Emergency Management Dir.	Tremonton City (Box Elder)
Stephen W. Hodges	Police Chief	Tremonton City (Box Elder)
Denton Beecher	Emergency Management Dir.	Box Elder County
Bob DeGasser	Emergency Management Dir.	Cache County Corp.
Mark Teuscher	Countywide Planner	Cache County Corp.
Jim Gass	City Manager	Smithfield City (Cache County)
Kelly Pitcher	Fire Chief	Cache County Corp.
Kevin Hansen	Public Works Dir.	Logan City Corp. (Cache County)
Scott Douglas	Emergency Management Dir.	Logan City Corp. (Cache County)
Paul Morgan	GIS Coordinator	Logan City Corp. (Cache County)
Kevin Maughan	Emergency Management Dir.	Hyrum City Corp. (Cache County)

Comments made at the Natural Hazard Mitigation Meeting 9-12-02

- The Mayors need to be informed about the Hazard Mitigation Program before they are asked to sign on. They should be informed about their responsibilities.
- BRAG should develop a fact sheet describing the Program that is sent to the Mayors.
- A fill-in-the-blank type letter that asks if they have any hazards beyond what is listed would get a better response.
- BRAG should attend the Cache County Mayors Association the Box Elder Commission, and the League of Cities meetings to give presentations.
- Brag should include previous mitigation plans that were developed for the individual cities.
- Does this program just cover Natural Hazards?
-

Emergency Manager Meeting Invite List 9-12-2002

Box Elder County

Name: Mr. Denton Beecher
Title: Emergency Services Director
Address:
01 South Main
Brigham City, UT 84302
Phone: 435-734-3357
Email: sbosgieter@boxeldercounty.org

Brigham City

Name: Mr. Jim Buchanan
Title: Emergency Services Director
Address:
P.O. Box 1005
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Name: Mr. Bruce Leonard
Title: Public Works Director
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P.O. Box 1005
Brigham City, Ut 84302
Phone: 435-734-2001 ext.2214
Email: cibb.brucel@state.ut.us

Tremonton

Name: Chief Warren Hodges
Title: Emergency Services Director
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Email: police@tremontoncity.com

Name: Mr. Paul Fulgham
Title: Public Works Director
Address:
P.O. Box 100
Tremonton, UT 84337
Phone: 435-257-2676
Email: pfulgham@tremontoncity.com

Name: Mr. Richard Woodworth
Title: City Manager
Address:
P.O. Box 100
Tremonton, UT 84337
Phone: 435-257-3324

Email:

Willard

Name: Mr. LeLand Jacobson
Title: Zoning Administrator
Address:
P.O. Box 593
Willard, UT 84340
Phone:
Email:

Name: Ms Lynne Buland
Title: Emergency Services Director
Address:
P.O. Box 593
Willard, UT 84340
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Cache County

Name: Captain Robert DeGasser
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50 W. 200 N.
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Email: bdegasser@cache.state.ut.us

Name: Sheriff Lynn Nelson
Title: Emergency Services Director
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50 W. 200 N.
Logan, UT 84321
Phone: 435-752-4103
Email: glnelson@cache.state.ut.us

Name: Chief Kelly Pitcher
Title: Cache Fire Chief
Address:
50 W. 200 N. Suite A
Phone: 435-750-7494
Email:cachechief@sisna.com

Hyrum City

Name: Mr. Brent Jensen
Title: City Manager
Address:
83 W. Main
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Phone: 435-245-6033
Email:

Name: Mr. Cardell Nielsen
Title: Emergency Services Coordinator
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Email:

Logan City

Name: Mr. Scott Douglas
Title: Emergency Services Director
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Name: Mr. Kevin Hansen
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Mendon City

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No. Logan City

Name: Mr. Jeff Jorgensen
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Richmond City

Name: Mr. Marlo Perkins
Title: City Manager
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P.O. Box 9
Richmond, UT 84701
Phone:
Email:

Smithfield City

Name: Mr. Warren Hullinger
Title: Emergency Services Director
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526 E. Parkview Cir
Smithfield, UT 84335
Phone: 435-750-9981
Email:

Name: Mr. Jim Gass
Title: City Manager
Address:
P.O. Box 96
Smithfield, UT 84335
Phone: 435-563-6226
Email: jgass@smithfieldcity.org

Wellsville

Name: Mr. Don Hartle
Title: City Manager
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Wellsville, UT 84339
Phone:
Email:

Rich County

Name: Mr. Dan Ames
Title: Emergency Services Director
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Laketown, UT 84038
Phone:
Email:

NATURAL HAZARD MITIGATION PLANNING
BEAR RIVER DISTRICT EMERGENCY MANAGEMENT MEETING
AGENDA

Thursday, September 12, 2002
12:00 p.m.
BRAG Conference Room - rear entrance
170 North Main
Logan, Utah 84321

12:00 p.m.	Welcome and Introductions- Roger C. Jones (BRAG Executive Director)
12:15 p.m	Local Natural Hazard Planning - Jeff Gilbert (BRAG Community Dev. Dir.) Disaster Mitigation Act of 2000
12:50 p.m.	Questions and wrap-up
1:15 p.m.	Adjourn

LUNCH WILL BE SERVED

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
MEETING WITH CACHE MAYOR'S ASSOCIATION OCTOBER 12, 2002 @ JUNIPER INN, LOGAN, UTAH
ATTENDANCE LIST

Name	Representing
County Executive Lynn Lemon	Cache County
Mayor LeRoy Atwood	Paradise City
Mayor Parry Spackman	Trenton City
Councilman Tom Kerr	Logan City
Mayor David Kooyman	Hyde Park City
Mayor Victor Jensen	River Heights City
Mayor Sydney Larsen	Mendon City
Mayor Gordon Olson	Hyrum City
Mayor Paul Dent	Lewiston City
Mayor Alma Leonhardt	Providence City
Mayor Ruth Maughan	Wellsville City
Mayor Ray Winn	Smithfield City
Mayor Val Potter	North Logan City
Mayor A. Lynn Welker	Nibley City
Mayor Kip Panter	Richmond City
Mayor John Dryer Pitcher	Cornish Town
Mayor Floyd Salisbury	Newton City
Mayor Gale Hall	Millville City
Mayor Mervin Thompson	Clarkston City
Mayor David Wood	Amalga City

Mayor Ruth Maughan of Wellsville City was not in attendance. Other arrangement will be made to contact her.

Meeting Summary: Information about the new requirements of the DMA 2000 and local natural hazard planning was conveyed to the mayors present. The information was well received, particularly when they were assured that this would require minimal time and resources from their jurisdiction and would be done without cost for them. A number of mayors asked questions related to timing, regulatory implications that may result from the plan, and what role cities will play. The mayors were giving information on the Hazard Mitigation Grant Program, Hazard Mitigation Planning Fact-sheet and a Local Government Natural Hazard Survey. Mayors were asked to complete the survey and return to BRAG in about a week.

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
MEETING WITH BOX ELDER COUNCIL OF GOVERNMENTS OCTOBER , 2002 @
BRIGHAM CITY PUBLIC SAFETY BUILDING, BRIGHAM CITY, UTAH
ATTENDANCE LIST

Name	Representing
Mayor Lou Ann Christensen	Brigham City
Mayor Richard Owen	Garland City
Mayor Paul Orme	Honeyville City
Mayor Keith Wadman	Portage Town
Mayor Michael Morgan	Snowville Town
Mayor Greg Iverson	Elwood Town
Mayor Deverle Wells	Corinne City
Mayor Ed Skrobiszewski	Perry City
Mayor Max Weese	Tremonton City.
Mayor Gil Miller	Bear River City
Commissioner Royal Norman	Box Elder County
Commissioner Suzanne Rees	Box Elder County
Commissioner Scott Hansen	Box Elder County

Mayor Jean Loveland Willard City, Mayor Robert Ash Mantua City, Mayor Rebecca Bronson Plymouth Town, Mayor Lyle Nesson Howell Town, Mayor Jim Garn Fielding Town, Mayor Jim Poulsen Deweyville City were not present. These individuals will be mailed information with an invitation to meet with BRAG staff for more information.

Meeting Summary: This meeting was organized by the Box Elder County COG and Emergency Management officials with a primary focus toward homeland security issues. BRAG was given some early agenda time to present the natural hazard mitigation planning requirements of DMA 2000. Because the focus was homeland security the COG meeting was also well attended by various City Council Members, Health Department Officials, Emergency Management Staff and Police/Fire Officials representing Box Elder County. BRAG staff presented those in attendance with information about the new requirements of DMA 2000 and the state's approach to regional natural hazard mitigation planning. Those present were given a Natural Hazard Mitigation Planning Fact Sheet, information on the Hazard Mitigation Grant Program and a Local Government Survey of Natural Hazards. Mayors were asked to complete the survey and return to BRAG by November 8, 2002.

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
MEETING WITH BRAG GOVERNING BOARD, SEPTEMBER 24, 2002 @ LAKETOWN, UTAH
ATTENDANCE LIST

Name	Representing
Mayor Lou Ann Christensen	Brigham City
Commissioner Bill Cox	Rich County
Mayor Paul Orme	Honeyville City
Commissioner Bryce Nielson	Rich County
Commissioner Norman Weston	Rich County
Mayor McKay Willis	Laketown
Mayor Craig Showalter	Woodruff Town
Councilman Darrel Gibbons	Cache County
County Executive Lynn Lemon	Cache County
Commissioner Suzanne Rees	Box Elder County
Commissioner Royal Norman	Box Elder County

Meeting Summary: Governing Board Members were introduced to the new requirements for local natural hazard mitigation planning. Board members were giving a Natural Hazard Mitigation Planning Fact Sheet. A number of questions were asked related to the planning process, timing and plan implementation. Board members were generally satisfied with BRAG's approach.

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
CERTIFIED CITIZEN PLANNER SEMINAR
NOVEMBER 7 & 8 NORTH LOGAN LIBRARY

Name	Title	Representing
Aguilar, Jay	Director	CMPO
Atwood, Gladys Ann	City Council	River Heights City
Bennett, Dave	Planning & Zoning Commission	Hyrum City
Bentley, Carolyn	Planning Commission	River Heights City
Bertine, Leisa	Board of Adj/Planning Comm.	Brigham City
Bohn, Laura		Utah State University
Brown, Richard	Planning & Zoning Commission	Millville City
Chase, Joshua		Utah State University
Coleman, Deen	Planning Commission	Brigham City
Ellison, Carmalee	Planner	Hyrum City
Godfrey,	Planning & Zoning	Clarkston Town
Hansen, Mike	Planner	GOPB
Hansen, Maurine	Concerned Citizen	Brigham City
Hemme, Chris	Planning Commissioner	River Heights City
Izatt, Char	Deputy Recorder, Planning & Zoning	Smithfield City
Krum, Robert	Planning Commission Chairman	Willard City
Lane, Kevin W.	Planning Commission	Brigham City
Lind, Sheila	City Recorder	Rivr Heights City
Lynne, Mark	Planning & Zoning	Hyde Park City
Mair, Chris	Planning Chairman	Stockton Town
Marshall, Jim	Planning & Zoning Commission	Honeyville City
McKay, Bryant	Planning & Zoning	Smithfield City
Meadows, Harry	Planning & Zoning Commissioner	Millville City

Name	Title	Representing
Moss, Rolayne D.	Board of Adjustments	Honeyville City
Moss, Carrel Y.		Honeyville City
Orme, H. Paul	Mayor	Honeyville City
Peterson, Celia	Student	Utah State University
Rickson, Michael	Planning & Zoning Commission	River Heights City
Robison, Ray	Planning Commission	Logan City
Sadler, Don	Cache County P & Z	Richmond City
Steinagel, Mark	Policy Analyst	State Legislature
Stokes, Barbara	Planning Commission Chair Person	Brigham City
Stott, Greg	Planning & Zoning	Millville City
Summers, Annette G.	Board of Adjustment	Clarkston Town
Teuscher, Mark	Countywide Planning	CPDO
Thorsted, Lloyd	Planning Commission	Honeyville City
Tinney, Kenneth	Board of Adjustment	Honeyville City
Toth, R. E.	Professor	Utah State University
Vernon, Rik	Planning & Zoning Commission	Smithfield City
Willers, Daniel		Utah State University
Williams, Sharon	Concerned Citizen	
Wright, Blake	Planning Commission	River Heights City
Young, Stanford	Planning Commission	Hyrum City

Comments made

•

NATURAL HAZARD MITIGATION PLANNING
PUBLIC OUTREACH AND INPUT
BEAR RIVER DISTRICT
MEETING WITH BRAG GOVERNING BOARD, November 25, 2003 @ BRAG, Logan, UTAH
ATTENDANCE LIST

Name	Representing
Mayor Lou Ann Christensen	Brigham City
Mayor Paul Orme	Honeyville City
Commissioner Norman Weston	Rich County
Commissioner Thomas Weston	Rich County
Councilmen Cory Yeates	Cache County
Councilman Darrel Gibbons	Cache County
County Executive Lynn Lemon	Cache County
Mayor Alma Leonhardt	Providence City
Commissioner Scot Hansen	Box Elder County
Commissioner Suzanne Rees	Box Elder County
Commissioner Clark Davis	Box Elder County

Meeting Summary: A full draft version of the PDM plan was given to each board member. The board discussed a number of the plans findings and recommendations and board member were informed of how the process will proceed to final approval. Board members were again encouraged to review the plan and make comments and help develop and refine mitigation projects and strategies.

Natural Hazard Mitigation Goals and Objectives

BRAG is assisting communities in compliance with new Federal requirements of the Disaster Mitigation Act of 2000. We need your help in identifying local projects to be included in the plan. Developing strong mitigation goals and objectives is crucial in the planning process and will likely influence future mitigation project funding. **Lack of participation in the plan could reduce the level of "post-disaster" assistance from FEMA in the event of a disaster in your community.**

"Hazard Mitigation" means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural and human-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities. **Potential projects should be designed to mitigate the impacts of flooding, wildfire, landslides, earthquakes, dam failure, severe weather, insect infestation, drought or any other category of disaster you identify.**

Please complete and return to BRAG by December 19, 2003
BRAG, 170 N. Main, Logan UT 84321 or Fax (435) 752-6962

Format Example:

Goal: : Protect citizens and property from flooding

Objective:	Reduce flood threat from Chalk Creek within Floodsville City
Action:	Maintain and improve existing levee along Chalk Creek
Priority:	High
Timeframe:	Six months to one and half years
Potential Funding:	Routine maintenance County public works
Estimated Cost:	Minimal
Participation\Staff:	County Public Works
Background (if needed)	Flatten the sideslopes, filling in depressions and rodent holes, and removing any deep-rooted plants along the levee. Fill and protect locations where the levee is eroded with riprap or other armoring.

Objective:	Reduce flood threat from Chalk Creek within Floodsville City
Action:	Initiate flood plain mapping study to determine whether a flood threat does exist.
Priority:	Medium
Timeframe:	Three to five years
Potential Funding:	Undetermined local source potentially HMGP
Estimated Cost:	$4,000
Participation\Staff:	State and Contractor
Background (if needed)	FEMA has designated Floodville as a nonflood hazard area

Objective:	Reduce flood threat from Chalk Creek within Floodsville City
Action:	Advise residents of the availability of flood insurance.
Priority:	High
Timeframe:	Immediate
Potential Funding:	County
Estimated Cost:	Minimal
Participation\Staff:	County Floodplain manager
Background (if needed)	Inform residents adjacent to the channel of the potential risk of flooding and advise them flood insurance is available. Because of Floodsville's designation, flood insurance is priced very reasonable.

(Civil)

PROOF OF PUBLICATION

STATE OF UTAH
COUNTY OF CACHE, ss.

On this 10th day of December A.D. 2003

personally appeared before me Rachelle S. Thomas who being first duly sworn, deposes and says that she is the chief clerk of the Cache Valley Publishing Co., publishers of The Herald Journal a daily newspaper published in Logan, City, Cache County Utah, and that the advertisement

BEAR RIVER DISTRICT NATURAL HAZARD PRE-DISASTER MITIGATION PLAN

a copy of which is hereto attached, was published in said newspaper for One (1) issue

commencing December 10, 2003 and ending December 10, 2003

Signed Rachelle S. Thomas

Subscribed and sworn to before me, the day and year above written.

Signed Cynthia K Fulton
Notary Public.

My Commission expires September 7, 2007

Notary Public * State of Utah
CYNTHIA K FULTON
320 West 1330 North
Logan, UT 84341
My Comm. Exp. September 7, 2007

Bear River District Natural Hazard Pre-Disaster Mitigation Plan

As required by the Disaster Mitigation Act of 2000, a regional Pre-Disaster Mitigation Plan has been produced in draft form and is available for public review and comment. The plan identifies potential natural hazards, estimates vulnerabilities and recommends mitigation strategies for local jurisdictions in Box Elder, Cache and Rich Counties. Those interested can view the draft plan online at: http://www.brag.dst.ut.us/BRAG%20pdm%20plan.htm or at the BRAG office at 170 N. Main, Logan Utah 84321. Send comments, concerns or questions before December 31, 2003 to jeffg@brag.dst.ut.us or call Jeff Gilbert at 435-752-7242 for more information.
Publication Date: December 10, 2003

RECEIVED
DEC 12 2003
BRAG
LOGAN, UT

APPENDIX D
HAZARD MAPPING DATA SOURCES & FACILITY COST ESTIMATES

Bear River District Pre-Disaster Mitigation Plan
Metadata – Information about the GIS data

Data Layer	Creator	Date Produced	Scale	Description	Classes
Population	U.S. Census Bureau	2000	Census Block Level	Total number of individuals within each block	
Housing Units	U.S. Census Bureau	2000	Census Block Level	Total number of dwelling units within each block	
Housing Value	U.S. Census Bureau	2000	Census Block Group	Average value of owner-occupied dwelling units within the block group	
Critical Facalities				HAZUS DATA	Schools, police stations, hospitals and fire stations
Businesses				HAZUS DATA	All non-home businesses
Water Related Land Use	Utah Division of Water Resources	Bear River area produced 1996, Published 2000	1 : 24,000	Land use types from aerial photography	All built-up classes labeled with "v"
Quaternary Faults	United States Geological Survey	09-01-02	1 : 100,000	GIS data digitized from Hecker, Utah Geological Survey Bulletin 127.	All Quaternary Faults were used in the analysis with a 100' buffer on both sides of the fault
Earthquake Epicenters 1963-1993	University of Utah Seismograph Station	1993	1 : 100,000	All earthquakes large enough to register on seismograph	
Data Layer	**Creator**	**Date Produced**	**Scale**	**Description**	**Classes**
Wildfire Hazard	Bureau of Land Management and Division of Emergency Services	March 2000	Unspecified 1: 100,000	Hazard rating based on the population density, fire hazard potential (based on vegetation type), and fire occurrence (fire density) of a given location	Only classes labeled "extreme" and "high" were used in this analysis

Data Layer	Creator	Date Produced	Scale	Description	Classes
Wildfires 1986 - 2000	?	?	?	Location of Fires	
Flood Zones	FEMA and FIRM	1978-1981	1 : 10,000	Areas considered within 100 year floodplains by FEMA	Only Zone A considered in analysis
Landslide Areas	USGS	Published 2001	1 : 100,000	Landslides that have been mapped	Only active landslide areas considered in analysis
Liquefaction Potential	Utah Geologic Survey	1994	1 : 100,000	Liquefaction Potential	Only areas of high liquefaction potential considered in analysis

INFRASTRUCTURE COSTS
(HAZUS) ROAD CONSTRUCTION PER MILE
COST TEMPLATES

Road Tunnels
1 million dollars per 10 meters

Bridges see attachment page 3-30
Major bridges (think I-15) 20 million Dollars
Wood bridges 1 million
Concrete bridges 1 million

Natural gas distribution lines
$150,000 per km

Rail Track
$1.5 million per km

Waste Water Distribution lines
$150,000 per km

Potable water distribution lines
$150,000 per km

Electric power distribution lines
$30,000 per km

Communication distribution lines
$50,000 per km

Water treatment plants page 3-37

Sewer and waste water treatment plants 3-38

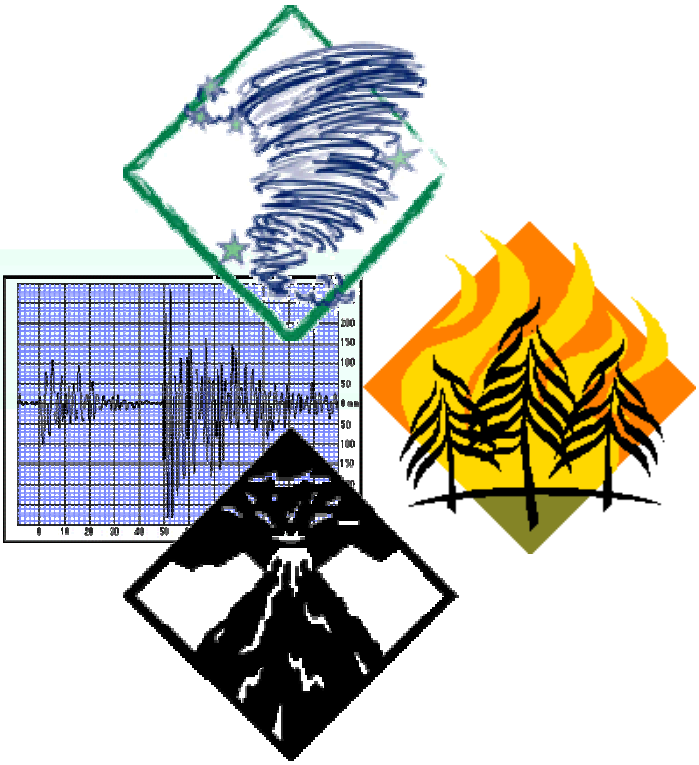
Power plants and substation 3-40

ROAD REPLACEMENT COSTS		
RIGHT-OF-WAY Feet	**CONSTRUCTION Cost Per Mile**	**DESCRIPTION**
110	$ 4,500,000	6 Lanes, 1 Center or Median, and 2 Shoulders
110	$ 4,700,000	4 Lanes, 1 Center or Median, 2 Shoulders, and 2 Sidewalks
110	$ 4,700,000	6 Lanes, 1 Center or Median, and 2 and Sidewalks
84	$ 3,900,000	2 Lanes, 1 Center or Median, 2 Shoulders, and 2 Sidewalks
84	$ 3,900,000	4 Lanes, 1 Center or Median, and 2 Sidewalks
66	$ 3,100,000	2 Lanes, 1 Center or Median, and 2 Sidewalks
66	$ 3,500,000	4 Lanes, and 2 Sidewalks
66	$ 3,600,000	4 Lanes, and 1 Center or Median
150+	$ 7,100,000	8 Lanes, 2 Median, and 4 shoulders
220	$ 5,500,000	4 Lanes, 2 Median, and 4 shoulders
125	$ 6,100,000	6 Lanes, 1 Center or Median, 2 shoulders, and 2 sidewalks
I-15 (widening)	$ 10,000,000	Add one lane each direction
Legacy Hwy / I-80 / SR-201	$ 30,000,000	
I-15 (reconstruction), 5600 W. Freeway	$ 50,000,000	

Five County Association of Governments

Natural Hazard Mitigation Plan

A Regional Approach
for Southwestern Utah



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Executive Summary

The mission of the Five County Association of Governments (FCAOG) Natural Hazards Mitigation Plan is to substantially reduce the vulnerability of communities, within the region, to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, private property, critical facilities, and infrastructure. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer community.

Plan Organization

The FCAOG Natural Hazards Mitigation Plan was developed and organized within the rules and regulations established under 44 CRF 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within FCAOG, as well as a hazard identification study and a vulnerability analysis of ten hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the ability of communities within the FCAOG planning district to address hazards and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing

The FCAOG Plan has been financed and developed under the Pre-disaster Mitigation (PDM) Program provided by the Federal Emergency Management Agency (FEMA) and the Department of Public Safety Division of Emergency Services and Homeland Security (DESHS). The FCAOG aided in funding, providing in-kind assistance to local governments.

Plan Participation

The FCAOG Natural Hazards Plan has been completed with participation and guidance from the FCAOG Regional Hazard Mitigation Team and as a result of a collaborative effort between the Five County Association of Governments, Department of Public Safety Division of Emergency Services and Homeland Security, public agencies, and the citizens, elected officials, and public employees of the cities and towns within Beaver, Garfield, Iron, Kane, and Washington Counties. Questionnaires were provided community leaders, and workshops and public meetings were conducted during plan development. Public Participation for any planning project is vital and care was taken to provide many opportunities for public comment and participation. Comments, questions, and discussions were given strong consideration in the development of this plan. This multi-jurisdiction mitigation plan was completed with assistance and input from:

Beaver County
- Emergency Manager
- LEPC
- NRCS
- Beaver City
- Milford City
- Minersville Town

Garfield County
- Emergency Manager
- LEPC
- Antimony Town
- Boulder Town
- Cannonville Town
- Hatch Town
- Henrieville Town
- Escalante City
- Panguitch City
- Tropic Town

Iron County
- Emergency Manager
- LEPC
- Brian Head Town
- Cedar City
- Enoch City

Kanarraville Town
Paragonah Town
Parowan City

Kane County
Emergency Manager
LEPC
GIS Department
Alton Town
Big Water Town
Glendale Town
Kanab City
Orderville Town

Paiute Indian Tribe of Utah
PERC
Cedar Band Council
Indian Peaks Band Council
Shivwits Band Council

Washington County
Emergency Manager
Washington City LEPC
Enterprise City
Hildale City
Hurricane City
Ivins City
LaVerkin City
Leeds Town
New Harmony Town
Rockville Town
St. George City
Santa Clara City
Springdale Town
Toquerville Town
Virgin Town

Hazards Identified
Natural Hazards to be addressed in the plan were determined at a meeting of the FCAOG Regional Hazard Mitigation Team. The Team recognized the following hazards as being the most significant to the counties and towns within the FCAOG planning district: Wildfire; Landslide; Flood; Earthquake; Volcanoes; Drought; Problem Soil; Severe Weather; Insect Infestation; Radon Gas

Plan Goals
In an effort to ensure that the mission of the FCAOG PDM Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan. The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.
- Minimize the impacts of flooding

- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

Purpose
To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote Natural Hazard mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the Region. This plan is an aid in enhancing city and state officials, agencies, and public awareness to the threat that hazards have on property and life. It identifies what can be done to help prevent or reduce the vulnerability, risk and impact of natural hazards. Another function of this Plan is to provide information to local jurisdictions regarding the availability of funding sources for natural hazard mitigation projects. A partial listing of funding sources is included in this plan as Appendix H.

Scope
The FCAOG Natural Hazard Mitigation Plan was developed in accordance with the requirements of FEMA Section 322 regulations, DESHS, local planning and the FCAOG.

The goal of this plan is to assist the five counties of Southwestern Utah, in reducing the costs of natural disasters; namely Wildfire, Landslide, Flood, Earthquake, Volcanoes, Drought, Problem Soil, Severe Weather, Insect Infestation, and, Radon Gas through mitigation practices. This plan provides comprehensive hazard identification, risk assessment, vulnerability analysis, mitigation actions, and implementation schedule for the region.

The FCAOG met the regulations set forth by FEMA in completing the plan. Regulations, including future monitoring, evaluating, updating and implementing, will take place as new incidents occur and or every three to five years and will be included in the local mitigation plans as well.

Acknowledgements

County Commissioners
Billie Dalton, Chair- Beaver
Patrick R. Yardley
Mark S. Whitney

Maloy Dodds, Chair- Garfield
Clare M. Ramsay
Dell LeFevre

Gene E. Roundy, Chair- Iron
Dennis Stowell
Wayne A. Smith

Ray Spencer Chair- Kane
Daniel W. Hulet
Mark Habbeshaw

Alan D. Gardner, Chair- Washington
James J. Eardley
Jay Ence

PITU Tribal Council
Lora Tom, Chairwoman

Mayors
Wade Bradshaw,. Beaver City
Robert Craw, Minersville
Eugene H. Mayer, Milford
Shannon Allen, Antimony
Keith Gailey, Boulder
Alma Fletcher, Cannonville
Lenza Wilson, Escalante
Kevin Eldridge, Hatch
Riley Miller, Henrieville
Janet Oldham, Panguitch
Jean Seiler, Tropic
H.C. Deutschlander, Brian Head
Gerald R. Sherratt, Cedar City
Patrick Franks, Enoch
Randy Williams, Kanarraville
Constance Robinson, Paragonah
Ronald K. Smith, Parowan
Claren Heaton, Alton
Will Marshall, Big Water
William Spencer, Glendale
Brad Adair, Orderville
Kim Lawson, Kanab
Merrill Fisher, Enterprise
David K. Zitting, Hildale
Tom Hirschi, Hurricane
Daren Barney, Ivins
Tom Stocks, LaVerkin
Norma Gier, Leeds
Joel Webster, New Harmony
Dan McGuire, Rockville
Daniel D. McArthur, St. George
Dennis Drake, Santa Clara
Bruce Vanderwerff, Springdale
Kenneth Powell, Toquerville
Jay Lee, Virgin
Terrill Clove, Washington City

PITU Band Chairpersons
Anthonia Tom, Indian Peaks
Travis Parashonts, Cedar
Glenn Rogers, Shivwits

Regional Natural Hazards Mitigation Team
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Clare Ramsay-Commissioner, Garfield
Merrill Fisher-Mayor, Enterprise
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Nathan Rousseau-LEPC, Garfield
Charlie Morris-LEPC, Iron
Dave Owens-LEPC, Kane
Dean Cox, LEPC, Washington
Mac Hall-Public Works, Hurricane
Jim McGuire-Planning, Washington City
Bob Hansen-Fire/EMS, Santa Clara
Bill Lund-Utah Geographical Survey
Steve Rundquist-DESHS

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Valentina Ferguson, Beaver Ambulance
Twinkle Erwig, Beaver Valley Hospital
Ken Yardley, County Sheriff
Veda Cox, EMT Training Officer
Ann Pierce, County Search & Rescue
Pete Jones, Minersville FD

Teddy Bridge, Milford FD
Kathy Hendricks, USDA Farm Service
Jerry Jorgenson, SWPHD
Darrick Whipple, USDA Farm Service
Lynn Kitchen, USDA Farm Service
George Humphreys, County FD dist 1
Randy Marshall, USDA Farm Service

Garfield County LEPC & Mitigation Team
Kris Hatch, County Emergency Manager
Allen Henrie, Panguitch City Manager
Nathan Rousseau, LEPC Chair
Clint Pierson, Deputy Sheriff
Becki Bronson, Media Rep
Bob McCullough,Garfield Memorial Hospital
Chad Justus, Hatch FD
Dave Dodds, Panguitch FD
Don Porter, Escalante FD
Jens Munthe, LEPC Escalante
Karen Ott, LEPC Secretary
Kerry Alvey, Tropic FD
Mona Partridge, County Ambulance
Nick Reynolds, School District
Ron Harris, Tropic FD
Sandrea Francisco, Tropic Town
Eric Packer, Garfield Memorial Hospital
Tammy Barton, County Ambulance

Iron County LEPC & Mitigation Team
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Larry LaForte, Forestry, Fire & State Lands
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Kit Wareham, Cedar City Engineer
Chad Nay, County Building Inspector
Chad Reed, USU Extension Office
Charlie Morris, County Emergency Manager
Debbie Morris, County Emergency Manager
Earl Gibson, Public Works Director/ Enoch
Kelly Stones, Public Works/ Parowan
Ryan Riddle, County Fire Warden
Garry Bulloch, Brian Head Town Marshall

Kane County LEPC & Mitigation Team
Lamont Smith, Sheriff
Bev Dinsmore, Dispatch Supervisor
Mark Habbeshaw, Commissioner
Dan Hulet, Commissioner
Dave Owens, Emergency Services Director
Earl Levanger, County Fire
Warden/Orderville Fire Chief
Keith Mcallister, Kanab City Manager
Kim Lawson, Kanab City Mayor
Dilworth Perkins, Kane County EMS
Jeff Mosdell, Kanab Fire /County HazMat
Alan Alldredge, Kanab Fire Chief
Doug Crosby, Kanab Police Chief
Keith Robinson, Kanab Public Works
Ken Johnson, Cedar Mountain Fire Chief
Terra Sue Robinson, Volunteer Center
Tom Corrigan, Fredonia Town

Paiute Indian Tribe of Utah PERC
Tara Marlowe, Environmental Officer
Delice Tom/Jackie Bow, Cedar Band
Robert Borchardt, Indian Peaks Band
Cordelia Wall, Shivwits Band

Washington County LEPC & Mitigation Team
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Ron Sappington, County Assistant
Dave Patterson, Asst. County Attorney
Bryan Bracken, BLM
Esther Benson, BLM
Rich Caulfield, American Red Cross
Matthew Brower, Santa Clara City Mgr
Robert Hansen, Santa Clara City PS
Mike Vercimah, Hurricane City Pub. Works
Lynn Excell, Hurricane City PD
Ed Campbell, Hurricane City FD
Wade Carpenter, Ivins City PS
Jeff Dial, St. George City PD
Jason Jolley, SWUPHD
Ron Whitehead, Washington County PW
Hal Carlson, St. George City EM
Roland Barlow, Hildale City FD

State DESHS staff
Ryan Pietramali, Planning Coordinator
Steve Rundquist, Five County Area Rep.

Five County AOG staff
John Williams, Executive Director
Curt Hutchings, Project Manager
Gary Zabriskie, Associate Planner
Edward Dickie, GIS Coordinator

Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be lessened when attention is turned to mitigating their impacts and effects before they occur or re-occur. This Natural Hazard Mitigation (NHM) Plan is the initial step in identifying natural hazards and the impacts they may have on the residents of the Southwestern District of Utah.

What is Hazard Mitigation

Hazard mitigation is defined as any cost-effective action(s) that have the effect of reducing, limiting, or preventing vulnerability of people, property, and the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation measures, which can be used to eliminate or minimize the risk to life and property, fall into three categories. First; are those that keep the hazard away from people, property, and structures. Second; are those that keep people, property, and structures away from the hazard. Third; are those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation measures must be practical, cost effective, and environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

The primary focus of hazard mitigation actions must be at the point at which capital investment decisions are made and based on vulnerability. Capital investments, whether for homes, roads public utilities, pipelines, power plants, chemical plants or warehouses, or public works, determine to a large extent the nature and degree of hazard vulnerability of a community. Once a capital facility is in place, very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which insure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

Previously, mitigation measures have been the most neglected programs within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures take time to implement. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to eliminating long-term risk to people and property living in Utah from hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

Scope

Pre-Natural Disaster Mitigation Planning (PDM) is a statewide activity. The State of Utah has worked with all local jurisdictions by means of the seven regional Associations of Governments to accomplish this planning project. The Five County Association of Governments, which includes Beaver, Garfield, Iron, Kane, and Washington Counties, located in southwestern Utah, has completed a regionally based, multi-jurisdictional plan that addresses issues facing each individual county and their respective local communities. Natural hazards addressed are: Flooding; Wildfire; Landslide; Volcanism; Earthquake; Drought; Severe Weather; Problem Soils;

Insect Infestation; and Radon Gas. In much of the Five County planning area natural-hazards information is limited in nature and scope. Therefore, the information, data, and conclusions, which form the basis of the current PDM plan, are not comprehensive. However they do form a basis for future planning. This generalized regional plan does not answer all questions relative to natural-hazard impact in the Five County area, but rather represents a common point from which further study and analysis should begin.

Goals

To coordinate with each participating local government to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document and any additional State planning expectation, both regionally and specifically, as needed, by gathering local input. And to also meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

Local Goals

These goals form the basis for the development of the Natural Hazards Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Promote activities designed for protection of life prior to a natural disaster event.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards.
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources

- Establish a framework and data base for the communities in the Five County Region to use to apply for available funding.

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation.
- Projecting a time frame for implementation.
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available.
- Identifying alternative measures, should financing not be available.
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties.
- Be based on the Vulnerability Analysis.
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters.
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options.
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal.
- Prevent property damage to homes, businesses and critical facilities
- Prevent economic losses, hardship or human suffering.
- Meet applicable permit requirements.
- Not encourage development in hazardous areas.
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem.
- Assure that the benefits of a particular mitigation measure are cost effective
- Have manageable maintenance and modification costs.
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement.
- Whenever possible, use existing resources, agencies and programs to implement the project.

Purpose & Process

To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is an aid in enhancing city, county and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability and risk of each Utah jurisdiction. A partial listing of funding sources to accomplish natural hazard mitigation projects is included in this plan as Appendix H.

This regional/multi-jurisdictional plan evaluates the impacts, risks and vulnerabilities of natural hazards in a jurisdictional area affected by a disaster. The plan supports, provides assistance, identifies and describes mitigation projects for each hazard. The suggestive actions and plan implementation for local and tribal governments could reduce the impact of future disasters. Only through the coordinated partnership with emergency managers, political entities, public works officials, community planners and other dedicated individuals working to implement this program was it accomplished.

To develop the mitigation plan, The Utah DESHS, based on the Governor's Office of Planning and Budget, the Utah League of Cities and Towns, and the U.S. Department of Housing and Urban Development, chose to use the planning services of the Utah Associations of Governments.

Seven regional Associations of Government:

1. Bear River Association of Governments
2. Five County Association of Governments
3. Mountainland Association of Governments
4. Six County Association of Governments
5. Southeast Utah Association of Governments
6. Uintah Basin Association of Governments
7. Wasatch Front Regional Council

Cities and Towns within the Five County Area are:

Beaver County
Beaver City, Milford, Minersville

Garfield County
Antimony, Boulder, Cannonville, Hatch, Henrieville, Escalante, Panguitch, Tropic

Iron
Brian Head, Cedar City, Enoch, Paragonah, Parowan, Kanarraville

Kane County
Alton, Big Water, Glendale, Kanab, Orderville

Paiute Indian Tribe of Utah
PITU Council, Cedar Band, Indian Peaks Band, Shivwits Band

Washington County
Enterprise, Hildale, Hurricane, Ivins, LaVerkin, Leeds, New Harmony, Rockville, St. George, Santa Clara, Springdale, Toquerville, Virgin, Washington City

The Five County Plan will be included as part of the State-wide PDM Plan developed by the Utah Division of Emergency Services and Homeland Security. Future monitoring, evaluating, updating and implementing will take place as new incidents occur and or every three to five years and will be included in the local mitigation plans as well.

Federal Authority

Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidentially declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards risks and vulnerabilities in that plan.

State Authority

The Governor's Emergency Operation Directive, The Robert I. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title *44,* CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code *53-2, 63-5,* Disaster Response Recovery Act, *63-5A,* Executive Order of the Governor, Executive Order II, Emergency Interim Succession Act, 63-5B.

Five County Association of Governments Authority

The Associations of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

> **The Five County Association of Governments (FCAOG), as presently constituted, was established in 1972. The intent of the local governments in establishing the organization is given in the Articles of Association:**
>
> ***"Therefore, we the representatives of local government of Beaver, Garfield, Iron, Kane, and Washington Counties in the State of Utah, hereby join together in a voluntary organization. . . for the purpose of meeting at regular intervals to discuss and study area wide problems of common interest and concern, and to develop policy and action recommendations for ratification and implementation by member governments in the area served by the region."***

Local Authority

Local governments play an essential role in implementing effective mitigation, both before and after disaster events. Each local government will review all damages, losses, and related impacts to determine the need or requirement for mitigation action and planning whenever seriously effected by a disaster, or when applying for state or federal recovery assistance. In

each county the local executive responsible for carrying out plans and policies is the Board of Commissioners. Local governments must be prepared to participate in natural hazard mitigation as outlined in this document.

Environmental Considerations

Natural disasters are naturally occurring phenomena. They play an integral part in maintaining balance in our world. Meteorological, geological, and hydrological processes are what have shaped the geology of the Five County area and will continue to do so. These phenomena are only considered disasters when they affect humans and infrastructure. Modern engineering has made it possible in many cases to prevent damage from natural hazards. However the economic and environmental costs of such measures can be rather high. Tampering with natural systems may also create an imbalance in the natural environment. Effects of many of these imbalances long-term are still unknown. An open question remaining is whether it is better to live with an acceptable amount of risk to the human environment, respecting the natural processes where appropriate, than to attempt to develop mitigation measures at every chance. Nature provides its own mitigation measures that need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation measures, all applicable city and county ordinances, state laws and federal regulations pertaining to the environment must be followed. All federally funded projects must comply with federal environmental laws. See Appendix A, for an explanation and details.

Planning Process

The process includes several steps beginning with identifying hazards that may occur; profiling hazard events that have occurred; making an inventory of community assets such as hospitals, fire stations, sheriff/police stations, schools, community centers, airports, bus stations, water tanks, sewer facilities, TV/radio facilities, power plants; and, estimating the effect of a hazard on community assets; See Appendix B, for details.

Risk Assessment Process

A risk assessment process involves estimating risks that a natural hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Sources

Source of data for the histories, profiles, and maps found inside this Hazard Mitigation Plan are taken from a collection of different sources. The majority of data for the Plan came from multiple departments within the State of Utah Government. Some Data came from professional journals and Federal Government websites (ex. USGS). Other data came from the five county area local governments' and citizen's input. For more information on the sources of data please see sources in Appendix F.

General Regional Profile

History

Early History

Southwestern Utah has a rich heritage, which dates back 10,000 to12,000 years. Early inhabitants were Desert Archaic hunter gatherers, who were supplanted by the Anasazi basket and pottery makers. These early people generally organized themselves into small bands of several families, groups that were limited in size because of their limited resources.

The Anasazi disappeared about 800 years ago and were replaced by Uto-Aztecan hunters, which were the forerunners of the Southern Paiute Indian Tribe, and related to the mighty Aztecs of Mexico. The quest for food kept them on the move; they lived principally on fish, birds, wild game, wild fruits, roots, and seeds.

In the early 1550s, Spanish conquerors led by Coronado first explored the Colorado River Plateau region. However, the Colorado Plateau and Grand Canyon prevented Spanish exploration into the area of present day Southwestern Utah for hundreds of years. The earliest documented evidence of exploration in this area was in 1776 when a party led by Father Escalante and Father Dominguez traveled through the region searching for a route to the California Missions. From the Milford region, the party turned southeast and was forced southward by the high mountains to the east. They traveled along the foot of a rough and rugged escarpment known as the Hurricane Fault. They continued south until a group of Parrusit Indians (related to the Paiutes) agreed to show them a route over the Hurricane Fault. Once the route was discovered by the Spaniards, it became a common route for Spanish traders and immigrants.

As more Spaniards entered the region, Native Americans experienced increasing disruption to their traditional way of life. Paiute encampments were raided for slaves and forced to mine gold. However, the small settlement of Spaniards that oversaw the mining was short-lived as the Native Americans revolted and killed the Spaniards. Although the route remained a well-used trading route known as the Old Spanish Trail, no permanent, non-Native American, settlements were attempted in the region until the arrival of Mormon Pioneers. The area remained Mexican territory until 1848, when the treaty of Guadalupe Hidalgo ceded much of the West to the United States. All of what is now Utah was designated as Indian Territory, and remained so until 1868.

European Settlement

Mormons first traveled through the region in 1847, when church leaders called a group of sixteen men to open up a route to California to get seeds, cuttings, and roots. This mounted company established a route along the Old Spanish Trail. Brigham Young sent Parley P. Pratt with 50 young men to the region in 1849 to look for sites for future towns. Upon finding friendly Indians who engaged in primitive agriculture, as well as discovering iron in the region near present day Cedar City, Pratt's group hurried back to Salt Lake City with a report of many potential settlement sites. The first outposts were established in New Harmony and Santa Clara for the purposes of setting up an Indian mission. Other outposts were soon established along the streams and rivers of the region.

Iron County was established in 1850. George A. Smith was appointed as the county's first Chief Justice. His job was to settle the area for the purpose of developing the iron ore deposits. Both Parowan and Cedar City were established in 1851. During the first year of development, 2,500 pounds of iron were produced, the first iron refined west of the

Mississippi River. To facilitate the processing of iron in the two towns, skilled tradesmen were brought in from the Mormon European Missions.

The first settlers in Beaver County came from Parowan in 1856. The county's first town was laid out in the spring of 1858, and was named for the many beaver dams found on the river there. In 1852, lead was discovered in Beaver County, which led to the establishment of the town of Minersville in 1859.

Brigham Young called 300 families to establish the new community of St. George in 1861. The town was named after his counselor, George A. Smith, because he was nominally in charge of the southern Utah colonies. The Mormon prophet dispatched the group, which included 26 Swiss immigrant families, to grow cotton. The first experimental crop was planted in the Santa Clara Valley. The soil and climate were well suited for growing cotton, and two years later the only Dixie-style cotton mill in the northern states was established. The cotton boom lasted until the close of the Civil War.

For years saints were called or directed to the Washington County region to settle. In 1863, St. George was designated as the county seat for Washington County. Young, himself, eventually established a winter home in St. George, where he later initiated and oversaw the completion of the first Mormon temple in the West in 1877.

As Washington County grew and prospered, people began moving into the Kanab region. In 1864, Kane County's boundaries were set by the Territorial Legislature. The communities of Kanab and Orderville were established in 1870 and 1873 respectively.

Back north, silver was discovered in the San Francisco Mountains west of the Beaver area, which gave impetus to one of the biggest "rushes" of Western history. Because of the mining industry in this region, the telegraph was brought south to Frisco, the railroad was brought to southern Utah, and the town of Milford was established in 1880. Beaver County was created in 1886.

During this time, Garfield County was formed from parts of Iron and Kane counties in 1882. Mormon colonists from Parowan and Beaver had already settled Panguitch. Exploration parties moved east into what they called "Potato Valley" and founded Escalante. The town was named for Father Escalante at the suggestion of a U.S. Government survey party lead by John Wesley Powell, who encountered the Mormon explorers at the future town site. Communities in Bryce Valley were subsequently settled in the 1880s and 1890s, mainly by people moving up the Paria River after floods downstream washed away the small amounts of arable lands.

Much of the Mormon settlement in the region was accomplished without legal title to lands. Some lands were formally purchased from American Indians in the area, but much more was simply settled without title. After 1868, the lands became subject to U.S. land tenure laws, including the Homestead Act. Federal and state land offices were established and the titles to lands settled before 1868 began to be perfected. The climate and topography of the region limited the amount of land that could be "proven up," thus creating the large blocks of federal lands found in the region today.

As settlement increased throughout this region, Native Americans' traditional homelands were eventually taken over. The Native Americans were subject to unfortunate policies of the federal government that resulted in termination of tribal recognition. Late in the 19th

century, the Paiute bands in southern Utah coalesced into five bands: the Shivwits, Indian Peaks, Cedar, Kanosh, and Koosharem bands. Reservations were established between 1903 and 1929.

The Twentieth Century

At the turn of the Century, the Mormon settlements and regions of southwestern Utah experienced moderate growth. The area was heavily dependent upon the agriculture and mining sectors of the economy. Most communities experienced decline during the Great Depression and into the mid-1960s. The construction of Interstate 15 through the region promoted increased interest in the area and precipitated the resurgence of Cedar City and St. George. The area also became increasingly attractive to retirees from the Midwest and Pacific Northwest.

Around this time, an act of Congress restored the federal trust relationship to the five bands of Paiutes, which constitutes the Paiutes Indian Tribe of Utah. By 1983, the majority of tribal members had access to adequate housing and health care, although chronic health problems, low educational attainment, underemployment, and alcoholism persisted.

Today Southwestern Utah is one of the fastest growing areas of the state. The I-15 corridor communities are experiencing rapid population and employment growth, while communities off the I-15 corridor rely on a burgeoning tourist and trade economy, still heavily reliant upon natural resource-based employment.

As we enter the twenty-first century, it is likely that the rapid growth of this region will continue. Some residents fear for the future since rapid growth has already had some negative impacts on the region, such as an increasing crime rate, increasing housing prices, the surfacing of environmental problems, and a loss of cultural heritage and regional identity. However, others are optimistic about the growth, citing low unemployment figures and increased amenities.

Area Background

The five counties that make up the southwestern area of Utah, Beaver, Garfield, Iron, Kane and Washington, are unique to the state and country. These counties have unique characteristics including geographical, geological, historical, and demographic that define the regions environment.

Jurisdictions

Southwestern Utah conjures up many images to the minds of those who live in or visit the region including red rock cliffs and mesas, pristine wilderness and desert, scenic national parks and monuments, hiking, camping, and other outdoor recreation. The fact is that few people associate this region with its growing population and economic base. Yet, over 140,000 people reside here in this region, a majority of which resides in 36 different cities and towns (see Table 1).

Table 1. Jurisdictions of the Five County District

Beaver County	Garfield County	Iron County	Kane County	Washington County
Beaver City	Antimony	Brian Head	Alton	Enterprise
Milford	Boulder	Cedar City	Big Water	Hildale
Minersville	Cannonville	Enoch	Glendale	Hurricane
	Escalante	Kanarraville	Kanab	Ivins
	Hatch	Paragonah	Orderville	LaVerkin
	Henrieville	Parowan		Leeds
	Panguitch			New Harmony
	Tropic		Paiute Tribe	Rockville
			Cedar Band	Saint George
			Indian Peaks Band	Santa Clara
			Shivwits Band	Springdale
				Toquerville
				Virgin
				Washington City

Geography and Environment

The geography and environment of a region play important roles in community planning. As towns, cities, and counties develop, planners must consider the "lay of the land" and the many environmental issues that come with it. It is now more important than ever that we understand the land on which we develop, and its accompanying limitations and potential problems. The Five County Area is no exception, and has many unique issues pertaining to its distinct geography and environment.

Physical Description

The Five County District is located at the southwest corner of Utah, near the heart of the Intermountain West. The five counties are contained in two major physiographic provinces. Most of Beaver, Iron, and Washington County lay within the Basin and Range province, which generally consists of north-south trending mountain ranges separated by broad arid valleys with interior drainage, and vegetated with sagebrush and other plants of the Great Basin. Garfield and Kane counties are located in the Colorado Plateau, which consists of uplifted sedimentary rock strata vegetated with desert sage scrub.

On a more localized scale, the area is also speckled with a variety of topographic features. Some of this area has experienced a great amount of volcanic activity, which is evident in extinct volcanoes, mountains, great lava fields, and mesas. Geologic forces have uplifted huge portions of the land, and have created great rifts in others. Of particular notoriety are the erosional features of the area including the great canyons and cliffs carved by water and wind that make up the national and state parks, such as Zion’s, Bryce, and Snow Canyon.

The soil in this area consists mostly of aridisols, an iron-rich desert soil that can be quite productive if cultivated. Aridisols are used mainly for range, wildlife, and recreation. Because of the dry climate in which they are found, they are not used for agricultural production unless irrigation water is available. Native to the valleys throughout most the region is a variety of grasses, junipers, and pinion pines, while xerophytes and desert scrub are native to the lower elevations. Farming has produced a diversity of crops, including barley, alfalfa, hay, and cotton (which earned the southern region the name of "Dixie"). Much of the region has also been prime land for ranching cows, sheep, and horses.

Climate

Because of its general location, the Five County District is mostly semi-arid. As moist air moves in from the Pacific Ocean, it is forced to rise over the Sierra Nevada Mountain Range, which causes it to cool and drop its precipitation, leaving very little moisture left for the region East of the Sierra Nevadas. While all of the Intermountain West is generally dry due to this phenomenon, the aridity in the Five County District is accentuated by its lower latitude, which makes it warmer than most regions to the north. Much of this area is characterized by lower elevation, which also increases the mean annual temperature.

For example, St. George's warm climate, which is unique to the state of Utah, can be attributed to the fact that it has the lowest elevation of any Utah city and lies at the very southern end of the state. In fact, St. George has the highest mean annual temperatures in Utah, averaging 61-62 degrees Fahrenheit. It also boasts the highest maximum temperature ever recorded in Utah, which was 117 degrees Fahrenheit, observed on July 5, 1985.

Though scholars classify most of the region as "desert," only the areas with lower elevations are considered "hot" deserts, or regions where the winters average above 32 degrees Fahrenheit. This would include most of Washington County. This region usually does not have snow in the winter, and has extremely warm summers. The rest of the region, which consists of higher elevations, is considered to be a "cool" desert, with snowy winters and warm summers. Some exceptions exist over the highest elevations, mountainous regions such as Brian Head, which are classified as "undifferentiated highlands" since they experience cooler temperatures and higher humidity than the rest of the area. These regions generally have very cold, snowy winters and cool summers.

Like the rest of the Intermountain West, during the winter, most precipitation results from the passage of mid-latitude cyclones, while in the summer, convection from localized heating can trigger isolated thunderstorms. Without the moderating effects of the ocean, and therefore, cloud cover from water vapor in the air, this region experiences great daily and yearly fluctuations in temperature.

The nature of the climate in this region leaves it susceptible to a few hazardous weather recurrences. Although most of the country is subject to flash floods, they are particularly damaging in this region since the soil is dry, somewhat un-vegetated, and easily eroded. Threats to human lives and damage to property are not only a result of rapidly rising waters, but of catastrophic mud slides as well. This area is also subject to tornadoes, although they are a rare occurrence. More common in the warmer regions are dust devils, which are rarely severe enough to damage property. The higher elevations always have the potential for blizzards, cold spells, and avalanches in the winter. The entire region is susceptible to fires resulting from lighting strikes in the spring and summer, which is actually a frequent occurrence.

Demographics and Population

The tables in this section provide a sense of the population characteristics in the Five County District (see Tables 2 & 3).

Migration Patterns

Any long time resident of the Five County District could tell you that this region has changed in the last several years. The 90s brought a population boom to most of the area, which was obvious by the prospering housing and real estate market. Since the Five County District is generally rural and people generally migrate to urban areas, the migration boom came as a surprise to many residents. However, the boom was actually part of a much larger phenomenon taking place all over the Intermountain West. In the past two decades, Western rural towns have become increasingly attractive to urban dwellers all over the country, especially Californians. Tired of city traffic, pollution, crime, an economic recession in California, people moved to the rural West to find a simpler, and slower-paced life. Southwestern Utah is no exception.

Based on the net migration figures between the years 1987 to 1997, all of the counties have experienced positive net migration since 1992, except Garfield County, which had negative migration as recently as 1994. For all of the counties, positive migration peaked in 1994 or 1995 except Garfield, which peaked in 1991. Washington County was the only county to experience positive net migration every year since 1987. Iron County has experienced positive net migration since 1990, and Beaver and Kane had similar migration patterns, both experiencing positive net migration since the early 1990s. Garfield had intermittent periods of positive migration and negative migration until 1995, and has had positive net migration since 1995.

Table 2. Utah net migration for fiscal years 1987-97 by county

	Beaver	Garfield	Iron	Kane	Washington
1987	-91	-43	-298	-18	1873
1988	-130	-73	-487	62	1236
1989	-27	-3	-3	-68	1620
1990	-25	-82	188	-153	1324
1991	-25	118	288	47	2224
1992	56	-14	563	53	2534
1993	76	73	1080	57	3116
1994	118	-39	1017	222	4024
1995	195	68	1236	163	4382
1996	158	58	678	42	3456
1997	80	90	829	43	2507

Source: Utah Governor's Office of Planning and Budget.

Profile of Populations

As the Five County Region grows, it is becoming more racially and ethnically diverse. The 2000 U.S. Census shows the current population, identified by race and ethnicity. (See Table 3).

Table 3 Five County Population by County & Race/Ethnicity

	Beaver	Garfield	Iron	Kane	Washington	Region
White	5,599	4,496	31,416	5,804	84,543	131,858
Black or African American	16	8	119	2	186	331
American Indian or Alaskan Native	54	87	737	94	1,328	2,300
Asian	37	19	251	13	405	725
Native Hawaiian or Other Pacific Islander	5	2	92	3	384	486
Some other race	188	53	600	45	2,020	2,906
Two or more races	106	70	564	85	1,488	2,313
Hispanic or Latino (of any race)	333	136	1,383	140	4,727	6,719

Source: 2000 U.S. Census Bureau, Census 2000

Age is another important indicator of population characteristics, since the needs and desires of a population will vary according to its age structure. For example, a population with a high percentage of retirees will require more recreation and medical facilities, while a population with a high percentage of children will require more schools, parks, and infrastructure geared for the family. The Governor's Office of Planning and Budget made predictions of the age and sex structure for all counties in the state. Although the predictions for age structure are available for the years 1990 to 2020 for each county, included in this document are just the 1998 figures by county, However, the totals for the Five County Region are included from 1990 to 2020. More information on predictions by county can be obtained from the Governor's Office previously mentioned, or from the Department of Workforce Services in St. George.

The selected results showed that all five counties have similar age ratios, with approximately 9 percent of the population five years and under, 22 percent between 5 and 17, 20 percent between 18 and 29, 14 percent between 30 and 39, 24 percent between 40 and 64, and 15 percent 65 years or older. The two exceptions are Iron County, which has higher percentages in the younger age groups indicating a younger population, and Washington County, with lower percentages in the youngest age groups and higher percentages in the 65 and older category, indicating an older population. See Appendix C for detailed Census data.

Economic Factors

Although the five counties of the Southwest District share common geographic boundaries, the economic make-up of the individual counties varies considerably. Information taken from the Utah Department of Workforce Services quarterly newsletters (first half, 2001), shows a wide variety of economic conditions. The three counties that share access to Interstate 15 (Beaver, Iron and Washington) also exhibit more diverse economic bases and more resilient economies. The two more remote counties (Garfield and Kane) are

dependent upon tourism as their primary economic base. The nation-wide economic slowdown that began in early 2001 is reflected in recent district statistics. The events of September 11, 2001 are not yet documented in official statistics, but anecdotal information confirms a dramatic slowdown in travel-related economic activity.

The following information on each county is an abridgment of county newsletters for the first half of 2001, published by the Utah Department of Workforce Services in December 2001. Special thanks are given to Lecia Parks Langston, Western Region Economist, who authored the original text.

Beaver County

The Beaver County economy didn't have a particularly auspicious beginning to 2001. However, after a string of employment losses, job growth crept over the line into positive territory. All in all, the county's economic indicators are not presenting a clear economic picture. But, there does seem to be some light at the end of the tunnel as second quarter figures were, in general, better than first quarter indicators. Despite a two-quarter drop in employment, Beaver County's unemployment rate remained relatively low—3.6 percent for both the first and second quarters of 2001. In addition, both rates were down from figures from the same quarters Beaver County in 2000. During the first six months of 2001 the Beaver County average unemployment rate equaled the Utah figure and registered below the national rate. Small counties often exhibit roller coaster-like changes in job growth rates. Beaver County is no exception. Most of the drag on jobs comes out of the services industry. Most other industries experienced increasing rather than decreasing payrolls

Garfield County

Garfield County's slumping economy didn't see recovery in the first half of 2001. The county has been losing employment for almost a year. Not surprisingly, this contraction has taken its toll on the unemployment rate that just kept edging up. The picture might not get much brighter by year-end. Garfield County is heavily dependent on tourism to support its economy. The events of September 11 will undoubtedly affect the county's economy during the last two quarters of the year. The unemployment rate is never Garfield County's strong suit. Seasonality creates a situation where seasonally adjusted unemployment rates always seem to be extraordinarily high. First quarter's 8.2 percent jobless rate was nothing out of the ordinary. However, add another percentage point to that number and you have second quarter's figure—the highest in more than two years. Unemployment in Garfield County during the first half of 2001 was double the national rate.

Garfield County is unusual in that the largest industry sales producer is services. Typically, retail trade generates the largest pool of sales revenue. So, it isn't surprising to discover that Garfield County's total gross taxable sales performance follows the lead of services. Most industries decreased their expenditures during both quarters. The Garfield County economy has certainly stumbled during the last several quarters. Moreover, the county will no doubt suffer at least some aftereffects of the slow down in travel as many visitors come from overseas. In addition, the county may also feel the pains of a decline in non-flying tourism if the national recession makes a deep dent in individuals travel plan

Iron County

Months before September 11 changed the landscape of the U.S. economy, Iron County had started to show signs of a downturn. Joblessness was creeping up, construction activity had started to wane and (despite several new retail establishments) sales were less than robust. However, it was the decline in the number of non-farm jobs during the second quarter of

2001 that provided the clinching signal of a less than robust economy. Iron County is particularly vulnerable to economic downturns. Because of incentives, economic development, and the railroad, Iron County has a large manufacturing sector for a county its size. And, manufacturing feels the brunt of a downturn more heavily than a more service-oriented economy. The job losses aren't that large, and a number of construction projects are in the offing. But, expect the county to see signs of further struggle.

Iron County's unemployment rate has been increasing for the past year. However, in historical terms, even the 4.2 percent rate registered in the second quarter of 2001 truly is low. Also, while the county's jobless rate measures higher than the Utah six-month average of 3.6 percent, it remains slightly below the U.S. 4.3-percent rate.

Total construction values were up 19 percent when the first six months of 2000 and 2001 are compared. New nonresidential permitting was the major bright spot in an otherwise dismal construction picture during the first quarter of 2001. Nonresidential construction values totaled $12.6 million during the first half of 2001— an increase of 160 percent over the first half of 2000. Retail sales took a slight tumble during the first quarter of 2001. In comparison to the first quarter of 2000, sales in the retail trade industry were down about 1 percentage point.

By the June of 2001, Iron County's economy was beginning to sputter. Private sector job growth dropped noticeably and unemployment crept past the 4-percent mark. Construction permitting activity also began to ebb, and sales were mediocre at best. And, keep in mind that this happened before September 11.

Kane County

Kane County's indicators for the first half of 2001 split down the middle. Labor market measures showed expansion—jobs grew nicely and unemployment decreased. On the other side of the coin, construction activity and sales were both down on a year-over basis. Kane County is not an island and will undoubtedly feel some recessionary pressures trickle down from the national level.

Unemployment in Kane County followed the path of the bouncing ball. First quarter's jobless rate registered 4.6 percent. But, by second quarter, unemployment had dropped to only 3.2 percent. This sort of behavior is not uncommon for smaller counties where a small numeric change can result in a large percent change. This has proved the pattern over the past several years. Amusement/recreation services created most of these new positions with a little help from agricultural services and hotels/motels. In other words, most of the new positions created in Kane County during the first six months of the year are related to tourism.

Kane County construction activity took a breather during the first two quarters of 2001. Both quarters showed declining permitted values when compared with 2000. In fact, the value of authorized construction fell in virtually every category during the first six months of the year.

Like many of its compatriots in the Beehive State, Kane County's year-over change in gross taxable sales took a negative bent during the first half of 2001. Moreover, the declines proved fairly substantial. Based on a year-to-year comparison, first quarter sales dropped by almost 10 percent; second quarter sales declined by 7 percent. If you followed the trend throughout 2000, this shouldn't come as a huge surprise. The rate of sales growth had been

shrinking since the first quarter of 2000 when the growth rate peaked. This drop in sales revenues appeared decidedly broad-based.

Although Kane County's labor market indicators look good right now, most of the job growth is focused in just one area—recreation and lodging. Several industries showed declining employment no doubt in response to an already faltering U.S. economy. With construction activity down and with falling sales, the county is particularly vulnerable to the country's downward economic trend

Washington County

During the first half of 2001, unemployment remained moderate, jobs were booming, and sales were up nicely. Construction activity dropped somewhat. However, construction is the most sensitive (and erratic) economic indicator available on the county level. Although the county did experience a little 3.7-percent blip in the unemployment rate in the first quarter of 2001, joblessness still remained very low. In fact, by the second quarter of 2001, Washington County's unemployment rate had edged back down to 3.4 percent. Job growth in the county has been so strong in recent quarters that one would have expected the labor force to have increased even more. Washington County's rate for the first half of 2001 (3.5 percent) falls below the comparable figure for Utah (3.6 percent) and the U.S. (4.3 percent.).

For the last year and a half, non-farm job growth rates in Washington County have proved decidedly monotonous. They have just been bouncing around in a narrow 5.5- percent to 6-percent range. Compared to the national and state slowdown (even before September 11), Washington County is showing remarkable economic expansion. Almost universally, services subcategories all experienced strong expansion. Retail trade industries experienced almost universal growth. General merchandise stores (like WalMart), showed some of the fastest expansion. Perhaps the biggest industrial surprise of the first half of 2001 was the growth in manufacturing employment. Stone/clay/glass products, fabricated metal, and electronic equipment all showed noticeable employment improvements.

Construction permitting in Washington County ebbed somewhat during the first six months of 2001. Yet, despite a 14 percent year-over decline in total authorized values, construction activity remains very strong. New construction activity was down decidedly during the first quarter but returned refreshed during the second quarter. Still, it wasn't quite enough to keep the overall growth rate positive. Moreover, every category showed a decline in values. While not much changed in residential building, new nonresidential construction values dropped by almost 30 percent. Keep in mind that this set of permits included only one "big box" retailer. Moreover, the new IHC project has yet to be reported.

Growth in Washington County's gross taxable sales figures just continued on its merry way during the first half of 2001. With all the new retail trade business establishing a presence in the county, this shouldn't come as a great shock. Residents are now able to buy many things in the county that they often shopped for out of the county and more particularly, out of the state. When the first quarters of 2000 and 2001 are compared, sales are up 8 percent. Second quarter's numbers proved even better—an increase of almost 12 percent. This expansion is proving to be quite broad-based. Very few industrial subcategories are showing any kind of decreased revenues at all. Most industries in the business investment category displayed robust gains during both quarters. Most increased expenditures in the double-digit range.

Will Washington County be affected by the national downturn? Probably. However, given the strong nature of the current economy, the “for sure” projects, employment in the offing, and predictions of a short U.S. recession, the effect is most likely going to be more like a tap on the cheek than a body blow.

Transportation and Commuting Patterns

The Southwestern portion of Utah is traversed by: an Interstate Freeway (I-15); a U.S. Highway (Highway 89); and, several State Highways (SR9, SR12, SR14, SR18, SR20, SR21, SR22, SR56, SR59, SR95, SR130, SR143, SR153, SR257, and SR276). Highway 12 has been designated as both a state scenic byway and a national scenic highway. These roadways bring visitors in and through our area and provide access for residents to the workplace. The United States Census , Census 2000 lists resident responses to their workplace by county, state and country.

Table 4 illustrates the information provided by residents to the Census Bureau.

Table 4 Commuting Patterns by County

Workplace of Beaver Residents by County, State, and Country

Workplace	Number of Residents
Within County	2,258
In neighboring county within the SW area	126
In state North and East of the SW Area	56
Counties in Nevada and Arizona	12
Out-of-State	8
Out-of-Country	

Workplace of Garfield Residents by County, State, and Country

Workplace	Number of Residents
Within County	1,776
In neighboring county within the SW area	61
In state North and East of the SW Area	118
Counties in Nevada and Arizona	13
Out-of-State	15
Out-of-Country	

Workplace of Iron Residents by County, State, and Country

Workplace	Number of Residents
Within County	13,882
In neighboring county within the SW area	915
In state North and East of the SW Area	157
Counties in Nevada and Arizona	130
Out-of-State	141
Out-of-Country	

Workplace of Kane Residents by County, State, and Country

Workplace	Number of Residents
Within County	1,867
In neighboring county within the SW area	120
In state North and East of the SW Area	133
Counties in Nevada and Arizona	460
Out-of-State	41
Out-of-Country	

Workplace of Washington Residents by County, State, and Country

Workplace	Number of Residents
Within County	32,708
In neighboring county within the SW area	489
In state North and East of the SW Area	395
Counties in Nevada and Arizona	1,088
Out-of-State	257
Out-of-Country	30

BECGS

Some communities in our region participate in the BCEGS (Building Code Effectiveness grading schedule) compiled by ISO (International Organization for Standardization) See Appendix D for details.

The BCEGS assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards.

The concept is simple: municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of lessening catastrophe-related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously especially as they relate to windstorm and earthquake damage.

The anticipated upshot: safer buildings, less damage, and lower insured losses from catastrophes.

The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. ISO develops advisory rating credits that apply to ranges of BCEGS classifications (1-3, 4-7, 8-9, 10). ISO gives insurers BCEGS classifications, BCEGS advisory credits, and related underwriting information.

One score in the table is for residential the other for commercial. If a community is not listed it does not participate in the ISO BCEGS rating system. This rating system serves as an independent review of building codes, ordinances and enforcement.

NFIP

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods.

The Mitigation Division a component of the Federal Emergency Management Agency (FEMA) manages the NFIP, and oversees the floodplain management and mapping components of the program.

Communities in the Five County Area are part of nearly 20,000 communities across the United States and its territories that participate in the NFIP (See Appendix E) by adopting and enforcing floodplain management ordinances to reduce future flood damage. In

exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and businesses in these communities.

Flood damage is reduced by nearly $1 billion a year through partnerships with communities, the insurance industry, and the lending industry. Further, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance. And, every $3 paid in flood insurance claims saves $1 in disaster assistance payments.

Army Corps of Engineers Study

The U.S. Army Corps of Engineers Sacramento District completed a flood hazard identification study through a contract with the seven associations of governments in Utah. Funding was provided under the USACE Planning Assistance to States Program (Section 22). The purpose of the study was to aid in detailing natural hazards associated with fluvial processes for entities within each AOG region currently unmapped as part of the National Flood Insurance Program or mapped as D Zone areas. This study, entitled “Flood Hazard Identification Study, Five County Association of Governments” dated August 18, 2003, was provided to the planning team. A copy of this study is on file at the offices of the Five County Association of Governments.

Hazard Identification and Justification for Inclusion in Plan

The Five County Association identified ten hazards that are addressed in this multi-jurisdictional plan. These hazards were identified through a process that included, but was not limited to responses in the FCAOG Natural Hazard Assessment Questionnaire, completed by local officials; input from the Regional Team and Emergency Managers; citizen comments from the Public Forums; data and correspondence with appropriate agencies; review of data, maps and documents available on the internet; and use of the FCAOG Geographic Information System (FCAOG GIS).

Table 4a: Hazard Identification & Justification for Inclusion in Plan

Hazard	How Identified (Primary Sources)	Why Hazard is Identified in Plan
Wildfire	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums -Utah Forestry, Fire and State Lands - Internet searches	Southwestern Utah has experienced numerous wildfires over several years. Among the most notable were the Apex Fire west of St. George in 2003 and the Sequoia southwest of Cedar City in 2002. There are many areas in southwestern Utah with the potential for wildfire. Even with additional management efforts for forest sustainability, the likelihood of additional naturally and man-caused wildfires in the region remains.
Landslide	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	Landslides are one of the most common geologic hazards in Utah and annually cause significant economic losses. Approximately 45 percent of the state of Utah is mountain, hill, and steep-valley terrain conducive to landslides. Also, some geologic formations in Utah are particularly prone to develop landslides. Southwestern Utah is the location of many active and historic landslides. The Springdale landslide, triggered by the September 2, 1992 earthquake 10 miles east of St. George was the most dramatic result of ground shaking. This slide destroyed two water tanks, several storage buildings, three homes in a subdivision, blocked State Route 9, and ruptured utility lines. Another landslide of note, the Cedar Canyon landslide of approximately 1.5 million cubic yards, occurred about 7 miles east of Cedar City in the early morning hours of March 27, 1989. Many other smaller landslides have occurred and given the right conditions can occur in many locations.
Earthquake	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	Earthquakes have occurred in southwestern Utah in the past and are historically problematic. There are known earthquake faults located throughout the area. The most notable earthquake in recent history was on September 2, 1992, a magnitude 5.8 earthquake that occurred in southwestern Utah at a location about 10 miles east of St. George. Earthquakes are unpredictable and can be costly and deadly.
Problem Soils	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	There is a great variety of geology in the five southwestern counties. There are known soil and rock related engineering geologic problems in a variety of geologic settings. Some of these conditions are localized and some are widespread hazards. This hazard is considered in the plan as it was determined that there are six types of problem soil and rock are present in southwestern Utah.

Table 4a: Hazard Identification & Justification for Inclusion in Plan		
Hazard	**How Identified (Primary Sources)**	**Why Hazard is Identified in Plan**
Flood **(Including inundation from dam failure)**	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Flood Insurance Rate Maps - U. S. Army Corps of Engineers - Review of Local Emergency Operations Plans - Input from City and County Emergency Operations Managers - Utah Division of Water Rights, Dam Safety Section - Inundation Maps - Internet searches	Flooding is a common geologic hazard in Utah and annually cause significant economic losses. Summer cloudbursts and rapid snowmelt have flooded many Utah communities. Cloudburst storms in Southwestern Utah are historically problematic. As an example, there was property damage from a flood in the town of Tropic on August 24, 2003, when 30 structures sustained damage, the majority of them residential homes. In addition, there have been several deaths, since 1952, in southwestern Utah, from flooding. There are numerous dams and water impediments in southwestern Utah. While the risk is relatively low the threat is high should a failure occur. The most notable dam failure in southwestern Utah was the failure of the earthened dam at Quail Creek Reservoir. Water released by this dam failure entered the Virgin River and destroyed a bridge on Utah 9 in Hurricane. Flood waters swept through a farm many farm animals Traffic into Zion National Park had to be diverted onto Utah 17. Interstate 15 through the Virgin River Gorge, south of St. George, was closed due to fear of damage to bridges. Approximately 1,500 residents of St. George fled to high ground. About 30 homes in Bloomington area of St. George sustained serious water damage. Estimates placed the total damage at $11,959,732.
Drought	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	Droughts generally affect most or all of the state of Utah. Southern Utah, in particular the Virgin River drainage basin, began experiencing drought conditions during the winter of 1998-99. By 2000, drought conditions were evident throughout all of Utah. The current drought (1999-2004) is comparable in length and magnitude to previous droughts. Because of population growth and increased demand for water in Utah, the general effect is more severe. It is likely that the cyclical nature of drought followed by periods of normal or above normal precipitation will occur in the future.
Severe Weather	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Internet searches	Severe weather events occur at times throughout southwestern Utah. This region is not immune from even the rare occurrence of tornadoes. With the exception of Kane County there have been 12 reported tornadoes in the other four counties. Many more instances of severe lightning, windstorms and cloudburst storms have affected the region. There have been 4 deaths and 10 injuries reported as lightning caused in the five southwestern Utah counties.
Volcanism	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	There has been caldera-type eruptive volcanic activity in southwestern Utah dated as occurring in the early Cenozoic period. As the geologic conditions that created those types of eruptions has long since disappeared there is zero chance of their repetition. The current hazard relating to volcanic activity is strictly limited to localized, small, cinder cone basaltic eruptions. According to geologists, the hazard is real, but extremely infrequent and would be limited to a relatively small area. For this reason this hazard is not considered with the same emphasis as other natural hazards that are much more likely to reoccur and or affect a larger area.

Table 4a: Hazard Identification & Justification for Inclusion in Plan		
Hazard	**How Identified (Primary Sources)**	**Why Hazard is Identified in Plan**
Radon Gas	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Geology Publications - Internet searches	The Utah Geologic Survey began identifying and studying areas of Utah with a high potential for radon as part of the Toxic Substances Control Act and the Indoor Radon Abatement Act of 1988. UGS studies showed radon-gas hazard potential in the Beaver Basin area is one of the highest in the state. The Basin was identified by the Utah Department of Environmental Quality as an area of concern after tests showed indoor radon levels were the highest recorded in the state. The basin encompasses about 160 square miles in eastern Beaver County in southwestern Utah. Additional radon gas hazard studies are necessary throughout the region to organize and prioritize testing in existing buildings and to indicate where radon-resistant construction should be considered in new buildings.
Insect Infestation	- Natural Hazards Assessment Questionnaire to officials - Citizen Comments from Public Forums - Input from City and County Emergency Operations Managers - Internet searches - Utah State University Agricultural Extension	Insect Infestation has the potential to significantly affect one of the sectors of the region's economy, agriculture. Northern Beaver County and portions of Iron County are experiencing the effects of insect infestation that coincidently follows in many cases the pattern of severe drought. Infestations are currently taking a severe toll on some of the forests in southwestern Utah. Secondary effects of these forest infestations are the increased risk of devastating forest fires. Additionally, effects of insect infestation can range from simply a major inconvenience to having actual health and safety implications.

Hazard Descriptions

What is a Wildfire?

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the area for miles around. Naturally occurring, and non-native species of grasses, brush, and trees fuel wildfires.

A **wildland fire** is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An **Urban-Wildand Interface fire** is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

Additionally, areas anywhere that have experienced prolonged droughts, or are excessively dry, are also at risk of wildfires.

People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires.

Wildfire behavior is based on three primary factors:

- Fuel
- Topography
- Weather

The type, and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential and behavior. The continuity of fuels, expressed in both horizontal and vertical components is also a factor, in that it expresses the pattern of vegetative growth and open areas.

Topography is important because it affects the movement of air (and thus the fire) over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels.

Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity and wind (both short and long term) affect the severity and duration of wildfires.

What is a Landslide?

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors:

- erosion by rivers, glaciers, or ocean waves create oversteepened slopes
- rock and soil slopes are weakened through saturation by snowmelt or heavy rains
- earthquakes create stresses that make weak slopes fail
- earthquakes of magnitude 4.0 and greater have been known to trigger landslides

- volcanic eruptions produce loose ash deposits, heavy rain, and debris flows
- excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures

Slope material that become saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, thus blocking bridges and tributaries causing flooding along its path.

Where do landslides occur?

Landslides occur in every state and U.S. territory. The Appalachian Mountains, the Rocky Mountains and the Pacific Coastal Ranges and some parts of Alaska and Hawaii have severe landslide problems. Any area composed of very weak or fractured materials resting on a steep slope can and will likely experience landslides.

Although the physical cause of many landslides cannot be removed, geologic investigations, good engineering practices, and effective enforcement of land-use management regulations can reduce landslide hazards.

The United States Geological Survey produces landslide susceptibility maps for many areas in the United States. In every state, USGS scientists monitor streamflow, noting changes in sediment load carried by rivers and streams that may result from landslides. Hydrologists with expertise in debris and mud flows are studying these hazards in volcanic regions.

Types of Landslides

Fast-moving Debris Flows
Debris flows start on steep slopes—slopes steep enough to make walking difficult. Once started, however, debris flows can even travel over gently sloping ground. The most hazardous areas are canyon bottoms, stream channels, areas near the outlets of canyons, and slopes excavated for buildings and roads. Debris flows (also referred to as mudslides, mudflows, or debris avalanches) generally occur during intense rainfall on water-saturated soil. They usually start on steep hillsides as soil slumps or slides that liquefy and accelerate to speeds as great as 35 miles per hour. Multiple debris flows that start high in canyons commonly funnel into channels. There, they merge, gain volume, and travel long distances from their source. Debris flows commonly begin in swales (depressions at the top of small gullies) on steep slopes, making areas down slope from swales particularly hazardous. Road cuts and other altered or excavated areas of slopes are particularly susceptible to debris flows. Debris flows and other landslides onto roadways are common during rainstorms, and often occur during milder rainfall conditions than those needed for debris flows on natural slopes. Areas where surface runoff is channeled, such as along roadways and below

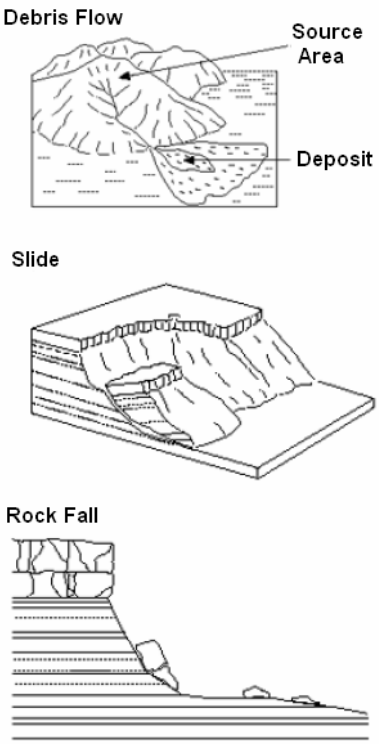


Figure 1

culverts, are common sites of debris flows and other landslides.

Slow-moving Landslides

Areas that are generally prone to slow-moving slides are those that on existing old landslides, at the base of slopes, in or at the base of minor drainage hollows, at the base or top of an old fill slope, at the base or top of a steep cut slope or on developed hillsides where leach field septic systems are used.

Areas that are typically considered safe from slow-moving landslides are those on hard, non-jointed bedrock that has not moved in the past, are on relatively flat-lying areas away from sudden changes in slope angle, are at the top or along the nose of ridges or are set back from the tops of slopes.

Features that might be noticed prior to major landsliding include: appearance of springs, seeps, or saturated ground in areas that have not typically been wet; new cracks or unusual bulges in the ground, street pavements, or sidewalks; soil moving away from foundations; ancillary structures such as decks and patios tilting and/or moving relative to the main house; tilting or cracking of concrete floors and foundations; broken water lines and other underground utilities; leaning telephone poles, trees, retaining walls, or fences; offset fence lines; sunken or down-dropped road beds; rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content); sudden decrease in creek water levels though rain is still falling or just recently stopped; sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb.

Rock falls are a generic term referring not only to rock falls, in the strict sense, but also to rock slides, debris slides, debris flows, and rock avalanches. Most rock falls are associated with triggering events, such as earthquakes, rainstorms, or after a rapid melting of snow. The magnitude and proximity of the earthquake, intensity and duration of the rainfall, thickness of the rapidly melting snowpack, can all influence the triggering of rock falls. However, some rock falls occur without any obvious triggering event. It is usually thought that these rock falls are probably due to the gradual release of stress. Rock falls can range in size from small individual rocks of less than a cubic yard to rock avalanches of several million cubic yards. Even a rapidly moving small boulder can cause serious injury to a person and considerable damage to vehicles or buildings.

Landslides can be both damaging and deadly. The U. S. Geological Survey in 1998 estimated that, in the United States, slope failures cause in excess of $1 billion in damages and from 25 to 50 deaths each year. Figure 1 illustrates the common types of landslides.

What is an Earthquake?

Earthquakes occur without warning and can cause injury and death, major economic loss, and social disruption (Utah Seismic Safety Commission, 1995). An earthquake is the abrupt rapid shaking of the earth caused by sudden slippage of rocks deep beneath the earth's surface. The rocks break and slip when the accumulated strain exceeds the rock's strength. The surface along which the rocks slip is called a fault. Seismic waves are then transmitted outward from the earthquake source producing ground shaking.

Table 5 Effects of Earthquakes by Type of Disruption

Principal earthquake hazards, expected effects, and hazard-reduction techniques (modified from Utah Seismic Safety Commission, 1995).

Earthquakes cause a wide variety of geologic hazards including ground shaking, surface faulting, liquefaction and related ground failure, slope failure, regional subsidence, and various types of flooding (See Table 5).

Ground shaking is the most widespread and typically most damaging earthquake hazard (Lund, in press). Strong ground shaking can last from several seconds to minutes, and can be amplified or attenuated depending on local soil and rock conditions. Ground shaking is usually strongest near the earthquake epicenter and decreases away from that point. The type and quality of construction plays a large role in determining the extent of damage caused by ground shaking. Large earthquakes (> M 6.5) are commonly accompanied by surface faulting. The rupture may affect a zone tens to hundreds of meters wide and up to kilometers long. Little can be done from a design perspective to protect structures or other facilities from the direct effects of surface rupture. Liquefaction, the temporary transformation of a saturated cohesionless soil into a fluid accompanying earthquake ground shaking, occurs in areas of shallow ground water and sandy soils. Liquefaction can cause a variety of kinds of ground failure. Slope failures, including rock falls and landslides, are common in steep terrain during moderate and large earthquakes. Subsidence due to tilting of the downdropped block during a large earthquake can affect large areas extending miles from the surface trace of the fault. Tilting of the ground surface may allow lakes or other water impoundments to inundate formerly dry areas, or lower the ground surface below the local water table causing waterlogged soils and areas of ponded water. Flooding may also

HAZARD	EFFECTS	MITIGATION
Ground Shaking	Damage or collapse of structures	Make structures seismically resistant, secure heavy objects
Surface Faulting	Ground displacement, tilting or offset structures	Set structures back from fault traces
Liquefaction	Differential settlement, ground cracking, subsidence, sand blows, lateral spreads	Treat or drain soil, deep pier foundations, other structural design solutions
Rock Fall	Impact damage	Avoid hazard, remove unstable rocks, protect structures
Landsides	Damage to structures, loss of foundation support	Avoid hazard, stabilize slopes, manage water use.
Subsidence	Ground tilting, subsidence, flooding, loss of head in gravity flow facilities	Create buffer zones, build dikes, restrict basements, design tolerance for tilting.
Flooding	Earthquake-induced failure of dams, canals, pipelines, etc with associated flooding	Flood-proof or strengthen structures, elevate building, avoid construction in potential flood areas

result during an earthquake due to damage of water storage or conveyance structures such as dams, pipelines, and canals.

A variety of magnitude scales are used to measure earthquake size (dePolo and Slemmons, 1990). The magnitude scale in most common use today is the Richter scale (Richter, 1938; Bolt, 1988), which measures earthquake magnitude based on the amount of earthquake-induced ground shaking recorded on a seismograph. The Richter scale has no upper or lower bounds and each one-unit increase in the scale represents a ten-fold increase in the amplitude of ground displacement at a given location. The Richter scale's relation to earthquake energy release is logarithmic so that each one-unit increase on the scale represents a 30-fold increase in energy release. Therefore, a Richter magnitude 6 earthquake is 30 times more powerful than a magnitude 5 earthquake, and a magnitude 7 earthquake is 900 times more powerful than a magnitude 5 event. Unless stated otherwise, all magnitudes reported here are Richter magnitudes. The human detection threshold for earthquakes is about magnitude 2 and significant damage begins to occur at about magnitude 5.5. In the Intermountain West, surface faulting begins at about magnitude 6.5.

What is a Flood?

A flood is a natural event for rivers and streams. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes, and oceans that are subject to recurring floods. Hundreds of floods occur each year, making it one of the most common hazards in all 50 states and U.S. territories. Floods kill an average of 150 people a year nationwide. They can occur at any time of the year, in any part of the country, and at any time of day or night. Floodplains in the U.S. are home to over nine million households. Most people killed in flood events are swept away by flood currents, and most property damage results from inundation by sediment-filled water.

Several factors determine the severity of floods, including rainfall intensity or other water source, and its duration. A large amount of rainfall over a short time span can result in flash flood conditions. A small amount of rain can also result in floods in locations where the soil is saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas.

Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

Frequency of inundation depends on the climate, soil and channel slope. In regions where substantial precipitation occurs in a particular season each year, or in regions where annual flooding is derived principally from snowmelt, the floodplains may he inundated nearly every year. In regions without extended periods of below-freezing temperatures, floods usually occur in the season of highest precipitation. In areas where flooding is caused by melting snow, and occasionally compounded by rainfall, the flood season is spring or early summer.

Fortunately, most of the known floodplains in the United States have been mapped. FEMA, administers the NFIP and when a flood study is completed for the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). An FIS is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community and includes causes of flooding.

The FIS report and associated maps delineate special Flood Hazard Areas (SFHAs), designate flood risk zones, and establish base flood elevations (BFEs), based on the flood that has a 1 % chance of occurring annually, or the 100-year flood. The study may have three components:

- The FIS – Flood Insurance Study text;
- The FIRM – Flood Insurance Rate Map; and
- A separate Flood Boundary and Floodway Map (FBFM) that was issued as a component of the FIS for each community studied prior to 1986. No BFE or flood zone names are shown on the floodway map and people often confuse the white floodway with the white area representing land that is free from flooding. Fly reports published since 1988 have corrected this problem by delineating the floodways as diagonally hatched areas on the FIRMs.

The 100-year flood designation applies to the area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100-year flood is also referred to as the base flood. The base flood is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE), as shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1 % chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NVD) of 1929, the North American Vertical datum (NAVD) of 1988, or other datum referenced in the FIS report.

Figure 2 Flood Zones

Zone A	The 100-year or base floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-A30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFEs are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	**V**	The coastal area subject to a velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to a velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.	
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.	
Zone D	Area of undetermined but possible flood hazards.	

Special Flood Hazard Area (SFHA) is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

FIRMS show different floodplains with different zone designations. These are primarily for insurance rating purposes, but the zone differentiation can be very helpful for other floodplain planning purposes. The more common zones are listed in Figure 2.

Floodway is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising the water surface elevation by more than one foot.

NGVD - National Geodetic Vertical Datum of 1929, the national datum used by the NFIP. NGVD is based on mean sea level. It was known formerly as the “Mean Sea level datum of 1929 (MSL).” NAVD 88 = North American Vertical Datum of 1988 is being phased in.

It's important to recognize that there is actually a range of floods, other than just the 100-year flood, that could happen within a planning area. For example, a house located close to a flood source might experience some level of flooding every 10 years. The level or depth of flooding is determined by the probability.

The probability of a flood is based on a statistical chance of a particular size flood (expressed as cubic feet per second of water flow) occurring in any given year. The annual flood is usually considered the single greatest event expected to occur in any given year. The percent annual chance of floods is estimated based on watershed and climatic characteristics or watershed models, water surface elevations, and hydraulic models that reflect topographic characteristics.

The risk created by the 100-year flood would be much greater than the risk from the annual flood based on the amount of damages each event produces - once. But the annual flood would occur much more frequently and over time may in fact produce a much greater risk to the structure than the 100-year flood.

Flood frequencies can be determined by dotting a graph of the size of all known floods for an area and determining how often floods of particular size may occur. In addition, hydrologic and hydraulic data gathered from rivers and streams is a valuable but time-consuming effort to calculate flood frequencies. If at least 20 years worth of data are available through stream gauging, models can be used to determine the statistical frequency of given flood events.

The USGS maintains river gauge records. Historical and current river gauge information can be observed at its Website at http://water.usgs.gov. Some local agencies may also have gauge records.

Conditions that may exacerbate or mitigate the effects of floods

The following factors will affect the severity of a flood:

- Impermeable Surfaces: Excessive amounts of paved areas or other surfaces upstream or in the community can increase the amount and rate of water runoff. Development affects the runoff of stormwater and snowmelt when buildings and parking lots replace the natural vegetation, which normally would absorb water. When rain falls in an undeveloped area, as much as 90 percent of it will infiltrate the grounds in a highly developed area, as much as 90 percent of it will run off.

- Steeply sloped watersheds: In hilly and mountainous areas, a flood may occur minutes after a heavy rain. These flash floods allow little or no warning time and are characterized by high velocities.

- Constrictions: lie-grading or filling within or on the edge of floodplains obstructs flood flows, backing up floodwaters onto upstream and adjacent properties. It also reduces the floodplain's ability to store excess water, sending more water downstream and

causing floods to rise to higher levels. This also increases floodwater's velocity downstream of the constriction.

- Obstructions: Bridges, culverts and other obstructions can block flood flow and trap debris causing increased flooding upstream and increased velocity downstream.

- Debris: debris from the watershed, such as trees, rocks, and parts of damaged buildings, increases the hazard posed by moving water. Moving water will float drag or roll objects, which then act as battering rams that can knock holes in walls and further exacerbate the effects of debris.

- Contamination: Few floods have clear floodwater, and the water will pick up whatever was on the ground within the floodplain, such as soil, road oil, farm and lawn chemical and animal wastes. In addition, if a wastewater treatment plant was inundated, the wastewater will likely include untreated sewage. Contamination is also caused by the presence of hazardous material storage in the floodplain and in the community, as well as upstream from the community.

- Soil saturation: rainfall in areas already saturated with water will increase the runoff.

- Velocity: Flood velocity is the speed of moving water, measured in feet per second. High velocities greater than 5 feet per second can erode stream banks, lift buildings off their foundations and scour away soils around bridge supports and buildings.

Flooding from Dam Failure

The five counties in southwest Utah - Beaver, Garfield, Iron, Kane, and Washington - have a total of 145 dams; these dams have been classified as Low, Moderate, and High for potential hazard by the State of Utah Division of Water Rights.

For mitigation purposes we will focus on the dams that are designated as a High Hazard. Each county will have details of all the dams designated as High in the Five County Jurisdiction.

What is Volcanism?

Eruptions from volcanoes can cause widespread property damage and fatalities. Worldwide over 27,000 human fatalities have resulted from volcanic activity in the past 500 years (Mabey, 1985). During the past several tens of millions of years, southwestern Utah has experienced extensive volcanism (Bugden, 1992). Early in that time period large statovolcanoes and caldera complexes erupted huge volumes of lavas and extensive sheets of volcanic debris and ash that often covered hundreds to thousands of square miles with thick layers of volcanic materials. These large volcanic centers are no longer active today, but later, smaller volcanoes have produced eruptions of chiefly basaltic lava flows and volcaniclastic debris, and are still potentially active in many areas of southwestern Utah. Characterized by comparatively small cones constructed of typically black or red cinders, these young volcanoes have been intermittently active for the past approximately 3 to 4 million years. The most recent eruptions from some cinder cones in southwestern Utah and

northwestern Arizona may be as young as a 1000 years, and in the Black Rock Desert near Fillmore, a flow as young as 600 years has been identified (Bugden, 1992). Although seemingly old, these young flows are of an age compatible with the most recent surface-faulting earthquakes in southwestern Utah and a potential for future eruptions exists. It is anticipated that the effects of future eruptions will be localized (likely confined to an area of a few to several tens of square miles), but many populated areas in southwestern Utah (St. George, Hurricane, La Verkin, Veyo, Dammeron Valley, Enoch, Brian Head, Duck Creek, Panguitch Lake) are located on or immediately adjacent to young volcanic cones or lava flows and could be severely impacted by future eruptions.

What is Drought?

Drought is a normal and recurring feature of climate. Although it occurs in virtually all of the world's climatic zones, its characteristics vary significantly from one region to another. In some of the world's most arid regions, a drought occurs when annual precipitation drops below 7 inches per year, while in the world's most moisture rich regions, a period of 6 days without rain might constitute a drought! Consequently, there is no universal definition of drought. In the most general sense, drought is a result of a deficiency of precipitation over an extended period of time, resulting in a water shortage, which impacts normal water usage. The severity of a drought depends upon the degree of moisture deficiency, its duration, and the size of the affected area. Because it is so hard to develop a quantitative definition for drought, it is difficult to determine precisely when a drought starts and ends.

In the United States, droughts have been among the most financially burdensome of all weather related disasters. In fact, in the past 20 years the single largest U.S. weather related disaster was the drought of 1988, which resulted in over 40 billion dollars in damages throughout the central and northeastern portions of the country. Unlike impacts from flood, hurricane, tornado or other weather-related disasters, drought impacts are not always immediate. Following a flood it is fairly easy to tally up the value of the destroyed and damaged property. But the effects of a drought can be felt for years. Failed crops can impact food prices well into the future. Devastated domestic livestock and wildlife herds can also take many years to recover.

Difficulties of Managing in a Drought Situation

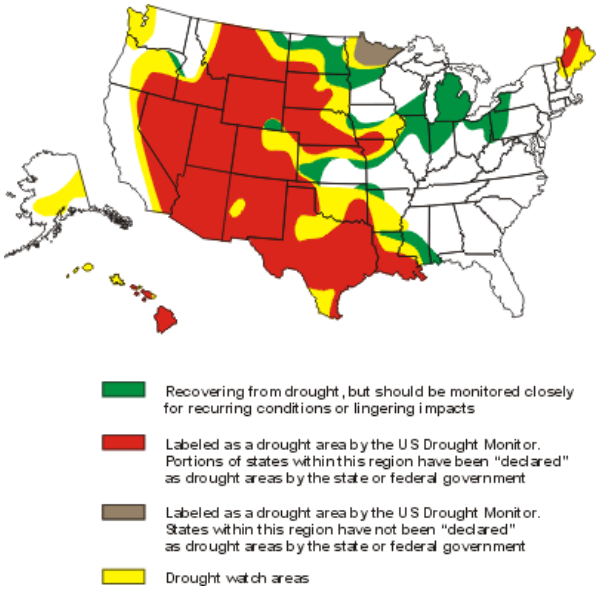
Drought creates unusual management problems due to the uncertainty surrounding it occurrence, duration, magnitude, and severity. The climatological and hydrological parameters normally used in defining drought are precipitation, soil moisture, snowpack, runoff, recharge, evapotranspiration, and temperature. Several indices employ indicators to measure the intensity or severity of drought.

Drought Indices

The Palmer Index is the most widely used measure of quantifying drought. An example of this index is shown in the mapped example below, identifying areas in the country generally experiencing drought conditions. The index is universal in that persistently normal temperature and precipitation produce an index near zero in all seasons and climates. In the plains areas originally studied by Palmer, the index is useful in quantifying drought periods; when applied in the mountainous regions of the west, it does not adequately reflect water supply conditions. It does not account for snowpack and runoff, which are the state’s most

significant sources of water. It may, however, still be used as an indicator of a trend, particularly over an extended period.

Drought Conditions in the U.S. as of June 2003



What are Problem Soils?

Geologic materials with characteristics that make them susceptible to volumetric changes, collapse, subsidence, or other engineering-geologic problems are referred to as problem soil and rock. Geologic and climatic conditions in southwestern Utah provide a variety of both localized and widespread occurrences of these materials.

Six types of problem soil and rock are found in southwestern Utah: (1) expansive soil and rock with high shrink/swell potential, (2) collapsible soil, (3) gypsum and gypsiferous soil susceptible to dissolution, (4) limestone susceptible to dissolution under some hydro geologic conditions, (5) soil subject to piping (localized subsurface erosion), and (6) active dunes. Some materials, such as expansive soil and limestone, cover large areas, whereas others, like active dunes, are of limited area extent.

Geology and climate are the main factors which influence the distribution of problem soil and rock. The geologic parent material largely determines the type of problem present. For example, expansive soil is most often associated with shale, and karst dissolution features form in limestone and gypsiferous formations. Weathering and erosion are controlled by local and regional climate. A prime example of the influence of climate is collapsible soils, which are common in arid southwestern Utah, but much less common in wetter northern Utah. (Engineering & Environmental Geology of Southwestern Utah, 1992, K. Harty)

Arroyos

Description of Arroyos

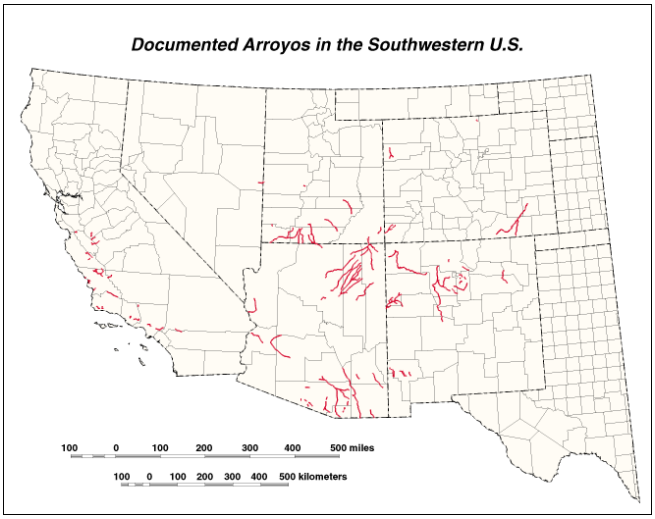
An arroyo is a nearly vertically walled, flat floored stream channel that forms in fine, cohesive, easily eroded material. Arroyos can cut as deeply as 20 meters (65 feet) into the valley floor, are often wider than 50 meters (165 feet), and can be hundreds of kilometers long.

Arroyos exist throughout the western United States, but are most common in arid and semi-arid climates in the Southwest (see Figure 3). The rapid widening and deepening of arroyos have both changed the physical environment and been a costly nuisance in the west since settlement began in the mid 1800's.

Earlier Cycles of Cutting and Filling

The most recent period of arroyo formation in the southwest, which occurred from about 1865 to 1915, was not unique. Previous cycles of arroyo cutting (erosion) have occurred at about 2000 years Before Present (B.P.) and 700 years B.P. These cycles of arroyo cutting were both followed by slower periods of filling (alluviation). Since about 1915, arroyo development, with a few notable exceptions, has slowed with many arroyos showing aggradation. The primary modifications since this time have been widening of trenches, grading of walls, aggradation, and slow changes in bed levels.

Figure 3



Causes of Arroyo Formation

Three factors may cause arroyo formation, but the relative contribution of each is difficult to discern. The main factor is thought to be a change in climate that produced unusually heavy rainfall. Land-use practices, such as grazing, may have enhanced arroyo formation in the southwest during the most recent period of erosion (A.D. 1865-1915). A natural cycle of erosion and deposition caused by internal adjustments to the channel system is a third possibility

Climate

Flooding caused by heavy rain may produce arroyos. Although climate records in the southwest were not systematically kept before about 1900, recent studies have found evidence for unusually heavy rainfall in Tucson, Arizona during the late 1800's . This rainfall was caused by strong and frequent ENSO (El Nino Southern Oscillation) events, suggesting that heavy rain was a regional phenomenon. Thus, the climate of the Southwest during the most recent period of arroyo

entrenchment was conducive to large floods . Drainages may have been especially vulnerable to arroyo cutting, if unusually wet ENSO conditions occurred immediately following a period of below normal precipitation. During a dry period, the enervated vegetation would not have its normal capacity to protect the soil from rain-drop impact or to absorb and slow runoff.

Land use

With the settlement of the West came the rapid introduction of cattle, sheep, and horses. From 1870 to 1890 the number of livestock in New Mexico increased from 300,000 to 2,300,000 . Similar increases were reported in other Western states during this time. Valley floors, which were the most dependable forage areas for the animals, were quickly overgrazed. The fragile vegetation was consumed, and the soil was compacted and left extremely susceptible to erosion. To further exacerbate the soil conditions, both humans and livestock created trails along stream channels and nearby hillsides forming small ditches, leaving the land surface susceptible to arroyo formation.

Nevertheless, earlier periods of arroyo formation predated the introduction of livestock, and thus overgrazing cannot be solely responsible. Spanish and Mexican ranchers, moreover, introduced large numbers of livestock in the 1700's without associated erosion. For these reasons, other factors such as climate change may have played a more important role in arroyo formation.

Natural Internal Adjustments

A third explanation for arroyo development involves external forcing and climate change as triggering mechanisms for incision. This theory postulates that the system has to be in a state ready for incision and involves random, heavy rain and flood events along with internal adjustments in the channel system. If a cloudburst occurs over a drainage, it may deeply erode a single channel, leaving hanging valleys where tributaries enter. Future runoff through the tributaries would cause incision at their mouths and arroyo elongation through upstream migration of headcuts . As sediment accumulates in stream valleys, the gradient of the water course changes. When the slope builds to a critical point, entrenchment may be triggered causing arroyo formation. This type of arroyo formation causes the channel to shift laterally across the stream bed with each cycle of incision. An example of this phenomenon is illustrated from the 800-year entrenchment history of Red Creek in Utah based on tree-ring data from trees growing in the flood plain. The author concluded that lateral movement of the stream channel in its flood plain was responsible for controlling arroyo development.

Summary

While it is arguable which component has contributed the most to arroyo formation in the Southwest, it is widely accepted that climatic events, human settlement and land use, and naturally occurring internal adjustments in drainages are probable causes. The temporal coincidence of the causes may have magnified the effect of each factor.

Effects of Arroyo Cutting

Swamps in the Southwest during the Last Century
Observations before 1865 describe verdant river bed marshes, known as cienegas, containing beaver ponds, fish, and tall grasses which were nourished by high water tables. These marshes have since been drained by arroyos, altering the flora and fauna of the area by widening and deepening the original stream channel.

Decreased Agricultural Productivity
Arroyo formation can be very destructive to agriculture. As soon as arroyo cutting begins, the surrounding water table is lowered making irrigation difficult. Arroyos can quickly remove as much as 25% of their valley floor, covering downstream agricultural land with unwanted flood-borne sediment. This sediment does not improve the fertility of the underlying alluvial soil because it contains large quantities of sand and gravel that originate from subsoils and deposits of soil forming materials.

Flooding
The often excessive deposits of sediment from upstream arroyo formation can decrease flood protection by reducing the natural regulatory functions of stream channels. Sediment from upstream arroyo erosion fills channels that otherwise would store flood water. Arroyos also increase flood severity by changing the geometry of the stream channel. Development of an arroyo in a previously braided or meandering drainage straightens and shortens the channel which limits flood water dispersal and increases velocity.

Displacement of People
Because of the loss of land to arroyos and the increased difficulties of farming, humans have occasionally been forced to either change their agricultural practices or to relocate. Where cropping had depended on irrigation, problems of increasingly fluctuating and decreasingly reliable water sources, and difficulties of transferring water to fields, drove out farmers or forced a change to grazing. Other damages include destruction to roads, railroads, bridges, culverts, fences, and irrigation works. In the late 1880's, the entrenchment of the Rio Puerco in New Mexico forced the desertion of the towns of San Ignacio, San Fernando y Blas, and San Francisco. Prehistoric arroyo cutting may have been one of the main factors leading to abandonment of southern Utah and northern Arizona by the Anasazi.

Corrective Treatments
Attempts to mitigate damage from arroyo cutting date back to the Civilian Conservation Core in the 1930's when attempts were made to slow the erosion of headcuts and banks by reducing grazing and installing control structures. Livestock growers, although fully conscious of the erosion menace, are generally not convinced that their herds are responsible for erosion or that their removal will effect a cure. In one study, isolated tracts of land near arroyo banks were fenced to keep livestock out to promote revegetation. The results varied widely. In some locations, the increase in vegetation stabilized the arroyo walls, whereas in others recovery was insignificant. Other methods of erosion control involve tree planting along banks, the introduction of debris into the channel to slow the flow, and the construction of spreader dikes to catch silt. Unfortunately, such erosion controls are costly. There is no known solution to the arroyo problem.

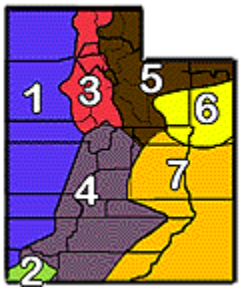
Continued Research and Education
Further research is needed to better understand the rapid and often destructive erosion caused by arroyos in the Southwest. To better conserve soil, we must continue to study the effects of land use practices on arroyo formation and develop efficient and cost-effective

erosion control methods. Finally, we must work to model and forecast the effects that future climate change may have on arroyo development. (Brandon J. Vogt, U.S. Geological Survey)

What is Severe Weather?

For the purpose of this mitigation plan the term severe weather is used to represent downbursts, lightning, heavy snowstorms, blizzards, avalanches, hail, and tornados.

Climate



In order to understand the types of severe weather that can occur in the state it is important to understand climate in the state. Utah is a region of diverse topography where wide ranges in temperature and precipitation prevail, and in some parts of the State a wide range in climate is found over short distances, such as the difference between the Cedar City area and St. George. According to the Utah Climate Center, Utah State University, because of the wide range in climate, Utah has been divided into seven climatological divisions. The Five County Association of Governments service area is located in four of those divisions: Dixie (2), Western (1), South Central (4) and Southeast (7). The normal pattern of precipitation varies considerably from one division to another. July is one of the wetter months in the Dixie and South East divisions. In the Western division, January is one of the driest months, with only September having less moisture.

Cloudburst

A cloudburst is a torrential downpour of rain which by its spottiness and relatively high intensity suggests the bursting and discharge of a whole cloud at once. In Utah, cloudbursts are usually associated with thunderstorms, and they occur when moisture-laden air rises rapidly and is cooled, thereby suddenly having its moisture-retaining capacity substantially diminished. The storms occur mostly when the air rises on approaching mountain fronts or, in flat areas, when lifted by thermal convection currents. When the storms occur over hilly or mountainous areas the resulting floods debouching from the catchment basins are usually flashy and destructive.

Downbursts

A downburst is a severe localized wind, blasting from a thunderstorm (see Figure 4). Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories by size. Microbursts, that cover an area less than 2.5 miles in diameter, and macrobursts, which cover an area with a diameter larger 2.5 miles.

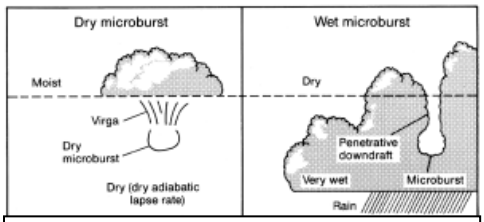


Figure 2

The definition of a microburst depends on its operational use. If wind damage is a concern, then the magnitudes of the wind gusts are important. If aviation is the area of concern, then critical values of the horizontal windshear and magnitude of the downdraft are the important considerations. In field experiments the operational definitions screen out the important events, allowing researchers to focus their attention.

Caracena:
A microburst is a three-dimensional circulation pattern of damaging winds driven outward near the surface by the ground impact of an unusually strong convective downdraft. Its horizontal extent is 5 km or less; and its lifetime is only a few minutes. It may contain lmbedded and leading edge vortices that rotate along a horizontal axis, reaching tornadic strength, presenting an extreme hazard to aircraft taking off and landing. The entire structure of downdraft, severe winds, and imbedded and leading edge vortices constitutes the microburst[1]s circulation pattern.

Fujita (1985): A downburst is a strong downdraft which induces an outburst of damaging winds on or near the ground. Damaging winds, either straight or curved, are highly divergent

Macroburst: A large downburst with its outburst winds extending in excess of 4 km (2.5 miles) in horizontal dimension. An intense macroburst often causes widespread, tornado-like damage. Damaging winds, lasting 5 to 30 minutes, could be as high as 60 m/sec (134 mph).

Micorburst: A small downburst with its outburst, damaging winds extending only 4 km (2.5 miles) or less. In spite of its small horizontal scale, an intense microburst could induce damaging winds as high as 75 m/sec (168 mph).

Lightning
During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightning is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes too great, there is a discharge of electricity that we know as lightning.

Heavy Snowstorms
A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to 20 degrees F or lower. All winter storms make driving extremely dangerous.

Blizzards
A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Waterspout
Waterspouts are simply tornadoes that form over warm water. This typically occurs in Utah during a cold fall or late winter storms.

Avalanches
Avalanches are a rapid down-slope movement of snow, ice, and debris. Snow avalanches are a significant mountain hazard in Utah, and nationally account for more deaths each year than earthquakes. Avalanches are the result of snow accumulation on a steep slope and can be triggered by ground shaking, sound, or a person. Avalanches consist of a starting zone, a track, and a run-out zone. The starting zone is where the ice or snow breaks loose and starts to slide. The Track is the grade or channel down which an avalanche travels. The run-out zone is where an avalanche stops and deposits the snow.

The two main factors affecting avalanche activity include weather and terrain. Large, frequent storms combined with steep slopes result in avalanche danger. Additional factors that contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

Topography plays a vital role in avalanche dynamics. Slope angles between 30 to 45 degrees are optimum for avalanches with 38 degrees being the bulls-eye. Slopes with and angle above 45 degrees continually sluff eliminating large accumulation. The risk of avalanches decreases on slope angles below 30 degrees.

Tornadoes
A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornados often occur at the edge of an updraft or within the air coming down from a thunderstorm. Tornadoes can have wind speeds of 250 miles per hour or more, causing a damage zone of 50 miles in length and 1 mile wide. Most tornados have winds less than 112 miles per hour and zones of damage less than 100 feet wide.

Tornadoes are classified by wind damage using the Fujita Scale (see Table 6). The National Weather Service has used the Fujita Scale since 1973. This scale uses numbers from 0 through 5 with higher numbers assigned based on the amount and type of wind damage.

Table 6 Tornado Classifications

Category F0	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobiles-size missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

What is Insect Infestation?

"Insect" means, but is not limited to, grasshopper, range caterpillar, mormon cricket, apple maggot, cherry fruit fly, plum curculio, and cereal leaf beetle. The above are the main insect pests in the state of Utah. Insect Infestation is pretty self explaining – it is virtually any insect pest that multiplies in numbers that become a pest to humanity. These infestations are usually in the form of insects that eat vegetation mainly crops and forest. This causes a huge loss of money and time for farmers and others who are trying to control the insects.

What is Radon Gas?

Radon is a naturally occurring, odorless, tasteless, radioactive gas produced by the breakdown of uranium in rocks and soil. It is harmlessly dispersed in outdoor air, but when trapped in buildings, can be harmful, especially at elevated levels. Radon is the second leading cause of lung cancer, after smoking. The U.S. Environmental Protection Agency and the Surgeon General have recommended that all residences (except those above the second floor) be tested for radon.

Radon comes from the soil surrounding and beneath the house, especially soil that contains uranium. It typically moves up through the soil into the air above and then into your home through cracks in foundations and walls, openings around sump pumps and drains, and construction joints. The highest concentrations of radon can be found in the lowest levels of the home.

Radon may also be present in well water and can be released into the air in your home when water is used for showering and other household uses. The risk of radon entering homes through water is small compared with that of radon entering through the soil. Usually, radon is not a problem with large community water suppliers, but private wells can contain high levels.

Radon, itself, naturally breaks down and forms radioactive decay products. As you breathe, the radon decay products can become trapped in your lungs. As these decay products break down further, they release small bursts of energy. This can damage sensitive lung tissue and lead to lung cancer over the course of a person's lifetime. If you smoke, and your home has high radon levels, your risk of developing lung cancer is especially high.

An estimated 14,000 deaths each year can be attributed to excessive radon exposure. Radon does not cause any short-term health effects, such as shortness of breath, coughing, headaches or fever.

Nearly 1 in 15 homes in the U.S. is estimated to have elevated radon levels. Elevated levels have been found in every state. While radon problems may be more common in some areas, any home may have a problem. In addition, the level of radon in a nearby home or building cannot be used to predict the level of radon in your home or building. Two adjacent houses may have very different radon levels. EPA recommends that all homes below the third floor be tested for radon and that all schools are tested.

The only sure way to determine if you have a problem with radon in your home or business is to test. Use an Environmental Protection Agency approved test kit. The EPA recommends

that homes with levels of 4 picocurie/liter (pCI/L) or higher should mitigate. Four pCI/L is considered the "action level."

There are two general ways to test for radon, a short-term test, and a long-term test.

Short-term Test: Short-term test kits remain in your home from two days to 90 days depending on the device and are available at a discount price from the Utah Safety Council.

Long-term test: Long-term test kits require a minimum testing period of 90 days and maximum of one year. Long-term radon test kits are available through the National Radon Hotline at (800) SOS-RADON.

Radon reduction measures can vary with radon levels, but most often the measures cost no more than having a new hot water heater installed or having the house painted. The cost of a contractor fixing a home generally ranges from $500 to $2500, depending on the characteristics of the house and choice of radon reduction methods. For a list of EPA approved contractors in Utah, contact: Utah Safety Council; 5263 South 300 West, Suite 201 Salt Lake City, Utah 84107

Profile of Natural Hazard Events in Southwestern Utah

Wildfire

This wildfire history is arranged by each county in the Five County Region and based on information from the Division of Forestry, Fire & State Lands, it includes information gathered for the period from 1984 to 2002.

Beaver

Beaver County had 286 fires between 1984 and 1996 of these fires five of them burned at least 5,000 acres or more. The cause of these five fires was lightning, and they were called the Negro Mag, the Milford Pass, the Milford Bench, the Honey Boy, and the Cunningham.

Between 1997 and 2000 there were 91 fires recorded of these there was one that was significant in size; it was the Meadow Springs fire which was caused by miscellaneous means and burned 1,226 acres on 7/31/1999.

In 2001 there were 21 recorded wildfires, and the largest one (caused by lightning) was the Cowboy fire on July 18th and it burned 30 acres.

Garfield

Garfield County had 64 fires between 1984 and 1996, with one over 5,000 acres; this fire was on 7/14/97. Lightning caused this fire and it was called the Uinta Flats fire.

Between 1997 and 2000 there were 42 fires recorded of these there was one that was significant in size; it was the Dog Valley fire which was caused by miscellaneous means and it burned 1,204 acres on 10/15/1999.

In 2001 there were 3 recorded wildfires all of which were quite small, however, the largest one (caused by miscellaneous activity) was the Henery Fire on June 16th and it burned ½ of an acre.

Iron

Iron County had 246 fires between 1984 and 1996 of these fires there were none that was in the 5,000 acre range, however, there were four that burned between 1,000 and 4,999 acres. The cause of these four fires were; two by lightning (Coyote Pond and Pinion Park), one by a cigarette (Burn Spot Point), and one was incendiary (Hiest North).

Between 1997 and 2000 there were 185 fires recorded of these there were two that were significant in size. One was the Ten Mile which was caused by incendiary means and burned 5,500 acres on 8/6/2000. The other one was the Cogswell Point which was caused by lightning and it burned 4,383 acres on 5/11/97.

In 2001 there were 67 recorded wildfires, and the largest ones (both caused by lightning) were the Baboon fire on June 24th that burned 210 acres and the North Pasture fire on July 28th that burned 200 acres.

Kane
Kane County had 318 fires between 1984 and 1996 of these there were none that was in the 5,000 acre range, however, there were two that burned between 1,000 and 4,999 acres. The cause of these two fires were; Debris Burn (Meadow Creek on 9/28/93), and lightning (Bullock on 7/21/94).

Between 1997 and 2000 there were 203 fires recorded of these there were two that were significant in size. One was the Moccasin Mt. fire which was caused by equipment and it burned 1,561 acres on 7/21/2000. The other one was the Buckskin fire that was caused by lightning and it burned 1,110 acres on 7/28/98.

In 2001 there were 105 recorded wildfires, and the largest one (caused by lightning) was the Lydias Canyon fire on August 5th and it burned 210 acres.

Washington
Washington County had 323 fires between 1984 and 1996 of this 323 five of them burned at least 5,000 acres or more. The cause of these five fires was lightning, and they were called the Cedar Pockets Wash, the Ox Valley Central Meadow, the Mogotsu Complex, and the Indian Reservation.

Between 1997 and 2000 there were 170 fires recorded. Two of these were significant in size. One was the Barn fire which was caused by equipment and burned 1,770 acres on 7/13/1998. The other one was the Pachoon Flat fire that was caused by lightning and burned 2,245 acres on 7/20/97.

In 2001 there were 57 recorded wildfires, three of which were significant. They were the Maple fire on June 22nd that burned 210 acres and was caused by lightning. The River fire on July 16th that burned 200 acres was caused by miscellaneous activity. The Water Canyon fire on August 8th that burned 280 acres was caused by lightning. See Table 7.

Table 7 Wildfire Information by County for 1997

County	# Fire Reports	# of Fires	Private Acres	State Other Acres	Federal Acres	Total Acres	Resources Damaged ($)	Resources Saved ($)
Beaver	**8**	**5**	**5**	**100**	**188**	**293**	**$0**	**$0**
Garfield	**7**	**5**	**2**	**0**	**128**	**130**	**$2,325**	**$4,230**
Iron	**27**	**26**	**22**	**1**	**1,060**	**1,083**	**$10,032**	**$245,100**
Kane	**44**	**39**	**3,011**	**215**	**1,938**	**5,164**	**$254,810**	**$1,435,180**
Washington	**22**	**21**	**80**	**365**	**2,589**	**3,034**	**$534**	**$161,850**
TOTAL	108	96	3120	681	5903	9704	$267,701	$1,846,360

Wildfire History 2001 and 2002
The extraordinary forest fire activity over the past few years has resulted in high suppression costs. Prevention dollars are the most effective dollars spent. To reduce fuel loads in the urban/wildland interface prescribed burns were used to restore and maintain the eco system.

During the 2001 fire season over 1,650 acres of private and state lands were burned. The impacts of these fires are described in table 8.

Table 8 Acres Burned and Cost by County

County	Incidence	Acres Burned		Cost
		State/Private	Federal	
Beaver	20	1.5	136	$ 18,905.00
Garfield	4	0.45	0.5	$ 5,208.00
Iron	74	42	444	$ 115,679.00
Kane	106	103	230	$ 290,000.00
Washington	54	220	475	$ 143,861.00
Region	258	366.95	1285.5	$ 573,653.00

During the 2002 fire season a total of 307 fires were reported in the Five County Region. These fires burned a total of 6,537 state and privately owned acres. Though 22 homes were damaged by fire and 121 people were evacuated, no homes were totally lost. 2,674 hours were spent in suppressing the fires.

On a five year average in 2001 447 acres of state and private land were burned each year while 2340 acres of federal lands were burned. Average suppression costs for the five year period were $207,530.00.

On July 7, 2001 a fire caused by an electrical problem started a brush fire in the vicinity of the Circle Four Farms Blue Mountain Complex. By the time units from Cedar City, Beaver City, Minersville and Milford arrived on scene, a number of buildings were also involved. Final damage assessment from this fire was: 12,890 pigs dead; an employee/office building and four gestation barns were destroyed; and an estimated 25 million dollars in damage, lost revenue and lost wages.

On August 26, 2001 a fast moving fire caused by a lightening strike three days earlier threatened 22 homes and caused the evacuation of 8 people. Local residents found a lone burning tree and thought they had extinguished the fire. However high winds fanned the flame and the fire burned approximately 72.5 acres. 122 personnel were assigned to the fire which ultimately cost $200,000.00 to contain and control.

The 2002 fire season was one of the most intense fire seasons seen in the Five County area. Four years of drought put the area in high to very high class by March. On March 25, 2002, a 250 acre fire was reported in Washington City. Minimal damage was caused by this fire due to the response of local fire fighters and an air tanker from New Mexico. In April a single and first lightening storm of the season sparked three fires.

On June 4 of 2002 a lightening storm started numerous fires in the area of “Big Wash”. The fire threatened numerous homes in the Webster Flat area and, before it was controlled, burned 4,500 acres.

Several other large fires occurred over the course of the season. The Sequoia, Sanford, and Eagle fires along with all the rest burned a total of 93,000 acres in Southwestern Utah.

It should be noted that that in 2003 one of the most costly fires occurred west of St. George. The human caused Apex Fire burned approximately 29,933 acres between June 28 and July 4, 2003 and cost of more than $2 million to suppress. Reseeding and regeneration of the area is expected to cost taxpayers another $1.3 million.

Landslides

Southwestern Utah contains many areas subject to landslide hazards, mainly on steep slopes underlain by slide-prone geologic units. The most frequently occurring landslides in the region include rock falls, slumps, debris slides, and debris flows. All counties in southwestern Utah contain prehistoric landslides and damaging historical failures. Landslides in Beaver and western Garfield Counties are predominantly in clay-rich Tertiary volcanic tuffs in and near the Tushar Mountains. In the plateaus of eastern Iron County, landslides have formed mainly in Tertiary volcanic rocks, the Tropic Shale, and the Moenkopi Formation. Throughout Washington County, landslides are common in the Petrified Forest Member of the Chinle Formation. In western Kane County, landslides occur predominately along cliffs where the Dakota Formation, Tropic Shale, and Carmel Formation crop out.

Landslides are common in areas of high precipitation, high elevation, steep slopes, and slide-prone geologic materials. In southwestern Utah, many of these conditions exist in the mountains and high plateaus of the Basin and Range and Colorado Plateau physiographic provinces, and along cliffs in the southern Colorado Plateau.
Rock falls consist chiefly of rock fragments that detach from parent bedrock along joints, bedding planes, or other zones of weakness. Rock falls occur in areas of southwestern Utah where un-vegetated, near-vertical cliffs border plateaus, mesas, and buttes, and where deeply incised stream channels in bedrock are abundant. Debris slides commonly initiate in the soil mantle or in weathered bedrock and colluvium that forms a thin cover over bedrock on steep slopes. Debris flows can cause damage and loss of life in developed areas at canyon mouths far-removed from the failure source. Deep-seated landslides, particularly rotational slumps, generally fail along a contact between two different bedrock units, or within a particular slide-prone geologic formation. Deep-seated landslides can block river channels and may cause flooding of areas both downstream and upstream of the blockage.

There have been approximately 660 landslides documented in southwestern Utah. The geologic units where these have been documented are the Sevier River Formation, Tertiary volcanic rocks, Claron Formation, Tropic Shale, Carmel Formation, Chinle Formation, Moenkopi Formation, Wheeler shale, and the Chisholm Formation. Additionally, these formations are strongly affected by weathering and erosion and thus are particularly prone to land sliding where factors such as slope angle, precipitation, aspect, and geologic structure are favorable.

County Landslide Profiles

Beaver

The majority of landslides identified in Beaver County occur in the Tushar Mountains east of Beaver. The U.S. Forest Service identified over 300 landslides in the Beaver, Piute and western Sevier County area. Most of these have occurred in Tertiary volcanic tuffs. Although most of the landslides mapped in this area likely occurred in prehistoric times, a number of landslides in the Tushar Mountains have reactivated as a result of road-building activity. There has been renewed landsliding in ash-flow tuffs in the mountains east of Beaver. Approximately 104 landslides occurred between 1978 and 1981 along a 3-mile stretch of Utah State Route 153 in Beaver Canyon. Highway widenening and oversteepening of slopes begun in 1962 are cited for the increase in frequency of landsliding and the reactivation of some of these older slope failures. Although major landslide movements in the area have decreased in recent years, rock falls and shallow slope failures continue to impact this road.

Garfield

As with Beaver County, many slides in Western Garfield County are in mountainous areas in Tertiary-age volcanic tuffs. One such concentration of landslides in volcanic rocks occurs in the Little Creek Peak area of the northern Markagunt Plateau about 9.3 miles west of Panguitch. There is a concentration of about 20 landslides about 15.5 miles east of Panguitch, in the southern Sevier Plateau/northern Paunsagaunt Plateau region. Most of these landslides are in the Oligocene/Eocene-age Claron Formation, a fluvial and lacustrine unit that contains soft shale strata conducive to landsliding. During the winter of 1982-1983, a damaging landslide in the Claron Formation was initiated by meltwater from the heavy snowpack. This landslide was located on an embankment of State Route 12 near Tropic and undermined and damaged a portion of the road such that one mile of highway had to be reconstructed.

Iron

Landslides in Iron County are concentrated in the plateaus on the eastern part of the county. Over fifty landslides have been identified in the Bear Valley/Little Creek Peak region of Northeastern Iron County about 12.4 miles northeast of Parowan. Most of these landslides formed in the Tertiary volcanic tuffs of the Mount Dutton Formation and tuffaceous sandstones of the Bear Valley Formation. Numerous landslides also occur along and east of the Hurricane Cliffs near Parowan, Cedar City and Kanarraville. In these areas, landslides are common in the clay-rich Cretaceous Tropic Shale and in mudstones of the Triassic Moenkopi Formation. Landslides are also found in the Claron Formation north and east of Kanarraville.

A number of large, prehistoric landslides lie within close proximity to populated areas of eastern Iron County. Two examples are the Green Hollow and Square Mountain landslides, respectively 1.9 and 3.7 miles south of Cedar City in the Hurricane Cliffs. These complex landslides are failures in the Tropic Shale, and involve approximately 290 and 47 million cubic yards of material respectively. These two landslides both measure 2.5 miles from head to toe. These landslides likely failed in the late Pleistocene or early Holocene, but the main scarp of the Green Hollow landslide has produced historical earth and debris flows, and recent rock falls.

An example of a recent, damaging slope failure in eastern Iron County is the Cedar Canyon landslide, about 7 miles east of Cedar City. In the early morning hours of March 27, 1989, a 1.5 million cubic yard complex landslide moved down the north-facing slope of Cedar Canyon. A failure in the Tropic Shale, the landslide destroyed about one-third of a mile of State Route 14, which remained closed to traffic for over a month. The cause of the failure is uncertain, but possible causes include highway or mine-related alterations to slope geometry, drainage, and/or ground-water hydrology.

Kane

Landslides are particularly common in the central and northern parts western Kane County, where the Cretaceous Tropic Shale and Dakota Formation, and the Jurassic Carmel Formation crop out extensively along the Pink Cliffs. All three of these formations, separately and in conjunction, have formed numerous landslides along the southern Pink Cliffs in the north-central part of western Kane County. In this area, the Dakota Formation consists mainly of alternating layers of sandstone and mudstone, with interbeds of coal, claystone, and bentonite. The Windsor Member of the Carmel Formation mainly consists of sandstone with thin beds of siltstone, and is the principle unit involved in landsliding in the Pink Cliffs area. These landslides likely occurred during Holocene time.

The subject of a number of detailed descriptions and studies, the Coal Hill landslide complex of western Kane County has been the most troublesome of any landslide in the county. Affecting an area of about 1.7 square miles, the Coal Hill landslide is a complex failure in the Tropic Shale, Dakota Formation, and the Windsor Member of the Carmel Formation. The main landslide complex, along with about a dozen smaller landslides in the immediate vicinity, have caused extensive damage to State Route 9 in the area between Zion National Park east entrance and Mt. Carmel Junction, since its construction in 1928. Movements of the main landslide complex necessitated realignment of the highway four times between 1930 and 1950. The Utah Department of Transportation completed a major realignment of the highway in 1964, which included rebuilding about two miles of the road. However, the new road alignment was constructed atop what has become a particularly active portion of the landslide complex, and continues to require frequent maintenance.

Washington

Landslides are scattered throughout much of the Colorado Plateau portion of Washington County. Landslides in central and eastern Washington County occur predominately in the Petrified Forest Member of the Triassic Chinle Formation, a mostly lacustrine shale unit with local interbeds of sandstone, gypsum, and bentonite derived from volcanic ash.

The high clay content and generally low shear strength make the Petrified Forest Member extremely prone to landsliding. The clays of the Petrified Forest Member hold much moisture and at times become a pasty substance almost capable of moving under its own weight. There are a number of large, prehistoric landslides in the Chinle Formation in the Zion National Park vicinity. During the 1980, slumps in this area damaged a road, a major canal, and utility lines in a subdivision. A recent landslide in the Chinle Formation occurred in May 1992 along the Santa Clara bench in Santa Clara City. The approximately 200 foot long by 100 foot wide slump damaged a utility line and removed backyard property at the top of the bench and deposited that material in the area of what used to be Truman Drive, which is now closed as a result of the landslide. The slump may be the result of a number of factors, including cutting of the base of the slope, lawn watering on the terrace above the landslide, and above average precipitation during the spring of 1992.

One of the largest slope failures in Washington County is the Eagle Crags landslide complex, about 31 miles east of St. George near the Washington/Kane County boundary. Primarily a failure of the Petrified Forest Member of the Chinle Formation, estimated to be about 1.5 miles wide by 2.3 miles long, involved about 180 million cubic yards of material. The landslide complex consists of multiple smaller landslides that show evidence of failure beginning during the Pleistocene era and continuing through historical time. The most recent active portions of the landslide lie adjacent to a creek that bisects the landslide complex, and likely caused local instability through downcutting. Due to the presence of unstable geologic units and active downcutting by both perennial and ephemeral streams, the possibility exists for future movement on portions of the landslide.

Identification of past landslides and areas of geologic conditions susceptible to landslides are crucial steps in reducing landslide hazards in southwestern Utah.

Earthquake

In Utah most earthquakes are associated with the Intermountain seismic belt (Smith and Sbar, 1974; Smith and Arabasz, 1991), an approximately 160-kilometer-wide (100 miles), north-south trending zone of earthquake activity that extends from northern Montana to northwestern Arizona. Since 1850, there have been at least 16 earthquakes of magnitude 6.0 or greater within this belt (Eldredge and Christenson, 1992). Included among those 16 events are Utah's two largest historical earthquakes, the 1901 Richfield earthquake with an estimated magnitude of 6.5, and the 1934 Hansel Valley magnitude 6.6 earthquake, which produced Utah's only historical surface fault rupture. In an average year Utah experiences more than 700 earthquakes, but most are too small to be felt. Moderate magnitude (5.5 – 6.5) earthquakes happen every several years on average, the most recent being the magnitude 5.8 St. George earthquake on September 2, 1992. Large magnitude earthquakes (6.5 – 7.5) occur much less frequently in Utah, but geologic evidence shows that most areas of the state within the Intermountain seismic belt, including southwestern Utah, have experienced large surface-faulting earthquakes in the recent geologic past.

Fault-related surface rupture has not occurred in southwestern Utah historically, but the area does have a pronounced record of seismicity. At least 20 earthquakes greater than magnitude 4 have occurred in southwestern Utah over the past century (Christenson and Nava, 1992); the largest events were the estimated magnitude 6 Pine Valley earthquake in 1902 (Williams and Trapper, 1953) and the magnitude 5.8 St. George earthquakes in 1992 (Christenson, 1995). The Pine Valley earthquake is pre-instrumental and poorly located, and therefore, is not associated with a recognized fault. However, the epicenter is west of the surface trace of the Hurricane fault, so the event may have occurred on that structure. Pechmann and others (1995) have tentatively assigned the St. George earthquake to the Hurricane fault. The largest historical earthquake in nearby northwestern Arizona is the 1959 Fredonia, Arizona, earthquake (approximate magnitude 5.7; DuBois and others, 1982). Since 1987 the northwest part of Arizona has been quite seismically active (Pearthree and others, 1998), experiencing more than 40 events with magnitudes >2.5, including the 1993 magnitude 5.4 Cataract Canyon earthquake between Flagstaff and the Grand Canyon.

Despite the lack of an historical surface-faulting earthquake in southern Utah, available geologic data for faults in the region indicate a moderate rate of long-term Quaternary activity. Mid-Quaternary basalt flows are displaced hundreds of meters at several locations

and alluvial and colluvial deposits are displaced meters to tens of meters in late Quaternary time.

Active Faults

Because earthquakes result from slippage on faults, from an earthquake-hazard standpoint, faults are commonly classified as active, capable of generating damaging earthquakes, or inactive, not capable of generating earthquakes. The term “active fault” is frequently incorporated into regulations pertaining to earthquake hazards, and over time the term has been defined differently for different regulatory and legal purposes. In fact, faults possess a wide range of activity levels. Some, such as the San Andreas fault in California, produce repeated large earthquakes and associated surface faulting every few hundred years, while others, like Utah’s Wasatch fault and many of the faults in the Basin and Range Province, generate large earthquakes and surface faulting every few thousand to tens of thousands of years. Therefore, depending on the area of interest or the intended purpose, the definition of “active fault” may change. The time period over which faulting activity is assessed is critical because it determines which faults are ultimately classified as hazardous and therefore in need of regulatory mitigation (National Research Council, 1986).

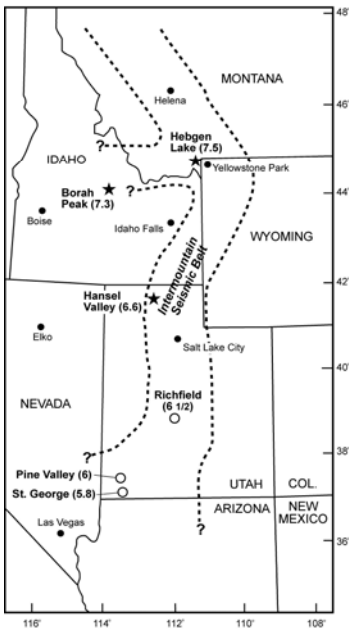


Figure 5 The Intermountain seismic belt and major historicall SB earthquakes.

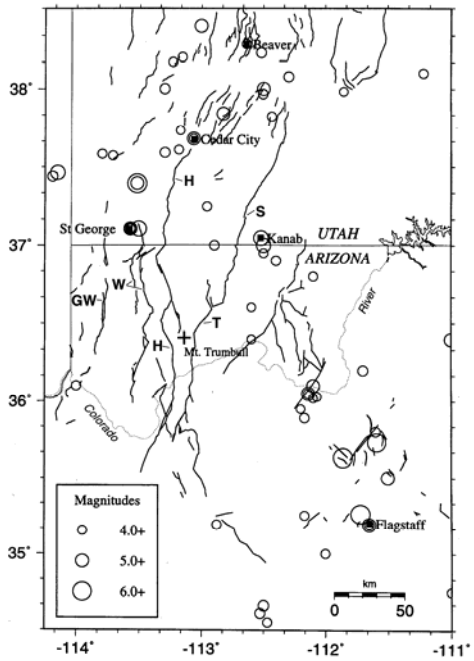


Figure 6 Earthquake epicenter map of southwestern Utah and northwestern Arizona and major Quaternary faults in the region: H = Hurricane fault; W = Washington fault; GW = Grand Wash fault; S = Sevier fault; T = Toroweap fault.

Flood

In the southwest, as elsewhere, flooding, erosion, and sediment discharge are responsible for loss of life, land, and infrastructure, along with damage to reservoirs and natural habitats. Stream flooding is the most prevalent and destructive (annually) of the geologic hazards that affect Utah. This destructive trend is nowhere more evident than in the southwest part of the state.

Two types of stream flooding typically occur in southwestern Utah: riverine floods and flash floods. Riverine floods are usually regional in nature, last for several hours or days, and have recurrence intervals of 25 to more than 100 years. They commonly result from the rapid melt of a winter snow pack or from periods of prolonged heavy rainfall. Flash floods result from thunderstorm cloudbursts. They are localized, quickly reach a maximum flow, and then quickly diminish. Recurrence intervals for flash floods are erratic, ranging from a few hours to decades or longer for a given drainage. Both types of flooding have caused extensive damage in southwestern Utah.

Three major riverine floods have affected southwestern Utah since the area was settled. They occurred in 1966, 1983 and 1984. The 1966 flood resulted from an intense three-day rainstorm that produced record peak flows on the Virgin River. This three-day storm produced between 1 and 12 inches of rain. The 1983 and 1984 floods occurred in response to the rapid melting of maximum-of-record and greater-than-average snow packs respectively. The 1983 and 1984 floods caused several landslides and a dam failure. Total damage was in excess of 640 million and the President issued a disaster declaration for 22 Utah counties. These three floods which usually happen once every 25 to100-years, happened in a 20 year period, this shows how unpredictable riverine flooding is in the southwest.

By nature flash floods are sudden, intense, and localized. Many undoubtedly occur every summer along isolated drainages in southwestern Utah and are never recorded. Flash floods have damaged every major town in southwestern Utah. The first recorded flash flood was on Shoal Creek in Cedar City in 1853. This flood carried away bridges and dams, brought immense quantities of boulders and rocks into town, and did extensive damage to the iron works. Since then more than 300 damaging floods have occurred in southwestern Utah. Many communities have implemented flood-control measures to reduce flash flood hazard; however, as communities expand into unprotected areas, new development is again subject to flash flooding.
Any new development in southwestern Utah must consider the potential for stream flooding, and through proper project planning and design, mitigate any flood hazard that may exist. In areas with a particularly high flood hazard, forgoing development completely may represent the best development alternative.

Floods, whether a riverine or a flash flood, are the most frequent and consistently destructive natural hazard in southwestern Utah. The conditions that cause floods are largely beyond human control; however, humankind can control its actions and do much to reduce the hazard from flooding.

Flood/Flash Flood Deaths in Southern Utah since July 1863:

July 17, 1863 – 4 deaths – Iron County - A flood generated by a series of cloudbursts raised Pine Creek to a level of 20 feet. A house was swept away and four children drowned.

August 5, 1901 – 1 death – Garfield County – A boy drowned while swimming in the gorge 15 miles south of Escalante when a fishnet came down the gulley.

August 10, 1903 – 1 death – Washington County – A man trapped in a flash flood in Dry Creek near Toquerville drowned.

July 30, 1936 – 1 death – Beaver County – Cloudburst rains caused heavy damage to property in Minersville. One woman drowned.

September 17, 1961 – 5 deaths – Washington County – A hiking party of 26 persons was caught in a flash flood in a narrow canyon (termed the Narrows) of the Virgin River in Zion National Park. Five members of that party drowned (scouts). The flood resulted from heavy rainfall and was said by old timers to be the largest they have ever seen coming through the Narrows. The crest of the flood reached 14 feet in some of the narrow gorges.

September 17, 1961 – 1 death – Kane County – At Wahweap Creek near Glen Canyon City a 9-year old girl drowned in a flash flood.

February 18, 1980 – 1 death – Washington County – Flooding was extensive due to heavy rains along the Virgin and Santa Clara Rivers in southwest Utah. A woman and her companion attempted to cross swollen Kolob Creek near Virgin. The vehicle they were riding in was carried several hundred yards downstream with the woman drowning and her companion swimming to safety.

July 27, 1998 – 2 deaths – Washington County – Two male hikers drowned in the Zion "Narrows" during a flash flood. One was 27 years old and the other 31 years old.

September 5, 1998 – 1 death – Kane County – A flash flood in Glen Canyon National Recreation Area's Ice Cream Canyon swept away and drowned a 10-year-old girl. She was standing on the side of the canyon observing the flash flood in the canyon below when the side gave way and she fell in.

May 13, 2001 – 1 death – Washington County – A 10-year-old boy was killed after being swept off a cliff by a "curtain" of water during a flash flood that was falling across a steep cliff-side trail. A second boy was rescued.

The total number of those who have drowned due to floods or flash floods in the Five County Region since 1863 is 18. (Excerpted from: Geology of Southwestern Utah, Utah Geological Association: publication 21, Kimm M. Harty, editor)

Beaver County Dam Information:

Beaver County has a total of 22 dams, six of which are rated as Low, 11 of them are Moderate, and five dams have a rating of High.
The five dams with a rating of High are:

Kent's Lake No 1 (Upper)
Kent's Lake No 2 (Middle)
Manderfield (aka Beaver)
Rocky Ford aka Minersville Reservoir (Beaver)
Three Creeks (Beaver)

Kent's Lake No 1 (Upper)
Owned by Kent's Lake Irrigation Company.
Year completed 1915.

Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 1 square mile.
Maximum Dam Breach Flow is 3,000 Cfs.
First downstream town is Beaver and it is 11 miles.
Was breached on September 10th 1988.
There are no visible structures in danger at the highest level of inundation if the dam failed; however, there are a couple of campgrounds that could be affected. There also could be minor damage to the town of Beaver.

Kent's Lake No 2 (Lower)
Owned by Kent's Lake Irrigation Company.
Year completed 1928.
Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 1 square mile.
Maximum Dam Breach Flow is 14,000 Cfs.
First downstream town is Beaver and it is 11 miles.
Renovated in 1979.

There are no visible structures in danger at the highest level of inundation if the dam failed; however, there are a couple of campgrounds that could be affected. There also could be minor damage to the town of Beaver.

Manderfield (aka Beaver)
Owned by Manderfield Reservoir and Irrigation Co.
Year completed 1937
Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 2.5 square miles.
Maximum Dam Breach Flow is 13,000 Cfs.
First downstream town is Manderfield and it is 12 miles.
AKA Lower Indian Creek.
There are no visible structures in danger of flooding if the Dam fails.

Rocky Ford (aka Minersville)
Owned by Rocky Ford Irrigation Company.
Year completed 1914.
Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 531 square miles.
Maximum Dam Breach Flow is 91,000 Cfs.
First downstream town is Minersville and it is 5 miles.
1977 Modified spillway.
The failure of this dam has the potential for great loss of property – there are approximately 158 structures that could be affected. There is also the potential for several sq. miles of property to be affected including agricultural. There could be numerous livestock lost and road closures.

Three Creeks (Beaver)
Owned by Kent's Lake Irrigation Company.
Year completed 1949.
Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 12 square miles.

Maximum Dam Breach Flow is 13,000 Cfs.
First downstream town is Beaver and it is 18 miles.
1973 Modified spillway.
There are no structures in immediate danger in the Three Creeks dam fails – there is however, the possibility of campers, hikers, or motorist being affected.

Garfield County Dam Information

Garfield County has a total of 36 dams, 24 of which are rated as Low, eight of them are Moderate, and four dams have a rating of High.
The four dams with a rating of High are:

Oak Creek (aka Upper Bowns)
Panguitch Lake
Tropic
Wide Hollow

Oak Creek (aka Upper Bowns)
Owned by Sandy Ranch.
Year completed 1918.
Was last inspected in August of 2003, by Utah Division of Water Rights.
Drainage basin is 2.5 square miles.
Maximum Dam Breach Flow is 14,000 Cfs.
First downstream town is Hanksville and it is 48 miles.
Was breached in 1973, and then rebuilt in 1982.
There are no structures in immediate danger if the Oak Creek (Upper Bowns) dam fails – there is however, the possibility of wildlife, campers, hikers, and motorist being affected.

Panguitch Lake
Owned by West Panguitch Irrigation and Reservoir.
Year completed 1872.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is 45.7 square miles.
Maximum Dam Breach Flow is 13,000 Cfs.
First downstream town is Panguitch and it is 14 miles.
There are at least 12 structures in immediate danger if the Panguitch Lake dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. If the breach is major enough there is potential for the flood to reach the city of Panguitch, therefore, putting more structures and lives in harms way.

Tropic
Owned by Tropic-East Fork Irrigation Company.
Year completed 1936.
Was last inspected in August of 2003, by Utah Division of Water Rights.
Drainage basin is 86.1 square miles.
Maximum Dam Breach Flow is 11,000 Cfs.
First downstream town is Antimony and it is 31 miles.
New Spillway constructed in 1977.
There are no structures in immediate danger if the Tropic dam fails – there is however, the possibility of wildlife, campers, hikers, and motorist being affected. If there is a large enough of a breach there is a possibility that the Town of Antimony may have 10 to 15 structures

affected – there should be time enough to evacuate those in danger due to the distance involved.

Wide Hollow
Owned by New Escalante Irrigation Company
Year completed 1954.
Was last inspected in August of 2003, by Utah Division of Water Rights.
Drainage basin is 10 square miles.
Maximum Dam Breach Flow is 43,000 Cfs.
First downstream town is Escalante and it is 2 miles.
No Flashboard in Spillway.
There are no structures in immediate danger if the Wide Hollow dam fails – there is however, the possibility of wildlife, campers, hikers, and motorist being affected. If there is a large enough of a breach there is a possibility that the Town of Escalante may have 100 structures affected, this being the case since the dam is less than 2 miles away there will not be much of a warning.

Iron County Dam Information

Iron County has a total of 29 dams, 10 of which are rated as Low, 11 of them are Moderate, and eight dams have a rating of High.
The eight dams with a rating of High are:

Cedar City – Fiddlers Canyon DB #2
Cedar City – Dry Canyon DB
Cedar City Stephens Canyon DB North
Cedar City Stephens Canyon DB South
Fiddlers Canyon DB #1
Newcastle
Red Creek (Iron)
Yankee Meadow

Cedar City – Fiddler Canyon DB #2
Owned by Kit Wareham.
Year completed UNKNOWN.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is 7.57 square miles.
Maximum Dam Breach Flow is UNKNOWN Cfs.
First downstream town is Cedar City and it is .1 miles.
There are over 255 structures in immediate danger if the Cedar City – Fiddler Canyon DB #2 dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. There is a 45 to 60 minute time frame from when the dam fails to when the water reaches I-15. This can cause substantial damage and possible loss of life due to the timeframe.

Cedar City Dry Canyon DB
Owned by Cedar City Corporation.
Year completed 2000.
Was last inspected in July of 2003, by Utah Division of Water Rights – Dam Safety.
Drainage basin is 1.21 square miles.

Maximum Dam Breach Flow is 1,400 Cfs.
First downstream town is Cedar City and it is 0 miles.
There are over 288 structures in immediate danger if the Cedar City Dry Canyon DB dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. There is less than a 30 minute time frame from when the dam fails to when the water reaches downtown Cedar City. This can cause substantial damage and possible loss of life due to the lack of time to evacuate. Since it is not a large amount of water there should not be substantial loss of property and life.

Cedar City Stephens Canyon DB North
Owned by Kit Wareham.
Year completed 2000.
Was last inspected in July of 2003, by Utah Division of Water Rights – Dam Safety.
Drainage basin is .14 square miles.
Maximum Dam Breach Flow is 200 Cfs.
First downstream town is Cedar City and it is 0 miles.
There would be about 130 structures in immediate danger of flooding if the Cedar City Stephens Canyon DB North dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. There is less than a 30 minute warning for residents west of North Main Street. Those homes before North Main Street will have no time to prepare if the failure is sudden. This dam failure will cause property damage but there should not be a loss of life due to the water crest being only 1 foot high, however, there is still the possibility of loss of life.

Cedar City Stephens Canyon DB South
Owned by Kit Wareham.
Year completed 2000.
Was last inspected in July of 2003, by Utah Division of Water Rights – Dam Safety.
Drainage basin is .14 square miles.
Maximum Dam Breach Flow is 200 Cfs.
First downstream town is Cedar City and it is 0 miles.
There would be about 130 structures in immediate danger of flooding if the Cedar City Stephens Canyon DB South dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. There is less than a 30 minute warning for residents west of North Main Street. Those homes before North Main Street will have no time to prepare if the failure is sudden. This dam failure will cause property damage but there should not be a loss of life due to the water crest being only 1 foot high, however, there is still the possibility of loss of life.

Fiddler Canyon DB #1
Owned by Fiddlers Canyon Development, LTD.
Year completed UNKNOWN.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is .9 square miles.
Maximum Dam Breach Flow is UNKNOWN Cfs.
First downstream town is Cedar City and it is 0.1 miles.
There could be about 100 structures affected if the Fiddler Canyon DB #1 dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. Since the dam is so close to population there will not be a whole lot of warning. This dam failure will cause property damage but there should not be a loss of life due to the water crest being only 1 foot high.

Newcastle
Owned by Newcastle Reservoir Company.
Year completed 1956.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is 134 square miles.
Maximum Dam Breach Flow is 126,000 Cfs.
First downstream town is Newcastle and it is 2 miles.
There could be about up to 10 structures affected if the Newcastle dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. This dam is located in a non-populated area with very few structures in the area. This is a good thing because this dam has the potential for a disastrous result if indeed it did breach. There will be a loss of wildlife and potential for livestock and hikers to be in danger.

Red Creek (Iron)
Owned by Paragonah Canal Company.
Year completed 1980.
Was last inspected in June of 2003, by Utah Division of Water Rights.
Drainage basin is 8.4 square miles.
Maximum Dam Breach Flow is 48,000 Cfs.
First downstream town is Paragonah and it is 8 miles.
There could possibly be 75 structures affected if the Red Creek (Iron) dam fails – there is also the possibility of wildlife, campers, hikers, and motorist being affected. This dam is located in a non-populated area with very few structures in the area. There should be enough time to evacuate parts of Paragonah if there is a major breach since the town is eight miles away.

Yankee Meadow
Owned by Parowan Reservoir Company.
Year completed 1926.
Was last inspected in April of 2003, by Utah Division of Water Rights.
Drainage basin is 2 square miles.
Maximum Dam Breach Flow is 18,000 Cfs.
First downstream town is Parowan and it is 10 miles.
The worse case scenario if the Yankee Meadow dam fails is a potential of over 600 structures being affected in the town of Parowan which is 10 miles downstream. There is also the possibility of wildlife, campers, hikers, and motorist being affected. This dam is located in a non-populated area with very few structures in the area. Although there are few structures and this dam is located in a remote area, the circumstances of a narrow canyons and high water crest if there is a breach will add to the potential risk of loss of property and possibly life, including wildlife.

Kane County Dam Information

Kane County has a total of 20 dams, 18 of which are rated as Low, 2 of them are Moderate, and zero (0) dams have a rating of High.

Washington County Dam Information

Washington County has a total of 37 dams, 11 of which are rated as Low, 10 of them are Moderate, and 16 dams have a rating of High.

The 16 dams with a rating of High are:

Ash Creek
Baker
City Creek Debris Basin – St. George
Enterprise (Lower)
Enterprise (Upper)
Gunlock
Ivins Bench
Kolob Creek
Quail Creek
Quail Creek South Dam
Sand Hollow North Dam
Sand Hollow West Dam
Santa Clara
South Creek – Washington Co
St. George City – Navajo DB
Warner Draw

Ash Creek
Owned by Washington County Water Conservancy District.
Year completed 1960.
Was last inspected in October of 2003, by Utah Division of Water Rights.
Drainage basin is 134 square miles.
Maximum Dam Breach Flow is 25,000 Cfs.
First downstream town is Pintura, 8 miles away.
Modification to the Spillway in 1987.
There are no structures in immediate danger if the Ash Creek dam fails – there is however, the possibility of wildlife, campers, hikers, and motorists being affected. If there is a large enough breach then there may be a possibility that the Town of Pintura could have 20 to 25 structures affected – The major damage that is expected would be to Interstate I-15, since this makes up the dam.

Baker
Owned by Baker Reservoir Company.
Year completed 1950.
Was last inspected in June of 2002, by Utah Division of Water Rights.
Drainage basin is 109 square miles.
Maximum Dam Breach Flow is 4,000 Cfs.
First downstream town is Veyo, 4 miles away.
Repaired the Spillway in 1967, damage was due to a flash flood.
There are structures in immediate danger if the Baker dam fails. If there is a large enough breach, there may be a possibility that the town of Veyo could have 10 to 20 structures affected. There is also the possibility of wildlife, campers, hikers, and livestock being affected.

City Creek Debris Basin – St. George
Owned by St. George City.
Year completed 1989.
Was last inspected in April of 2002, by Utah Division of Water Rights.
Drainage basin is 4 square miles.

Maximum Dam Breach Flow is 20,000 Cfs.
First downstream town is St. George, 1 mile away.
There are potentially 1000 or more structures in St. George that could be damaged if the City Creek Debris Basin dike fails. There is the potential for a major disaster depending on the volume of the dam if it fails. Roads and evacuation routes will be affected – the flood will run down Bluff Street in St. George and will also spill out into Green Valley on the west side of the Black Ridge.

Enterprise (Lower)
Owned by Enterprise Reservoir and Canal.
Year completed 1925.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is 35 square miles.
Maximum Dam Breach Flow is 43,000 Cfs.
First downstream town is Enterprise, 11 miles away.
There are no inundation maps for the Enterprise (Lower) dam – however, there would be danger to hikers, campers, wildlife, motorists, and potentially if the breach is large enough it may reach the city of Enterprise and affect up to 350 structures with flooding etc.

Enterprise (Upper)
Owned by Enterprise Reservoir and Canal.
Year completed 1912.
Was last inspected in July of 2003, by Utah Division of Water Rights.
Drainage basin is 29.1 square miles.
Maximum Dam Breach Flow is 54,000 Cfs.
First downstream town is Enterprise, 12 miles away.
There are no inundation maps for the Enterprise (Upper) dam – however, there would be danger to hikers, campers, wildlife, motorists, and potentially if the breach is large enough it may reach the city of Enterprise and affect up to 350 structures with flooding etc.

Gunlock
Owned by Lower Gunlock Reservoir Corporation.
Year completed 1970.
Was last inspected in June of 2002, by Utah Division of Water Rights.
Drainage basin is 306 square miles.
Maximum Dam Breach Flow is 222,000 Cfs.
First downstream town is Santa Clara, 6 miles away.
1985 Hydroelectric facility built.
There are potentially 250 or more structures in Santa Clara and St. George that could be affected if the Gunlock Reservoir Dam fails – there is also the possibility of wildlife, campers, hikers, and livestock being affected. The Shivwits Reservation will have about seven structures affected and they will have a 41 minute warning, whereas, the city of Santa Clara will have an hour warning before the first crest arrives. This should be enough to evacuate the most susceptible areas.

Ivins Bench
Owned by Ivins Irrigation Company.
Year completed 1943.
Was last inspected in June of 2002, by Utah Division of Water Rights.
Drainage basin is 1 square mile.
Maximum Dam Breach Flow is 20,000 Cfs.

First downstream town is Santa Clara, 5 miles away.
There are potentially 250 or more structures in Santa Clara and St. George that could be affected if the Ivins Bench dam fails – there is also the possibility of wildlife, campers, hikers, and livestock being affected. There are no inundation maps to show the crest height or the flow when breached – but even if small there should be a few structures in Santa Clara that are affected somewhat.

Kolob Creek
Owned by Washington County Water Conservation District.
Year completed 1956.
Was last inspected in October of 2003, by Utah Division of Water Rights.
Drainage basin is 8 square miles.
Maximum Dam Breach Flow is 89,000 Cfs.
First downstream town is Virgin, 23 miles away.
Dam is also called “Big Creek”.
If there is a major dam failure at Kolob Creek dam there could potentially be at least 275 or more structures affected along the Virgin River floodplain. The inundated area will traverse the Virgin River both East and West when it reaches the town of Virgin – there will be flooding in Rockville, Springdale, Virgin, historic Grafton may be lost, and the other towns along the river course including St. George. There will be damage to crops, trails, livestock, campgrounds and wildlife. This will be a significant flood – there will be a little time for authorities to evacuate when the failure occurs.

Quail Creek
Owned by Washington County Water Conservation District.
Year completed 1984.
Was last inspected in March of 2003, by Utah Division of Water Rights.
Drainage basin is 78 square miles.
Maximum Dam Breach Flow is 401,000 Cfs.
First downstream town is Washington City, 5 miles away.
There is a potential for extensive agricultural damage if the Quail Creek dam fails, mainly the damage will be in the Washington Fields area of Washington City. Depending on the size of the failure there could also be a high loss of livestock and wildlife. There will be roads washed away and a chance of loss of life. The inundation will reach Washington in one hour from dam failure and St. George in an hour and a half from dam failure; this gives officials little time to evacuate areas. The flood will follow the Virgin River floodplain. Over 250 structures could be affected.

Quail Creek South Dam
Owned by Washington County Water Conservation District.
Year completed 1990.
Was last inspected in March of 2003, by Utah Division of Water Rights.
Drainage basin is 78.4 square miles.
Maximum Dam Breach Flow is 144,000 Cfs.
First downstream town is Washington, 10 miles away.
There is a potential for extensive agricultural damage if the Quail Creek South dam fails, mainly the damage will be in the Washington Fields area of the city of Washington. Depending on the size of the failure there could also be a high loss of livestock and wildlife. There will be roads washed away and a chance of loss of life. The inundation will reach Washington in one hour from dam failure and St. George in an hour and a half from dam

failure; this gives officials a little time to evacuate areas. The flood will follow the Virgin River floodplain. Over 250 structures could be affected.

Sand Hollow North Dam
Owned by Washington County Water Conservation District.
Year completed 2000.
Was last inspected in March of 2003, by Utah Division of Water Rights.
Drainage basin is (DATA UNAVAILABLE) square miles.
Maximum Dam Breach Flow is 1064 Cfs.
First downstream town is Hurricane City.
There are no structures in immediate danger if the Sand Hollow North dam fails – there is however, the possibility of wildlife, campers, hikers, and motorist being affected. If there is a large enough of a breach there is a possibility that 20 to 25 structures along the Virgin River Floodplain will be affected – there should be time enough to evacuate those in danger due to the distance and volume of water involved.

Sand Hollow West Dam
Owned by Washington County Water Conservation District.
Year completed 2002.
Was last inspected in March of 2003, by Utah Division of Water Rights.
Drainage basin is (DATA UNAVAILABLE) square miles.
Maximum Dam Breach Flow is 1064 Cfs.
First downstream town is Hurricane City.
There are no structures in immediate danger if the Sand Hollow West dam fails – there is however, the possibility of wildlife, campers, hikers, and motorists being affected. If there is a large enough of a breach there is a possibility that 20 to 25 structures along the Virgin River Floodplain will be affected – there should be time enough to evacuate those in danger due to the distance and volume of water involved.

Santa Clara Dam
Owned by City of Santa Clara.
Year completed 1919.
Was last inspected in April of 2003, by Utah Division of Water Rights.
Drainage basin is 7 square miles.
Maximum Dam Breach Flow is 2000 Cfs.
This structure is within Santa Clara City
There are at least 175 structures that will be affected if the Santa Clara dam fails – most of these will be in the city of Santa Clara and will not have much time to evacuate. The flood will traverse the Santa Clara River south through western St. George and into the Virgin River.

South Creek – Washington County Dam
Owned by Trees Ranch.
Year completed 1988.
Was last inspected in October of 2003, by Utah Division of Water Rights.
Drainage basin is 18 square miles.
Maximum Dam Breach Flow is 48,000 Cfs.
First downstream town is Rockville, 5 miles away.
There are about 25 structures that could be affected if the South Creek dam fails – most of these will be along the Virgin River floodplain in the city of Rockville and Grafton. The flood

will traverse the Virgin River southwest through Washington County. It could affect some remote hikers, campers and wildlife.

St. George City – Navajo DB Dam
Owned by St. George Public Works.
Year completed UNKNOWN.
Was last inspected in April of 2003, by Utah Division of Water Rights.
Drainage basin is .386 square miles.
Maximum Dam Breach Flow is 217 Cfs.
First downstream town is Bloomington area of St. George where it is located.
There is not a whole lot of data on this dam – there are quite a few of structures nearby, however, since the CFS is so low there would be minor flooding if any at all.

Warner Draw Dam
Owned by St. George and Washington Canal Company.
Year completed 1975.
Was last inspected in October of 2003, by Utah Division of Water Rights.
Drainage basin is 4.4 square miles.
Maximum Dam Breach Flow is 58,000 Cfs.
First downstream town is NONE (drains to Virgin River) and it is 0 miles.
There is an emergency spillway in place.
There will be at least 250 structures affected if the Warner Draw dam fails – all of these in the Washington Fields area, which is south of the city of Washington. The inundation will affect the fields and empty into the Virgin River, from there it could cause the Virgin River's crest to rise enough to affect structures in St. George etc. There will be agricultural and domestic animals that will be affected when the inundation reaches the Washington Fields.

History of Dam Failure in the Five County Association of Governments (FCAOG) Jurisdiction (Southwestern Utah)

The Quail Creek reservoir dam failed in 1989, and it caused over $5 million in private property damage.

Quail Creek reservoir is located in southwest Utah near St. George. The Quail Creek South Dam was constructed along the eastern limb of the Virgin anticline and is located on Triassic age Moenkopi Formation deposits of predominately highly gypsiferous, siltstone and dolomicrites.

After the failure of the original earthfill dike in 1989, the dam was reconstructed as a roller compacted concrete (RCC) structure with a concrete and RCC cutoff trench which reached a depth of about 75 feet (22.9 m) through the maximum section, a maximum dam height of about 80 feet (24.4 m), and a crest length of about 2150 feet (655 m).

Since completion of the new dam in 1991, seepage has gradually increased. Seepage had been most notable along the left side of the dam, leading to the installation of a toe drain system. During the past few years, subsidence features have been noted down stream of this area. Since January 2002 seepage along the right side of the dam has increased significantly. About 800 feet (244 m) downstream of Station 5+00, water has been flowing out of several closely grouped open eroded fractures in a highly fractured, light greenish gray dolomicrite unit with about 20% visible gypsum. During the Spring, flows from this unit

reached peaks of 4.9 cfs and were slightly discolored and cloudy. Analysis showed the flow to be carrying up to 1.4 tons of sediment per day, dropping to about 760 lbs/day 6 days later. (Source – RB&G Engineering, Provo, Utah)

Volcanism

Southwestern Utah experienced prolonged volcanism during the Cenozoic time. Tumultuous eruptions of calc-alkaline volcanics and deposition of volcaniclastic debris dominated early to mid-Cenozoic volcanism. The active volcanic centers in the southwestern district area include the Escalante Deserts in the Basin and Range Province; the High Plateaus and adjacent areas in the Colorado Plateau Province; and the Pine Valley Mountains-St. George Basin and surrounding areas.
The youngest vents and flows in southwestern Utah are less than 1,000 years old. Remote eruptive centers present Utah's most imminent and potentially damaging volcanic hazard.

Past Major Eruptions:
From late Oligocene to early Miocene, stratovolcanoes and caldera complexes generated lavas and layer upon layer of volcaniclastic debris throughout the Basin and Range Province. Straddling the Utah-Nevada border and circling the southern portion of the Needles Range of Beaver and Iron Counties, the Indian Peak caldera complex served as the source for the calc-alkaline volcanics of the 29.5 million year old Wah Wah Springs Formation.

The Bullion Canyon Volcanics and the Mount Belknap Volcanics originated from calderas of the Tushar Mountains in Beaver and Piute Counties. Flows, pyroclastics, and associated rocks from this caldera complex range in age from 25 to 14 million years. South-Central Utah's mid-Cenozoic stratovolcanoes shed volcanistics onto low lands to the south and east, forming an apron of debris that eventually became the southwestern High Plateaus. Local, violent eruptions of andesitic and rhyolitic materials are no longer a hazard in Utah. Between 8 and 6 million years ago basaltic and rhyolitic magmas formed domes, plugs, cones, and shield-like volcanic features in the Great Basin and Range of Southwest Utah.

These predominately mafic-composition volcanics have augmented the present-day landforms in the three volcanic regions of southwestern Utah. Geomorphically fresh features and textures, geothermal anomalies, and recent eruptive histories present convincing arguments for the continuation of volcanic events in southwestern Utah.

There has been caldera-type eruptive volcanic activity in southwestern Utah dated as occurring in the early Cenozoic period. As the geologic conditions that created those types of eruptions has long since disappeared there is zero chance of their repetition. The current hazard relating to volcanic activity is strictly limited to localized, small, cinder cone basaltic eruptions. According to geologists, the hazard is real, but extremely infrequent and would be limited to a relatively small area. Because of the remote potential of these volcanic events affecting the built environment, and threatening people, this hazard is not considered in the same vein as many of the other natural hazards that this plan addresses.

It should be noted that there have been no reports of property damaged or human injuries or deaths attributed to any type of volcanic activity in southwestern Utah, since records have been kept.

Drought

Information on Drought in Southwest Utah is based upon the Palmer Drought Severity Index Chart. The Palmer Index was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness – it has become the semi-official drought index used today. The Palmer Index is most effective in determining long term drought – several months. The advantage of Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. The negative is that it is not as good for short term forecasts, and is not particularly useful in calculating supplies of water locked up in snow. (NOAA's Drought Information Center)

There are four Climate Divisions in Southwest Utah based: Division 1 – Western, Division 2 – Dixie, Division 4 – South Central, and Division 7 – Southeast. The Palmer Index has information for historic drought data from 1895 to 1995.
Below is the Historic Data by Division:

Division 1 – Western

The Western Division comprises 4,290 square miles or 24% of the total land area of the Five Counties, and is found in the western parts of Beaver, Iron, and Washington counties. Historically the Western Division has followed a drought pattern of normal to wet for 20 years, then having a severe to extreme drought problem that persist for six or seven years. However, 17 of the last 20 years have been severe to extreme drought. The Western Division has been in an extreme drought period since 1999.

Division 2 – Dixie

The Dixie Division comprises 1,423 square miles or 8% of the total land area of the Five Counties, the majority is found in Washington County with a small portion found in Kane County. Dixie Division has had three major drought periods since 1895, with the third one currently happening. The last two lasted at least seven years each and were about 50 years apart. The Dixie Division has been in an extreme drought for approximately four years.

Division 4 – South Central

The South Central Division comprises 9,097 square miles or 52% of the total land area of the Five Counties. The South Central Division is found in all five counties, mainly found in the central part of the Five Counties. The South Central Division has been pretty consistent throughout the 100+ years of record keeping. Until the mid 60's there has been a period of drought every 20 years on average, after the mid 60's the droughts have been more frequent primarily every 10 to 15 years.

Division 7 – Southeast

The Southeast Division comprises 2,813 square miles or 16% of the total land area of the Five Counties. The Southeast Division is found in the eastern half of Kane and Garfield counties. The Southeast Division had an eight year drought just as the other divisions did. Between 1896 to 1904 it was in the extreme part of the index. After this long extreme drought there were basically fifty years of normal to wetter than normal years followed by a four year drought in the mid fifties. Since the drought in the mid fifties there has been a two to three year extreme drought every 10 to 13 years.

Summary

The drought history of the four different divisions in the Five County area has been very similar except for the Southeast division. The Southeast Division is a bit different than the other Divisions, instead of a longer period in-between a drought and then followed with a drought lasting between five to eight years; the Southeast has a shorter period in-between a drought and the droughts are only 2 to 3 years long.

Problem Soil

There are six types of problem soils and rocks that are found in southwestern Utah – these types are listed below.

Expansive Soil

Expansive soil and rock is the most common type of problem deposit in southwestern Utah. In particular, the Jurassic-age Arapien and Cretaceous-age Tropic Shale's, and the Triassic-age Chinle and Moenkopi Formations are sources for expansive materials. Expansive deposits contain clay minerals that expand and contract with changes in moisture content. Clays absorb water when wetted, causing the soil or rock to expand. Conversely, as the material dries, the loss of water between clay crystals or grains causes the deposit to shrink. Expansive deposits are extensive around St. George, Washington, and Santa Clara. In these areas expansive clays in the Chinle Formation have been most damaging to structures. In Santa Clara, many homes and a church were damaged by expansive clays in the Chinle Formation. Common problems are cracked formations, heaving and cracking of floor slabs and walls, and failure of wastewater disposal systems. Sidewalks and roads are particularly susceptible to damage.

Collapsible Soils

Subsidence of the ground surface due to collapsible soil has caused extensive damage in and around Cedar City and the Hurricane cliffs, where it is most prevalent. Collapsible soil is common in Holocene alluvial-fan and debris-flow deposits in southwestern Utah. Soil and rock containing gypsum are also susceptible to subsidence. Collapse occurs when susceptible soils are wetted to a depth below that normally reached by rainfall, destroying the clay-bonds between bands. Collapsible soil is present in geologically young materials such as Holocene-age alluvial-fan and debris-flow sediments, and in some wind-blown silts. In Cedar City approximately $3 million in damage to public and private structures has been attributed to collapsible soil.

Limestone (Karsts Terrain)

Limestone susceptible to dissolution and subsidence occurs throughout mountains west of Sevier Lake, west of Richfield, and south of St. George. Karsts terrain is characterized by closed depressions (sinkholes), caverns, and streams that abruptly disappear underground. Most karsts terrain in southwestern Utah is relict and relates to moisture climates during the Pleistocene, or may have been created by ground water prior to the rock being uplifted and tilted during basin and range faulting. No known damage has occurred to structures from ground collapsing or subsidence related to limestone karsts, but because karsts ground-water systems have little filtering capacity, contamination of ground water is a major concern.

Gypsiferous Soil and Rock
Gypsiferous deposits are subject to settlement caused by the dissolution of gypsum, which creates a loss of internal structure and volume within the deposit. Gypsiferous soil and rock deposits are common in southwestern Utah, particularly along the base of the Hurricane cliffs. Gypsum in these deposits can cause damage to foundations, and induce land subsidence and sinkholes similar to those seen in limestone terrain.

Soils subject to Piping
Piping is subsurface erosion by ground water that moves along permeable, non-cohesive layers in unconsolidated materials and exists at a free face, usually along a stream bank or cliff that intersects the layer. Deposits susceptible to piping are common in the southwestern part of the state. Holocene-age alluvial fill in canyon bottoms is the most common material susceptible to piping in Utah. Collapse of soil pipes and subsequent erosion has damaged roads and agricultural land. Piping can cause damage to roads, bridges, culverts, and any structure built over soils subject to piping. Earth-fill structures such as dams may also be susceptible to piping.

Sand Dunes
Dunes are common surficial deposits in arid areas where sand derived from weathering of rock or unconsolidated deposits is blown by the wind into mounds or ridges. In areas where development encroaches on dunes, inactive or vegetated dunes may be reactivated, allowing them to migrate over roads and bury structures. Sand Dunes occur in the Escalante Desert and west of Kanab. Migration of dunes across roads and burial structures are common problems in areas where active dunes are present. Avoidance of dunes is the best way to prevent damage to structures. However, active dunes usually are a maintenance problem only and do not preclude development.

Severe Weather

Climate
Most of the moisture in the winter comes from fronts that develop in the Gulf of Alaska and move from west to east across the State. Tropical air from the Gulf of Mexico enters the state from the south and west during July through September and is the source of severe and often violent thunderstorms. Tropical Pacific airmasses from the southwest at times have caused extreme floods in the southwest part of the State.

The mountains form barriers to the flow of moisture-laden air, and orographic precipitation may occur any time during the year. Rain shadows, which are areas of reduced precipitation, on the leeward side of the mountains account for the low normal annual rainfall in many of the interior valleys in the State.

Several times during each year, typically, a counterclockwise circulation develops aloft over Utah, usually during May or October, when the general pattern of air movement over the State is changing. This circulation around a low pressure center aloft pulls the lower level air upward into the center of the low pressure, and often results in widespread, heavy precipitation over the entire State for a period of several days. Orographic influences are minor for these convectional-type storms.

Cloudburst storms and resultant floods occur principally during the summer. All parts of the State are subject to these storms, even the flat desert areas of the western portion.

However, they occur more frequently along the west slope of the Wasatch Range, the Colorado Plateaus, and the southwest part of the State.

Tornadoes

Generally speaking, atmospheric conditions are rarely favorable for the development of tornadoes in Utah due to its dry climate and mountainous terrain. In fact, Utah ranks as having one of the lowest incidences of tornadoes in the nation, averaging only about two tornadoes per year, with only one F2 or stronger tornado once every seven years. From January 1950 to June 1, 2000, 97 tornadoes and 22 waterspouts have been reported in the state.

In the central U.S., tornadoes are commonly one-fourth of a mile wide and often cause considerable destruction and death. However, Utah tornadoes are usually smaller in size--often no more than 60 feet wide (at the base)--with a path length usually less than a mile and a life span of only a few seconds to a few minutes. They normally follow a path from a southwesterly to a northeasterly direction and usually precede the passage of a cold front.

About 73% of all Utah tornadoes have occurred in May, June, July and August, when severe thunderstorms occasionally frequent Utah. Also, 69% of all Utah tornadoes have occurred between the hours of Noon and 5:00 PM (MST), while 55% of all waterspouts have happened in the morning hours.

There have probably been more tornadoes and waterspouts in Utah than the following statistics and accounts indicate. In fact, in recent years an increasing number of these storms have been reported--probably due to Utah's increasing population and greater public awareness about twisters. However, sometimes people have mistaken whirlwinds (or dustdevils), microburst winds and other natural phenomena as tornadoes. Thus, every report of possible tornadic activity that appears in this publication has been carefully reviewed and analyzed to assure the greatest degree of accuracy possible.

Snow Avalanches Common in Utah:

Dry or slab avalanches: occur when a cohesive slab of snow fractures as a unit and slides on top of weaker snow, breaking apart as it slides. Slab avalanches occur when additional weight is added quickly to the snow pack, overloading a buried weaker layer. Dry snow avalanches usually travel between 60-80 miles per hour, reaching this speed within 5 seconds of the fracture, resulting in the deadliest form of snow avalanche.

Wet avalanches: occur when percolating water dissolves the bonds between the snow grains in a pre-existing snow pack, this decreases the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour

While snow avalanches affecting people in southwestern Utah are rare, they can be deadly. In 1998, a group of Boy Scouts on a winter excursion in the mountains east of Beaver City accidentally triggered a class 3 avalanche that trapped four of them. The avalanche was 100 yards wide and at least 3 feet deep. The Scouts, who were buried in the snow, ran the risk of suffocation. They were lucky that they were only buried for a few minutes and survived with only minor injuries.

Insect Infestation

Insect infestation in Southwestern Utah is varied in location, species of insects and severity of infestation. The Mormon cricket, so called because of the heartache it once brought early Utah settlers, is devouring acres of wheat, barley, and oats in the state. The 2003 infestation, which also affected Idaho and Nevada, might be the worst in recent history. Forests of southwestern Utah are also infested with several species of beetles and other damaging insects.

Grasshopper and Mormon cricket Infestations
The State of Utah Department of Agriculture and Food has said that no one who works for their department has seen it this bad. For the sixth year in a row an estimated 5 million to 6 million acres of farm and ranchland in Utah are infested with crickets and grasshoppers.

A statewide agricultural disaster based on the continued drought, insect infestation, and high winds was recently declared by FEMA providing help from the federal government such as low-interest loans for farmers and ranchers. According to Utah state officials crickets and grasshoppers have caused $25 million in damages from lost crops. According to the Utah Department of Agriculture, wheat, barley, oats, and alfalfa are the main crops affected by the insect infestation, with most of the damage occurring in rural and central Utah. State officials say one cricket can consume 38 pounds of forage during its lifetime.

Utah has a long and colorful history of problems with the insect dating back to the early days. When Mormon settlers attempted to harvest crops in 1848 hordes of crickets swarmed the area destroying the crops. According to state history, failed attempts to fight the crickets sent the Mormon pioneers to their knees in prayer. Thousands of sea gulls appeared and devoured the crickets and saved the crops. On historic Temple Square in Salt Lake City visitors can see a monument to the sea gull that reads: "In grateful remembrance of the mercy of God to the Mormon Pioneers."

The largest infestation of grasshoppers in Utah in 2002 was in Millard County which neighbors Beaver County at the north of this region. 23,024 acres of BLM land in that county were infested with Grasshoppers with 11,512 acres being treated with an insecticide. Mormon cricket populations in 2003 are perhaps the largest in Utah's recorded history. Mormon crickets infestation has now extended into Beaver County reaching to near the northern city limits of Beaver City. Statewide, the acres affected by infestation of grasshoppers and Mormon crickets are shown in Table 15.

Forest Infestations
Forest health is a complicated topic. To keep things simple, this report focuses only on the effects of insects, diseases, and weather on trees. Within that realm, precipitation is crucial for trees to remain vigorous which increases the trees resistance to insects and pathogens. With adequate rainfall or snowmelt, the trees can maintain their defenses; flushing the attacking bark beetles with pitch or growing more leaves and needles to replace those eaten by defoliating insects. Without adequate precipitation, resistance is significantly reduced. The western states, including Utah, have been suffering from drought since 2000. The effect of drought and increased insect activity is becoming noticeable throughout the Intermountain Region.

Spruce Bark Beetle

The spruce beetle (*Dendroctonus rufipennis*) is the most significant natural mortality agent of mature spruce. Endemic populations usually exist in weakened or windthrown trees, logging slash, and fresh stumps. Outbreaks typically occur when beetle populations build to high levels in concentrations of windthrown trees. Dispersing adults may infest standing live trees, initially preferring larger diameter trees. In southwestern Utah, the spruce beetle was responsible for more infested acres in 2001 than any other forest insect pest. The total number of infested acres reached 31,892. Portions of Iron County, located within Dixie National Forest have been experiencing devastating spruce beetle outbreaks for a number of years which started in scattered windthrown trees. As of 2001, the spruce bark beetle had infested the following number of acres by county: Beaver, 839; Garfield, 2,728; Iron, 28,029; Kane, 296; and Washington, none.

Douglas-Fir Beetle

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is the most destructive bark beetle of this tree species in western North American forests. At endemic levels, these insects infest scattered trees of low vigor and poor health. Where there is an abundance of trees of low vigor and poor health, populations can build rapidly and spread to adjacent healthy, green standing trees. All five southwest counties surveyed in Utah have had Douglas-fir beetle caused mortality for a total of 791 acres affecting federal, state, and private land ownerships. These infestations began in the early 1990's and are slowly diminishing. As of 2001, the Douglas-Fir beetle had infested the following number of acres by county: Beaver, 76; Garfield, 387; Iron, 83; Kane, 45; and Washington, 200.

Mountain Pine Beetle

The mountain pine beetle (*Dendroctonus ponderosae*) is a destructive forest insect capable of killing trees on a landscape level, mountain pine beetle (MPB) kills thousands of trees a year during outbreak conditions, and millions of trees during extended epidemic periods in western forests. At endemic levels MPB will favor weakened, less vigorous trees to attack. During epidemics, trees down to 4 inches in diameter may be attacked. Large forest landscapes may be altered, causing a pine forest ecosystem to revert to grass and shrub landscapes for a period of 10-20 years. Wildlife species, composition, and distribution may change, water yields in drainages may increase, and dead trees left after epidemics may serve as a fuel source for wildfires. The MPB has caused tree mortality on 752 acres of forests in southwestern Utah. MPB affects Ponderosa Pines and limber pine. Limber pine is currently experiencing rapid decline in high-elevation pine communities in the western U.S. and Canada. Limber pine is an important element of high-elevation ecosystems in western North American forests. It is a pioneer sub-alpine and alpine species able to establish on cold, dry, and windy sites. Limber pine are important in watershed protection, because they help to stabilize soil and rock on harsh sites, and retain snowpack for extending ephemeral stream flow. As of 2001, the MPB had infested the following number of acres by county: Beaver, 20; Garfield, 386; Iron, 23; Kane, 258; and Washington, 65.

Pinyon Ips

Pinyon Ips (*Ips pilifrons*) is presenting an increasing problem in the pinyon pine forest ecosystem and affecting valuable home landscape trees. Continued drought conditions produce increased tree stress, which causes them to become more susceptible to Ips attack. Pinyon pine mortality observed for 2001 totaled 1,926 acres in Iron and Garfield County. In Iron County 1,680 acres were infested and in Garfield County 246 acres were infested.

Western spruce budworm

Western spruce budworm (*Christoneura occidentalis*) was responsible for 7,296 total acres of defoliation in 2001 in southwestern Utah, defoliating 3,211 acres in Garfield County alone. This insect affected subalpine, white, and Douglas-fir on the Dixie National Forest in Garfield and Iron counties and in the Fishlake National Forest in Beaver County. This defoliation on the Dixie and Fishlake National Forests has been occurring since 1998. In some sites, successive years of defoliation have caused understory tree mortality. As of 2001, the western spruce budworm had infested the following number of acres by county: Beaver, 1,154; Garfield, 3,211; Iron, 2,716; and Kane, 215.

Fir Engraver Beetle

The fir engraver beetle (*Scolytus ventralis*) is a major pest of true firs in western forests. It attacks trees three inches in diameter at breast height (dbh) and larger. Tree stress due to drought, disease, and defoliation may incite outbreaks, causing severe tree mortality. It is often associated with other forest pests such as Douglas-fir tussock moth, spruce budworm, bark beetles, woodborers, and fomes annosus root disease. As of 2001, 348 acres located in southwest Utah were infested with the fir engraver beetle. The following number of acres were affected by county: Beaver, 28; Garfield, 90; Iron, 71; Kane, 70; and Washington, 89.

Radon Gas

Radon is a radioactive gas of geologic origin that is found in many buildings in sufficient concentrations to represent a health hazard to building occupants. Radon is an odorless, tasteless, and colorless radioactive gas which forms as a product in three radioactive decay series. Most common of these is the uranium-decay series. In nature, radon is found in small concentrations in nearly all rocks and soils. Potential radon-hazard areas in southwestern Utah are widespread, and are generally underlain by silicic igneous rocks of low-grade metasedimentary deposits. The results of 36 indoor measurements of radon levels in southwestern Utah confirm predictions that levels are highest, with an arithmetic mean of 8.8 picocuries per liter (pCi/L) in hazard areas defined by geology, and are significantly lower, 2.4 pCi/L, outside of hazard areas (See Table 9).

The U.S. Environmental Protection Agency (EPA) estimates that from 8,000 to 40,000 Americans will die each year from lung cancer caused by long-term radon inhalation.

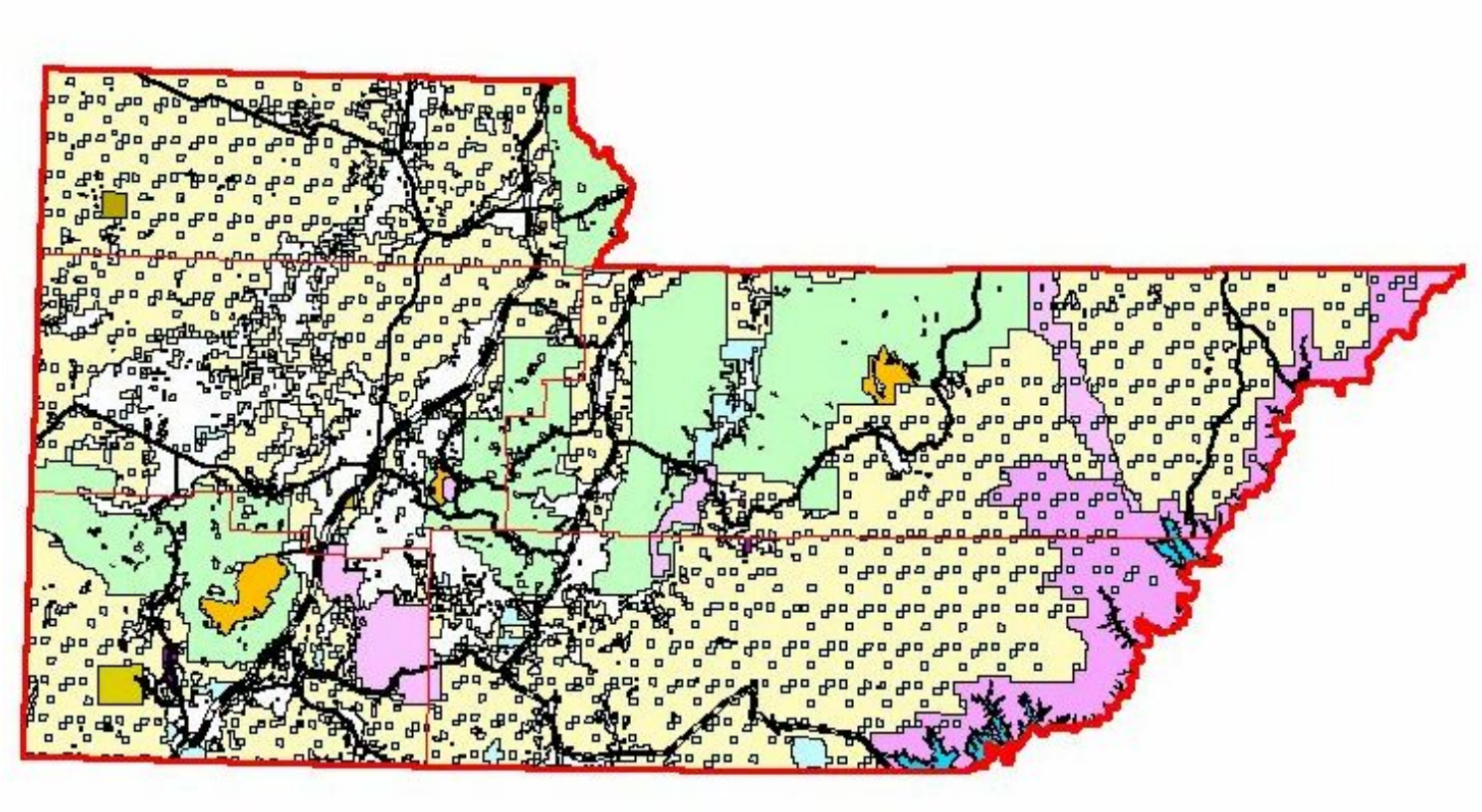
Table 9 Indoor Radon Test Results per City

County	City	#of Tests	Maximum Indoor Radon	In Radon Source Area?
Beaver	Beaver	1	10.5	Yes – 9
Beaver	Minersville	1	2.9	Yes – 9
Garfield	Panguitch	1	3.2	No
Iron	Cedar City	5	2.1	No
Iron	Paragonah	1	3.8	No
Kane	Kanab	1	0.5	No
Kane	Orderville	1	1.9	No
Washington	Enterprise	2	6.8	No
Washington	Hurricane	1	1.1	No
Washington	New Harmony	1	14.3	Yes – 11
Washington	Santa Clara	1	1.2	No
Washington	St. George	1	6.2	No
Washington	Washington	2	2	No

In 1998, in response to growing national concern over the threat of radon gas, Congress enacted Title III, Indoor Radon Abatement Act (IRAA), as an amendment to the Toxic Substances Control Act. The only way to know if a building is subject to radon hazard is for that building to be tested for indoor radon. Geology provides assistance to decision-makers, but decisions cannot be based on geology alone.

Annexes

Region Annex



Introduction

Why is this plan presenting several hazards on a regional basis?

Many of the hazards being assessed in this Hazard Mitigation Plan have widespread effects on multiple jurisdictions and are therefore being considered on a regional (multi-jurisdictional) basis with regards to impact. These multi-hazard action items are those activities that pertain to the following hazards in the mitigation plan: radon gas, insect infestation, drought, severe weather and volcanism.

Radon gas is a naturally occurring phenomenon that affects widespread areas of the state. The effects are very specific to the homes and businesses located in an area with a higher propensity for radon gas exposure and to the design of those structures, their placement and specific local geology. Mapping of the potential for radon gas is usually done at a very large scale and as such provides at best an indication of the potential for radon gas impact. For this reason this plan addresses radon gas on a regional (multi-jurisdictional) basis.

Insect infestation in most cases extends beyond the jurisdictional boundaries of communities and in many cases extends across county lines. For that reason this plan looks at the history, effects and mitigation of insect infestation on a regional (multi-jurisdictional) basis.

Likewise, drought differs from other natural hazards in several ways. First, it is a "creeping phenomenon," making its onset and end difficult to determine. The effects of drought accumulate slowly over a considerable period of time and may linger for years after the termination of the event. Second, the absence of a precise and universally accepted definition of drought adds to the confusion about whether or not a drought exists and, if it does, its severity. Third, the societal impacts of drought are less obvious and extend over a larger geographical area than damages that result from other natural hazards. Drought seldom results in structural damage. For these reasons the quantification of impacts and the provision of disaster relief is a far more arduous task than it is for other natural hazards. It is for this reason that this plan is considering drought on a regional (multi-jurisdictional) basis.

Severe weather has similar effects over a wide area, such as when a large mass of tropical moisture moving into the state develops summer cloudburst storms over a wide area of southwestern Utah. The level of risk created by severe weather events is dependent, in many situations, on specific local conditions such as available drainage potential or a community’s exposure to certain wind related hazards, such as tornados. All areas of this region are subject to potential for lightning related hazards. But in general these events affect all areas in similar manners and are not unique to a specific local, as is the case with landslides or wildfire. For this reason, severe weather is being addressed on a regional (multi-jurisdictional) basis.

Finally, the Utah Geological Association (Keaton, UGS Publication 21, 1992) states that the likelihood of renewed volcanic activity in the region during the next 100 years appears to be very unlikely. Their report also states that future volcanic activity probably will consist of localized eruptions of basaltic cinders and liquid basaltic flows which are controlled by topography. As volcanic eruptions during modern history have not occurred without some warning, sufficient indications of an impending volcanic eruption would provide sufficient time to formulate and implement a mitigation and contingency plan. Such a plan would need to be based upon specific details of the location and topography of a specific event.

Because of the extremely small likelihood of activity and the lack of specific data on where an event may actually occur, volcanism is being addressed on a regional (multi-jurisdictional) basis.

Volcanic Hazards In Southwestern Utah

There have been several major volcanic eruptions worldwide during the past 25 years. Among these were the eruption in 1980 of Mt. St. Helens in Washington State followed by the 1982 eruption of El Chichón in Mexico, the 1990 eruption of Mt. Pinatubo in the Philippines, and the 1995 eruption of the Soufriere Hills Volcano in Montserrat all generated unprecedented awareness to the potential calamitous effect of volcanic hazards. Fortunately, these events have not had any significant effect on residents of Southwestern Utah.

The U.S. Geological Survey and other scientific communities world-wide responded to the need for advanced understanding of the volcanic processes, related hazards, and well-defined mitigation procedures by encouraging research and funding studies in volcanology. During the 1980s the United States established volcano observatories in Vancouver, Washington; Anchorage and Fairbanks, Alaska; and Long Valley, California.

Over 270,000 human fatalities have resulted world-wide from volcanic activity during the past 500 years. Information from the Utah Geological Survey indicates that while most of the deaths world-wide have been related to the eruptions of high-silica alkali composition volcanics, fatalities and property damage can result from basaltic and rhyolitic flows, plugs and dome, features that are typical of volcanism throughout southwest Utah.

According to experts, the social and economic consequences of volcanic hazards can be far-reaching. Damage and loss can be effectively reduced by understanding volcanic processes, identifying active or potentially active eruptive centers, delineating extent of lands potentially affected by future eruptions, educating landowners and policy makers, and instituting a comprehensive mitigation strategy.

In order to suggest volcanic hazard reduction procedures, it is important to examine southwestern Utah’s recent volcanic activity, delineate active eruptive centers in the study area, define hazards expected to accompany future eruptions and examine how volcanoes outside the state of Utah may impact southwestern Utah.

When discussing volcanic hazards several problems arise. Because of the intermittent nature of volcanic eruptions and lengthy recurrence intervals, people tend to minimize volcanic hazards as a threat to property and lives.

Southwestern Utah experienced prolonged volcanism during the Cenozoic time. Tumultuous eruptions of calc-alkaline volcanics and deposition of volcaniclastic debris dominated early to mid-Cenozoic volcanism. The active volcanic centers in the southwestern district area include the Escalante Deserts in the Basin and Range Province; the High Plateaus and adjacent areas in the Colorado Plateau Province; and the Pine Valley Mountains-St. George Basin and surrounding areas.

From late Oligocene to early Miocene, stratovolcanoes and caldera complexes generated lavas and layer upon layer of volcaniclastic debris throughout the Basin and Range Province. Straddling the Utah-Nevada border and circling the southern portion of the

Needles Range of Beaver and Iron Counties, the Indian Peak caldera complex served as the source for the calc-alkaline volcanics of the 29.5 million year old Wah Wah Springs Formation.

The Bullion Canyon Volcanics and the Mount Belknap Volcanics originated from calderas of the Tushar Mountains in Beaver and Piute Counties. Flows, pyroclastics, and associated rocks from this caldera complex range in age from 25 to 14 million years. South-Central Utah's mid-Cenozoic stratovolcanoes shed volcanistics onto low lands to the south and east, forming an apron of debris that eventually became the southwestern High Plateaus.

Local, violent eruptions of andesitic and rhyolitic materials are no longer a hazard in Utah. Between 8 and 6 million years ago basaltic and rhyolitic magmas formed domes, plugs, cones, and shield-like volcanic features in the Great Basin and Range of Southwest Utah.

These predominately mafic-composition volcanics have augmented the present-day landforms in the three volcanic regions of southwestern Utah. Geomorphically fresh features and textures, geothermal anomalies, and recent eruptive histories present convincing arguments for the continuation of volcanic events in southwestern Utah.

Utah presents an unusually varied landscape with three major physiographic provinces extending into the state. The Rocky Mountain Province takes up a V-shaped section of northeastern Utah and includes the Uinta and Wasatch mountains. The Colorado Plateau Province dominates east central and southeastern Utah from the Uinta Basin south to Canyonlands and the high plateau country. Western Utah lies in the Basin and Range Province, an area of deserts as well as mountain ranges separated by broad valleys. Within these three provinces, Utah ranges in elevation from 2,350 feet above sea level in the southwest corner of the state to 13,528 feet on Kings Peak in the Uinta Mountains. Five major life zones, each with a distinctive community of plants, are found within that elevation range, from the sagebrush and juniper typical of the Sonoran desert to the meadow grass and moss of the alpine tundra.

Volcanoes are created by internal forces within the Earth that cause heated, melted rock (magma) to rise to the surface. First collecting in magma chambers, some of the magma eventually pushes upward through cracks (vents) to the Earth's surface. As the magma reaches the surface, it loses some of its gases and turns into lava. Volcanoes are created by the release and build-up of lava and other materials. Volcanoes have varied shapes and sizes, but are divided into three main kinds depending on the type of material that reaches the surface and the type of eruption that ensues. Utah has all three types.

The youngest vents and flows in southwestern Utah are less than 1,000 years old. The only current hazard would strictly be from local, small cinder cone basaltic eruptions (Lund, UGS, correspondence 2003). It appears, rather than local events, remote eruptive centers present Utah's most imminent and potentially damaging volcanic hazard. Areas east of Mt. St. Helens were the recipients of ash fallout.

(Portions excerpted from: Utah.gov Website - "A Brief History of Utah", 2002, and Utah Geological Survey Website, 2002)

Utah's Volcanic Types

Composite or Stratovolcanoes
Composite volcanoes (stratovolcanoes) develop from repeated explosive and nonexplosive eruptions of tephra (airborne lava fragments that can range in size from tiny particles of ash to house-size boulders) and lava that build up layer by layer. These volcanoes are the largest and form symmetrical cones with steep sides. Some composite volcanoes in Utah are in the Tushar Mountains (Mount Belknap, for example) in Piute County. Now extinct, they are too old (between 32 and 22 million years) to maintain the classic volcanic shape of their modern-day counterparts, such as Mount Hood and Mount St. Helens in the Cascade Range along the northwestern coast of the United States.

Shield Volcanoes
Shield volcanoes form from "gentle" or nonexplosive eruptions of flowing lava. The lava spreads out and builds up volcanoes with broad, gently sloping sides. The low-profile shape resembles a warrior's shield. In Utah a good example is the one-million-year-old Fumarole Butte in Juab County. Currently active volcanoes of this type are found in the Hawaiian Islands.

Cinder Cones
Cinder cones build from lava that is blown violently into the air and breaks into fragments. As the lava pieces fall back to the ground, they cool and harden into cinders (lava fragments about 1/2 inch in diameter) that pile up around the volcano's vent. Cinder cones are the smallest volcanoes and are cone-shaped. Cinder cones are found in many areas of Utah including Millard, Iron, Garfield, Kane, and Washington Counties, and they vary in age. The youngest, only about 600 years old, are in the Black Rock Desert in Millard County.

Dome Mountains
Dome Mountains are formed from hot molten material (magma) rising from the Earth's mantle into the crust that pushes overlying sedimentary rock layers upward to form a "dome" shape. Unlike a volcano, the magma typically does not reach the Earth's surface. Instead, the magma cools underneath the surface and forms the core of the mountains. Dome mountains in Utah include Navajo Mountain and the La Sal, Abajo, and Henry Mountains in the southeastern part of the state.

Volcanic Fields in Southwestern Utah

Mineral Mountains-Cove Fort Volcanic Field
The Mineral Mountains-Cove Fort volcanic field is a Quaternary bimodal, basalt-rhyolite association with some intermediate composition units. Silicic volcanism began at 800,000 years ago with eruption of two fluid, aphyric, rhyolite flows (3 kilometers long, 80 meters thick) along Bailey Ridge and Wildhorse Canyon. Subsequent activity from 700,000 to 500,000 years consisted of pyroclastic eruptions and extrusion of at least 11 domes distributed over 10 kilometers along the crest and western flank of the Tertiary Mineral Mountains pluton. Tephra from these eruptions are abundant in the lacustrine deposits of the Beaver Basin. East of the Mineral Mountains are lavas of basalt, basaltic andesite, and latite which erupted before the silicic episode of the Mineral Mountains and persisted afterwards. Activity began with outpourings of the tholeiitic basalt of the Black Rock field from vents on the eastern margin of the Mineral Mountains, followed by basaltic andesite of the Maderfield and Crater Knoll fields. Latite lavas were then erupted from Red Knoll cinder cone, followed by quartz-bearing basaltic andesite from the topographically dominant Cove

Fort cinder cone. The youngest lavas are latite of the Cedar Grove field, erupted from a cinder cone on the southwest margin of the Cove Fort field. In these two younger units surface features are readily apparent, including pressure ridges, squeezeups, and pahoehoe textures. The Mineral Mountains-Cove Fort volcanic field is approximately 300 kilometers south of Salt Lake City and approximately 100 kilometers north of Cedar City, Utah. Access to the silicic volcanoes of the Mineral Mountains is from the west via Milford, Utah. Interstate 15 crosses the Cove Fort flows immediately north of the interchange with Interstate 70.

Grass Valley

From North of Grass Valley on Grass Valley Road -- Pull off at crest of hill to view geologic features on east side of Grass Valley. Grass Valley is another eroded anticline produced by an unexposed intrusion that is interpreted to be an extension of the Pine Valley intrusion exposed in the hills to the right. The white cliffs just above the valley floor are exposures of the ash-flow tuff member of the rocks of Paradise overlain by the Big Mountain slide mass. The Rencher Formation was not deposited this far east. The Big Mountain slide is overlain by fanglomerates of the Page Ranch Formation and the Pine Valley slide mass. Overlying the Pine Valley slide is the Timber Mountain flow member of the Pine Valley Latite that extruded northward from the Pine Valley laccolith following the collapse of its flank by gravity sliding. Rencher Peak (source area for the slightly older Rencher Peak flow member of the Pine Valley Latite) is the high peak visible on the north side of Grass Valley. Continue south on Grass Valley road for one mile. Cinder cone of quartz-bearing basalt on right. Lava from this and other vents dammed Grass Valley, which then filled in with fluvial sediments and minor lacustrine deposits to form the relatively broad valley floor. Many fertile valleys in this area formed in this manner, including Pine Valley, Grassy Flat, and Diamond Valley.

Harmony Mountains

Harmony Mountains consist mostly of faulted Tertiary ash-flow tuffs.

Harmony Hills Tuff

Above the Bauers Tuff is the brown and tan, crystal-rich Harmony Hills Tuff (22.5 Million Years Ago). These unfractured ash-flow tuffs represent autochthonous rocks tilted eastward by the Iron Mountain Intrusion to the west.

Mountain Meadow Monument and Overlook

From the entrance road to Mountain Meadow monument -- proceed to the overlook parking area on Dan Sill Hill. You will pass a gravel road on the left that leads to the gravesite in Mountain Meadow. This is the site of the infamous 1857 massacre of about 120 emigrants while they were traveling the Old Spanish Trail that traverses Mountain Meadow. Park in monument parking lot and take short paved trail to monument overlook on Dan Sill Hill. The hill is made of the upper ash-flow tuff member of the Rencher Formation overlying allochthonous Claron rocks of the Big Mountain slide. Northwest of Mountain Meadow is Big Mountain (with radio towers on top) at the northern end of the Bull Valley-Big Mountain arch. The Big Mountain dome consists of Iron Springs rocks and locally some Carmel limestone and intrusive quartz monzonite. In this denuded area of the arch, the Iron Springs and/or Claron are overlain by the upper ash-flow tuff of the Rencher Formation. The hills on the east side of Mountain Meadow (east of SR-18 behind you) consist of the Big Mountain slide that originated on Big Mountain. These hills contain a thick section of the conspicuous allochthonous white lower Rencher, which has slid eastward from the crest or flank of the Bull Valley – Big Mountain arch prior to the eruption of the upper Rencher.

Mt. Belknap
Composite volcanoes (stratovolcanoes) develop from repeated explosive and nonexplosive eruptions of tephra (airborne lava fragments that can range in size from tiny particles of ash to house-size boulders) and lava that build up layer by layer. These volcanoes are the largest and form symmetrical cones with steep sides. Some composite volcanoes in Utah are in the Tushar Mountains (Mt. Belknap, for example) in Piute County. Now extinct, they are too old (between 32 and 22 million years) to maintain the classic volcanic shape of their modern-day counterparts, such as Mount Hood and Mount St. Helens in the Cascade Range along the northwestern coast of the United States.

Pine Valley Mountains
Rocks of the Pine Valley Mountains consist mostly of volcanic and intrusive rocks that range in age from Oligocene to Quaternary that were erupted upon or intruded into Mesozoic and Tertiary sedimentary rocks. The laccolithic bodies belong to a group of more than a dozen closely related, early Miocene intrusions that constitute a magmatic province trending northeasterly across the structural transition zone between the Basin and Range and Colorado Plateau in this region, generally along the trend of the Sevier orogenic front. Because laccoliths of the Iron Springs district and eastern Bull Valley Mountains are well aligned within the belt and have produced sizable iron deposits, the belt has known informally as the “Iron Axis” (Toby, 1976; Blank and others, 1992; Rowley and others, 1995; Hacker, 1998). Intrusions of Iron Axis affinity were forcibly emplaced within 3.0 to 0.25 kilometers of the surface as bulbous laccoliths, sills, and other partly concordant bodies, and were emplaced within the axial zones of some of the older, southeast-vergent Sevier thrusts and folds (Mackin, 1960). The largest Iron Axis intrusion forms the gigantic (>200 square kilometers) igneous mass capping the Pine Valley Mountains.

Snow Canyon State Park
Red Navajo sandstone, capped by an overlay of black lava rock, makes photography, hiking, biking, and camping in Snow Canyon a double treat. Early spring and fall use of the park is especially appealing due to southern Utah's moderate winter climate. Two recent volcanic cones are found near the head of the canyon.

Snow Canyon Inverted Topography
About 3 million years ago, after erosion coupled with regional uplift profoundly denuded the area of overlying rocks, volcanic eruptions began spitting scalding, pungent, black seas of basalt onto the land. Fiery channels of hot, molten rocks snaked their way over the earth and down into stream beds, valleys, and canyons; enveloping all that stood in their paths. These rivers quickly hardened into rocks, forming resistant, thick sheets of basalt that invaded and obstructed paths of rivers and steams. Seeking avenues of least resistance, drainages continued along their courses by shifting to the edges of the basalt flows (that now filled the earlier channels) and slicing new routes through the softer sedimentary rocks of the Navajo Sandstone. Erosion continued along the new channels until the water routes grew in size from stream beds, to ravines, to deep canyons. The sheets of basaltic rocks that initially filled low areas, cooled into resistant masses and eventually stood in relief as high ridges and plateaus. New volcanic eruptions occurred with lavas again invading flat lands, furrows, gullies, and depressions. This second blanket of basalt covered an area topographically lower than the first. Three distinct phases of the "inverted topography" are evident in Snow Canyon State Park. The oldest layer forms the plateau to the east of State Highway 18 (the road from St. George to Veyo). The next forms the plateau on which the highway is built, and the third forms the floor of Snow Canyon itself.

Snow Canyon Cinder Cones
Sometime between 1,000 to 10,000 years ago the youngest series of volcanic eruptions began emanating from cinder cones and vents in the north section of the park. Following drainage channels etched in soft sandstones along the sides of solidified volcanic flows, the new, scalding flows crept south onto the floor of Snow Canyon and nearby areas. Today, these flows line the canyon floor stretching south to the Santa Clara River.

Flows in the Park
Numerous features and textures characteristic of volcanic flows are well preserved in the park. For example, visitors to West Canyon can see motionless black cascades of basalt, and areas where the flows encircled mounds of Navajo Sandstone and cascaded down steep embankments onto the canyon floor. Hikers will notice that these black falls appear to have ended abruptly when they touched the floor of West Canyon. In truth, however, they extended across the canyon and, in places, may have touched the walls on the opposite side. Shifting desert sands and flash-flood debris of more recent times have obscured floor basalts in most areas.

St. George
A line of Quaternary lava flows and cinder cones stretches from St. George, Utah, nearly 200 kilometers northeastward to the village of Loa. Additional young vents and flows extend approximately 50 kilometers north of St. George. Volcanism near St. George is best known and most spectacular; lava flows erupted from vents in the Pine Valley Mountains flowed downslope into river valleys. Four different episodes of flow emplacement have been recognized, each preserving underlying Mesozoic rock from further erosion. The oldest flows, formed 3-6 million years ago, are up to 300 meters thick above their surroundings, and the younger flows occur at approximately 120 meters (1-2 million years ago), on the present drainage (500,000 years ago), and fill stream valleys (a few thousand years).

Santa Clara Flow
The most recent flows came from two cinder cones in Diamond Valley, 16 kilometers north of St. George. The cones, approximately 400 meters wide and 60 meters high, are the sources for the Santa Clara flow which traveled 16 kilometers to the south. Geomorphological features to be seen along the flow include inverted valleys, lava dammed lakes, displaced drainages, and 120-meter-high lava cascades. The Santa Clara flow can be viewed along State Highway 18, west of St. George in and around Snow Canyon State Park.

Tushar Mountains
Interstate-15 Exit 95, intersection with State Road 20 - Virtually all rocks you see to the west, north, and east consist of volcanic mudflow breccia of the Mount Dutton Formation. The high Tushar Mountains are mostly rhyolites of the Mount Belknap Volcanics, within the Mount Belknap caldera.

Zion National Park
Zion is located along the edge of a region called the Colorado Plateau. The rock layers have been uplifted, tilted, and eroded, forming a feature called the Grand Staircase, a series of colorful cliffs stretching between Bryce Canyon and the Grand Canyon. The bottom layer of rock at Bryce Canyon is the top layer at Zion, and the bottom layer at Zion is the top layer at the Grand Canyon.

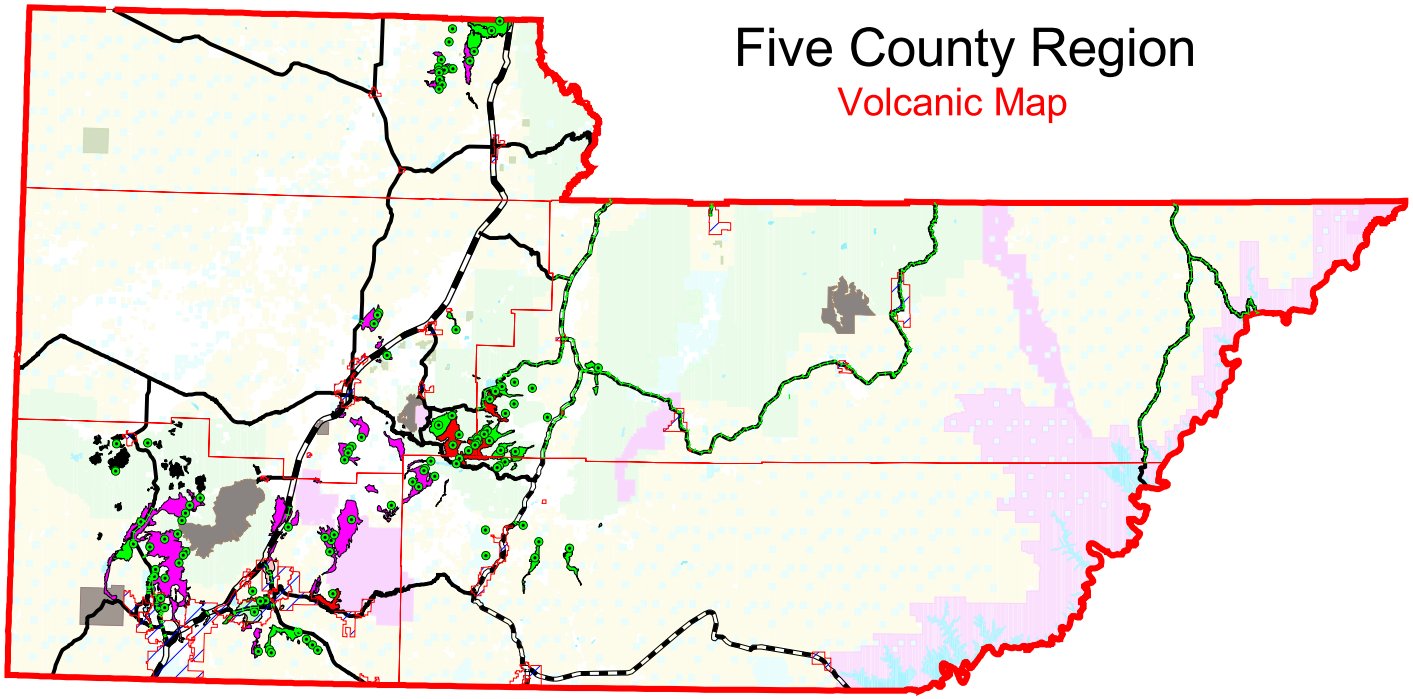
No property damage or human injuries or deaths have been attributed to any type of volcanic activity in southwest Utah since records have been kept.

Portions of the forgoing excerpted from:
Utah Geological Survey Website, 2001, 2002
Nash, 1990, IN: Wood and Kienle, 1990, Volcanoes of the North America: Cambridge University Press
Wood, 1990, IN: Wood and Kienle, 1990, Volcanoes of the North America: Cambridge University Press
U.S. National Park Service Website - Zion National Park, 2000, 2001;
Utah State Parks Website, 2002
Utah.gov Website, 2002, "A Brief History of Utah"
Utah.gov Website, 2002, "Utah History To Go"
Rowley, et.al., 2002 Geologic Map of the Central Marysvale Volcanic Field, Southwestern Utah: USGS Geologic Investigations Series I-2645-A
Lund (ed.), 2002, Field Guide to Geologic Excursions in Southwestern Utah and Adjacent Areas of Arizona and Nevada: U.S. Geological Survey Open-File Report 02-172.

Figure 7

Five County Region

Volcanic Map



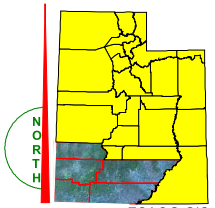
20 0 20 40 60 Miles

Volcanic Flows & Age
- 1 - 30k ya
- 3 10k - 130k ya
- 4 10k - 750k ya
- 5 < 1.65 million ya
- Volcanic Flows on Road

Five County Boundary
County Boundaries
Town Boundaries
Volcanic Events

Major Roads
- I-15
- State Route
- US Route

* Note: Administrative Ownership is the background layer



FCAOG GIS

Five County Association of Governments July 2003 Ed Dickie

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Drought

Drought in Utah

Utah has experienced periods of droughts since the pioneers first settled in the Salt Lake Valley. The lengthy droughts of the 1930s and 1950s caused significant economic problems for the state. While the drought of 1976-77 was not as long, the consequences were still intense and costly. The region is currently experiencing its fifth year of drought. The damages from this are yet to be fully comprehended.

Precipitation fluctuates greatly in Utah's relatively arid climate. As the demand for water continues to increase, even temporary shortages in supply can be disruptive to the normal process in urban and rural environments. Two or more consecutive years of significant reduction in precipitation, particularly snowfall in the mountains, may have serious and far-reaching impacts.

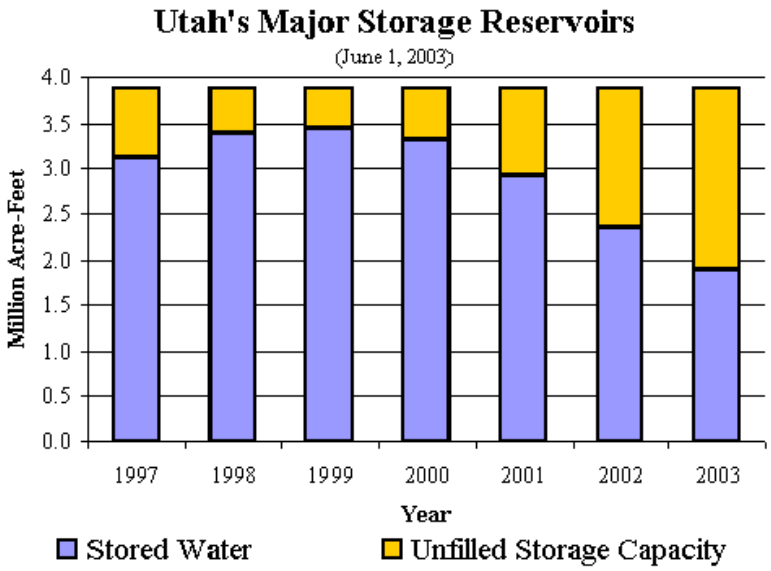
When droughts occur, the state experiences a variety of problems. If identified and evaluated, problems can be dealt with in an organized and cost-efficient manner. The most significant impacts relate to agriculture, municipal water supplies, tourism, and wildlife preservation. Electric power generation and water quality can also be adversely affected.

Impacts of Drought

As drought conditions worsen they create problems for municipal water and sewer systems, primarily from reduction of water supply. The length and degree of intensity of a drought period produces an impact on the state's agricultural industry that has a devastating effect on many farmers and ranchers. Drought creates varying degrees of impact on commerce and tourism within the state. One of the first industries impacted is the ski industry which is highly dependent on early and/or a substantial snowpack. The threat of wildfire in rural and forested areas is a weather-dependent activity that occurs
annually. The problem is usually seasonal, but it can and does occur year-round in Utah. Drought conditions, however, increase the severity of wildfire threat and strain normal fire defenses. As drought conditions worsen, there is need to make assessments and identify potential short- and long-range fire protection impacts.

Current Drought Situation

The entire state of Utah is still experiencing drought conditions. For much of the state it is the fifth consecutive year of below normal water precipitation. Throughout April, skies over Utah were cloudy and stormy. However, April 2003's storms were big on show but delivered little water. Average precipitation received at Utah's Snotel sites in April was a disappointing 2.32 inches compared to April's 10-year average of 3.39 inches. Not one of Utah's eleven basins received above average precipitation in April. Storms during the first two weeks of May, however, delivered a whopping 90% of May's 10-year average precipitation. The final two weeks of May were unseasonably hot and dry with record hot days being established around the state. Consequently, total precipitation received at Utah's Snotel sites for May was 2.73 inches compared to a 10-year average of 2.60 inches for May. The remarkably hot days of May's final fortnight have also resulted in a rapid snowmelt and runoff pattern. Statewide snowpack has been reduced to 19% of average. On the positive side, rapid runoff is more efficient at delivering water to reservoirs, as the ground is given less time to soak up the melting water.



Statewide, the total precipitation received at Utah's Snotel sites for this water-year (October 1, 2002 through May 31, 2003) is 78% of average. Much of the state's snowpack, however, is already gone and reservoir storage throughout the state is still well below average. In southern Utah, with very little snowpack left, streamflows have already dropped to about 40% of average. In northern Utah, while some streams are still flowing well, snowpack is disappearing rapidly and it is anticipated that flows will drop off quickly.

Throughout the state, most municipalities and other drinking water providers have taken steps to insure an adequate culinary water supply for future growth and projected water needs. These communities will survive the drought years with few problems. However, some communities, particularly in southern Utah, that rely upon springs or surface water sources could find their supplies marginal or inadequate especially in the late summer months. Typically these communities have imposed some form of outdoor water-use restrictions to reduce water consumption and stretch existing supplies.

Utah's agricultural community is suffering the greatest economic impacts from the drought. The agricultural industry operates with a smaller margin between supply and demand. Consequently, any shortage of agricultural water is keenly felt by agricultural producers. A recent estimate puts this year's statewide agricultural losses at just over $286 million as of April 30, 2003. Consequently, on May 20, 2003 Governor Michael O. Leavitt signed a statewide Declaration of Agricultural Disaster. This Declaration of Agricultural Disaster was the first step in providing the impacted counties with state and federal funding relief, and drought response programs.

Utah’s Long-term Water Supply Outlook

Even in normal years, Utah has a limited water supply. It is reportedly the driest state in the nation. Most of Utah is classified as a desert receiving less than 13 inches of annual precipitation. Fortunately, previous generations of Utahns provided for a sufficient water supply by constructing many water storage reservoirs along with the associated collection, transportation and distribution systems. Federal projects such as the Weber Basin, Central

Utah and Joes Valley, along with local projects funded in part by the Utah Board of Water Resources and the Utah Drinking Water Board, have provided additional water as well as infrastructure replacement.

The Utah Division of Water Resources and the Utah Board of Water Resources have been directed by the Utah Legislature to plan for the future water needs of Utah. An integral part of this process has been the development of a State Water Plan. The overall plan is based on hydrologic river basin plans developed in cooperation with local water users, and local and state government agencies involved in water use and management. The plan identifies resources available, current uses and future demand based on estimates of population growth by the Governor's Office of Planning and Budget. The plan also identifies areas of water quality, instream use and recreation that need to be addressed.

A significant finding of the Utah State Water Plan is that Utahns must become more efficient with the use of existing water supplies. In the residential sector, Utahns have the second highest water use rate in the nation, partly due to the desert environment and developed landscapes dependent on irrigation. We now we face the need to provide for future generations. To do this Governor Leavitt initiated a Statewide Water Conservation Initiative. Not only is the initiative a response to the current drought, it will provide a legacy of intelligent water use for future generations. Water conservation will play a significant role in meeting the water needs of future generations. Utah has set a goal of reducing per capita water usage by 25 percent over the next 50 years.

Drought Response and Mitigation Efforts

Prior to the Governor's formal Drought Emergency Declaration, the State Drought Response Plan was already in operation. The State Drought Review and Reporting Committee has met on a regular basis, since the onset of drought conditions, to be briefed on the statewide drought situation and discuss potential relief actions. With the Governor's formal drought emergency declaration, the Drought Response Committee was activated. This committee meets regularly to discuss drought impacts and coordinate response action.

In response to drought conditions in portions of southern Utah, and as a result of the emergency drought declaration, federal and state funds have been used to drill emergency wells insuring the availability of an adequate water supply for fire suppression and livestock watering. Federal funding has also been used to truck in feed for cattle.

To help reduce the impacts of the drought, state agencies have taken the following actions: The Division of Water Rights is prepared to expedite the well permitting process and approval of temporary water rights for drought-related mitigation. The Board of Water Resources has low and no interest loans and will give priority to projects that address drought related water problems. The State's Community Impact Board has also gone on record to give preferential consideration and priority status to projects that include drought mitigation.

Dissemination of information regarding the drought situation and raising public awareness about the critical nature of Utah's water supply levels has been effective. The state and other water agencies have worked with the local news media (television, newspapers and radio) to keep the general public aware of the drought situation and informed about ways the average citizen can help. Public response and support has been gratifying.

Regional Data

Utah's weather is prone to extremes—from severe flooding to multiyear droughts. Five major floods occurred during 1952, 1965, 1966, 1983, and 1984, and six multiyear droughts occurred during 1896-1905, 1930-36, 1953-65, 1974-78 (U.S. Geological Survey, 1991), and more recently during 1988-93 and 1999-2002. The extent of floods generally is limited in size from one to several watersheds, whereas droughts generally affect most or all of the state. Southern Utah, in particular the Virgin River drainage basin, began experiencing drought conditions during the winter of 1998-99. By 2000, drought conditions were evident throughout all of Utah. The current drought (1999-2002) is comparable in length and magnitude to previous droughts; however, with population growth and increased demand for water in Utah, the general effect is more severe. (USGS 2003)

During 2002, the fourth straight year of nearly statewide drought conditions, some areas of Utah experienced record-low streamflows. Several record-low streamflows occurred in streams with records dating back to the 1900s. The U.S. Geological Survey (USGS) uses streamflow data from eight long-term streamflow-gaging stations for comparison of hydrologic conditions in Utah.

Three of these gages registered new record-low annual streamflows for water year 2002 (October 1, 2001, to September 30, 2002): Colorado River near Cisco, San Juan River near Bluff, and Virgin River at Virgin. At two other gages in eastern Utah, Whiterocks River near Whiterocks and Green River near Green River, 2002 was the second driest year on record. Streamflow in the Upper Colorado River Basin has been so low that the water surface of Lake Powell is predicted to be 80 feet below the fill level by January 2003 (Bureau of Reclamation, 2002). The water level of Lake Powell is currently (2003) low enough near Hite Marina (at the upstream end of the lake) that much of the riverbed of the Colorado and Dirty Devil Rivers is exposed, as are the deltaic sediments that have been deposited since the lake began filling in 1963.

This aerial picture of Lake Powell near Hite, Utah shows the exposed channel of the Colorado and Dirty Devil Rivers, which are normally flooded by the lake, as well as the

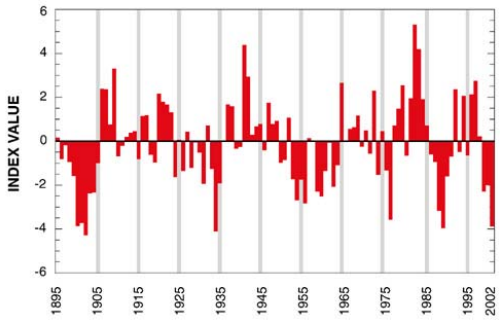
deltaic sediments that are deposited at the upper end of the lake. This picture was taken in October 2002.

The adjacent states of Colorado, Arizona, and New Mexico also have been experiencing extreme drought conditions and the negative impacts that result. Record-sized forest fires during the summer of 2002 in Arizona and Colorado were directly related to the extremely dry conditions.

Precipitation

Precipitation directly affects streamflow. Under normal precipitation conditions, Utah receives less precipitation than every other state except Nevada. Average annual precipitation at Salt Lake City is about 16.5 inches, and precipitation statewide ranges from about 5 inches on the Great Salt Lake Desert to about 60 inches in the highest mountains (Butler and Marsell, 1972). Three types of moisture-producing weather systems generally account for most precipitation in Utah: Pacific frontal systems, dissipating tropical storms, and summer thunderstorms with moisture originating from the Gulf of Mexico.

Pacific frontal storms generally produce winter mountain snowpack, and the subsequent spring snowmelt increases river flows and reservoir levels. During some winters, high-pressure ridges can dominate over the Western United States and push storm systems northward. These persistent high-pressure ridges result in decreased snowfall in Utah mountain ranges (U.S. Geological Survey, 1991). Mountain snowpacks have generally been below normal statewide since the winter of 1998-99, and Utah has experienced significant reductions in spring runoff since 2000.



Many Federal and State government agencies use the Palmer Drought Severity Index (PDSI) to classify and assess long-term meteorological droughts. The PDSI drought index responds to abnormally wet or dry weather conditions and classifies the conditions on a scale from -6 to 6. On this scale, -4.0 or less signifies extreme drought conditions and 4.0 or more signifies extremely wet conditions. Summarized data from the Utah State University Climate Center in Logan, Utah illustrates

the variable nature of precipitation in Utah. On the basis of the PDSI classification scale, the droughts of 1988-93 and 1999-2002 are severe to extreme, but conditions are not as dry as those during 1896-1905.

Streamflow

Data from eight long-term streamflow-gaging stations maintained by the USGS Utah District were used to assess historic and current drought conditions. The stations were selected from a network of more than 150 stations in Utah and are considered index sites because they generally reflect streamflow conditions in their local area. Major dams have regulated flow on the Colorado, Green, and San Juan Rivers upstream from the index sites since the early 1960s. The *Beaver*, *Virgin*, and Weber Rivers are lightly regulated by small headwater reservoirs or power generating facilities. Smiths Fork and the Whiterocks River have small diversions in upper watershed areas but are not regulated upstream from the gages. Despite these modifications to the drainages, these index sites are considered to generally reflect hydrologic conditions in their respective watersheds, including snowpack and the amount of water stored in reservoirs.

Historic Streamflow Data

A chronology of significant floods and droughts in Utah from 1884 to 2002 and a summary of their effects on infrastructure, population, and the environment is presented below in Table 10 (USGS 2003). Prior to current drought conditions, Utah experienced drought on a regional scale most recently in the late 1980s to early 1990s. Other major droughts occurred during 1896-1905, 1930-36, 1953-65, and 1974-78. The average length of these droughts is about 5 years and they recur about every 10 to 20 years.

Table 10 Chronology of Floods & Droughts

Flood or Drought	Date	Area affected	Remarks
Flood	July 4, 1884	Colorado River	Probably snowmelt combined with rainfall.
Drought	1896-1907	Statewide	Regional.
Flood	Aug. 13, 1923	Tributaries to Great Salt Lake between Ogden and Salt Lake City	Locally intense thunderstorms. Deaths, 7; damage, $300,000.
Drought	1930-36	Statewide	Regional.
Flood	Apr. 28-June 11, 1952	Strawberry, upper Price, upper San Rafael, Ogden, Weber, Provo, and Jordan Rivers; Blacksmith and Spanish Fork; upper Muddy and Chalk Creeks	Melting of snowpack having maximum-of-record water content for Apr. 1. Disaster declared. Deaths, 2; damage, $8.4 million.
Drought	1953-65	Statewide	Regional.
Flood	June 16,	Duchesne River	Dam failure.

	1963		
Flood	June 10-11, 1965	Ashley Creek and other streams between Manila and Vernal, and west of Manila	Three days of intense rainfall on thick snowpack above altitude of 9,200 feet. Deaths, 7; damage, $814,000.
Flood	Dec. 6-7, 1966	***Virgin and Santa Clara Rivers***	Four days of light to intense rainfall of as much as 12 inches. Damage, $1.4 million.
Flood	Aug. 1-2, 1968	Cottonwood Wash and other nearby tributaries to San Juan River	Locally intense thunderstorms following 11 days of rainfall. Damage, $34,000.
Flood	Sept. 5-7, 1970	San Juan River and tributaries from McElmo Creek to Chinle Creek	Record-breaking rainfall. Deaths, 2; damage, $700,000.
Flood	Aug. 27, 1972	Vernon Creek	Locally intense thunderstorms.
Drought	1974-78	Statewide	Regional.
Flood	Apr. 10-June 25, 1983	Lower Duchesne and Jordan Rivers and tributaries (including Spanish Fork); upper Price, Bear, Sevier, and San Pitch Rivers; Chalk, East Canyon, Trout, and George Creeks; Great Salt Lake and tributaries between Ogden and Salt Lake City	Rapid melting of snowpack having maximum-of-record water content for June 1. Result of large El Niño event. Disaster declared by President. Damage, $621 million.
Flood	Apr. 17-June 20, 1984	White, upper Price, and Fremont Rivers; lower Bear and Sevier Rivers and tributaries; Beaver River; Red Butte Creek; Spanish Fork; Jordan River	Runoff from greater-than-average snowpack for Apr. 1 and spring precipitation. Result of large El Niño event.
Flood	May 22, 1984	Sevier Lake	Runoff in Sevier River from Nov. 1982 through June 1984 exceeded upstream reservoir capacity; about 1.5 million acre-feet of water conveyed to Sevier Lake. On May 22, 1984, lake reported to be as deep as 35 feet after being dry or nearly dry since about 1880.
Flood	June 15, 1984	Utah Lake	Runoff from greater-than-normal precipitation since Sept. 1982 increased lake level to 101-year record of 5.46 feet above

			compromise level on June 15, 1984. Mainly a result of large El Niño event of 1983-84. Damage, $5.9 million.
Flood	June 3, 1986	Great Salt Lake	High runoff from greater-than-normal precipitation since Sept., 1982 increased lake level to 140-year record altitude of 4,211.85 feet on June 3, 1986. Partially a result of large El Niño event of 1983-84. Damage, $268 million.
Flood	June 7, 1986	Provo River	Trial Lake dam failure. Slope-area measurement.
Drought	1988-93	Statewide	Regional.
Flood	Jan. 1, 1989	***Quail Creek, lower Virgin River***	Quail Creek Reservoir dike failed on Jan. 1, 1989, releasing about 25,000 acre-feet of water to the Virgin River near Hurricane. Damage, $12 million.
Flood	Feb.-Mar. 1995	***Santa Clara River***	
Flood	May 1997	South Fork Ogden River, Logan River, Blacksmith Fork	Greater-than-normal snowpack in the Bear and Weber River drainage basins caused minor flooding. Minor damage occurred to cabins and campgrounds in the area.
Drought	1999-present	Statewide	Regional.

The lowest total annual flow on record at the Colorado River near Cisco, San Juan River near Bluff, and *Virgin River* at *Virgin* stations occurred during 2002, as did the second lowest total annual flow on record at the Whiterocks River and Green River stations. The 2002 drought was not as severe at the northern stations; however, 2002 was still one of the 10 driest years on record for Smiths Fork and the Weber and Beaver Rivers.

Effects of Drought on Selected Reservoirs

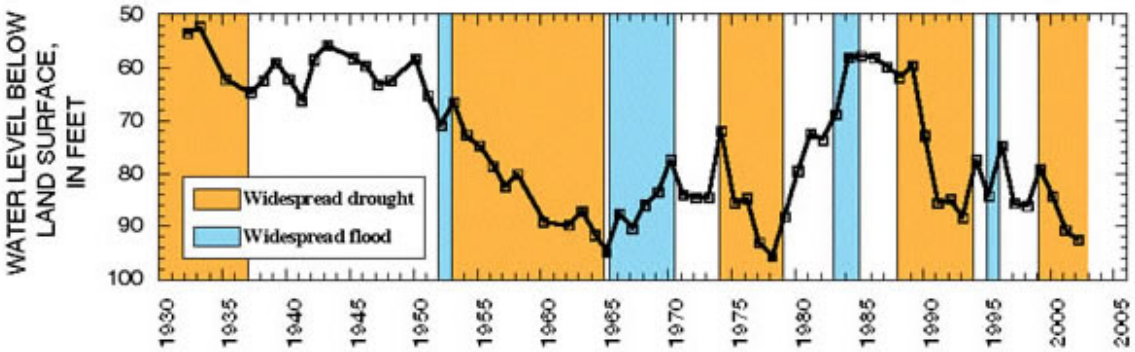
The compounded effects of 4 years of less-than-normal precipitation include lowered water levels of most major reservoirs in Utah. Releases from dams on these reservoirs have been, and most likely will continue to be, the minimum releases required for downstream water users. According to the Bureau of Reclamation, unregulated inflow to Lake Powell during water year 2002 was only 3.06 million acre-feet, or 25 percent of the 30-year average, which is the least amount of inflow to Lake Powell since the completion of Glen Canyon Dam in 1963 (Bureau of Reclamation, 2002).

Effects on Ground Water

Prolonged droughts have a primary and secondary effect on ground-water resources. First, decreased precipitation leads to decreased recharge to aquifers. Second, decreased surface-water resources generally lead to increased ground-water withdrawals, as well as to increased requests for water-well construction permits (Gates and Allen, 1996).

Aquifers in arid to semiarid regions are typically recharged from higher-altitude areas that receive more precipitation. Decreased precipitation and snowpack runoff in these areas leads to a decrease in aquifer recharge. In addition, dry conditions deplete soil moisture. This moisture needs to be replaced before recharge conditions can return to normal. Aquifers also can be recharged by seepage from lakes and streams. As these surface-water sources of recharge dry up during a drought, recharge to aquifers is again decreased.

As surface-water sources diminish during a drought, irrigators and public-supply systems withdraw more ground water. During the droughts of 1974-77 and 1988-93, the number of well permits granted rose sharply (Gates and Allen, 1996). This increased demand for ground water increased the stress on an already depleted aquifer. In general, ground-water levels in Utah have declined during the current drought years (Burden and others, 2002). The correlation between droughts and low water levels is shown in a well in Cedar Valley, near Cedar City, Utah.



Lower ground-water levels are the result of both decreased recharge and increased withdrawals; however, it is difficult to determine which causes the greater effect.

Summary and Conclusions

Utah has experienced drought conditions statewide for the past 4 water years, and in the southern part of the state for the past 5 water years. In general, drought has been more severe in the southern parts of Utah. Total annual flow during water year 2002 at the Colorado River near Cisco, Green River near Green River, Vir*gin River near Virgin*, and the San Juan River near Bluff, was the lowest recorded during approximately the past 100 years of record. During water year 2002, streamflow conditions at streamflow-gaging stations in southern Utah showed little to no effect from spring runoff and approached or exceeded the historic minimum flows. Decreased flow from major rivers in Utah has led to a decline in most reservoir levels and in the Great Salt Lake. Drought conditions in Utah are common and normally last an average of about 4 years. The current drought is not unusual for its length but rather for its severity, as water year 2002 will be recorded as one of the driest years on record for many parts of Utah. (Portions excerpted from USGS Fact Sheet 037–03)

Vulnerability Assessment

Overall Summary of Impacts

FEMA Hazard Profile for Drought

Frequency: Likely (drought patterns are cyclical)
Severity: Moderate to Severe throughout the five counties.
Duration: 4 year cycles are the norm

Current Drought Related Water Supply Conditions in Select Southwestern Utah Areas

Cedar/Beaver Basin

The water table dropped significantly last year-especially in the Cedar Valley. Cedar City is lowering all its pumps 50 ft. There was virtually no recharge last year to the aquifer, and it is declining faster than it usually does. Farmers and other private wells in the Cedar Valley west of Enoch saw their water levels drop sixty feet last year.

The National Weather Service has predicted the April to July runoff from Coal Creek to be only 40% of normal, and about 50 to 60% of normal on the Beaver River. Minersville Reservoir has less water than last year, Upper Enterprise Reservoir is a puddle, and Lower Enterprise Reservoir will empty this year by August. The precipitation reported from Snotel sites for the basin looks better than last year, but is still lower than the average.

The communities in this basin get the majority of their water from wells and the rest from springs. The cities are confidant their culinary supplies will last through the summer, but many will continue to restrict outdoor water use during the day.

Beaver City Water System - Beaver County

Beaver City is supplied by three culinary wells. The secondary system, that services approximately 95% of city, is supplied from the Beaver River. When river water is in short supply, the secondary system is supplemented with water from a culinary well. Last year the secondary system was supplemented for only three or four days. This year the river has much more water and reservoirs upstream (Kent's Lake and Three Creeks Reservoir) have filled substantially more than last year. Watering restrictions are currently voluntary but may become mandatory by the first of August. Present voluntary measure is time of day watering, restricted from 10:00 a.m. to 6:00 p.m. In August the city may implement twice-a-week watering restrictions as well.

Brian Head - Iron County

Brian Head's springs, which declined last year to a low of 16 gpm, are currently at peaking at (150 gpm). Low flows generally occur December through March. The city is selling bulk water to summer cabins at present, but will watch the level of the springs and may have to stop later in the summer. The area had 75% avg. snow-pack but the water content is higher than the past few years. The town currently does not allow watering between 10:00 a.m. and 6 p.m.

Cedar City - Iron County

Cedar City is supplied by seven culinary wells, which were lowered 50 feet last year due to declining ground water levels. The ground water surface is still much higher than the bottom depth of the wells. Of greater concern is that system is at 85 to 90% of capacity. They will be drilling an additional culinary well and irrigation well this year to supplement capacity. They

will also look at replacing a troublesome shallower culinary well. Springs were running about 50% in April, and are currently running at about 80% of normal due to late season precipitation.

Enoch City - Iron County
City wells dropped 30 feet last year and farm wells in the valley dropped 50 feet. This year there has been no drop so far. On May 1st a new rate structure went into effect with six pricing levels dependant upon usage. Citizens are generally more supportive of conservation measures now due to media messages and experiencing of dry conditions. The city is served by five culinary wells and currently has no secondary system. The city is also installing a demonstration garden with help from USU extension agents. The 1.5-acre landscape is located at the city offices and will feature 8 different low-water use hybrid turf grasses (three hot seasons and five cool seasons) distributed in 24 example garden spots.

Enterprise - Washington County
All customers use culinary well water for both indoor and outdoor use. They do not anticipate any problems this year.

Milford - Beaver County
The flow-rate on city wells is down very slightly. Two culinary and two irrigation wells currently serve the city. The irrigation wells supply only city recreation areas and schools, no residential secondary water system. Should have no problems with the water supply. Farmers nearby pumping from a different aquifer have experienced some ground water declines, but no shortages reported.

Parowan - Iron County
Parowan has two culinary wells. One is used approximately four hours per day and the other serves as a back up which has never been used. The city has just finished installing a second 1,000,000 gallon tank at the south end of town that will increase storage and improve service to the area. Culinary well supplies look good with no expected problems. Irrigation supplies are dependant upon the limited storage in Yankee Meadows Reservoir and wells located up the canyon, which produce 600 gpm during normal years. Parowan City water serves 2,500 residents.

Paragonah - Iron County
This town of approximately 500 is served by one spring. The town has first priority water rights from the spring, which is currently flowing at 200 gpm, 50% of normal. Other wells in the area are also experiencing declining water levels. Some had to lower pumps as much as 40 feet last year to stay ahead of the decline. Irrigation water from Red Creek Reservoir will supply 500 acre-feet or 60% of normal. Irrigation water from the reservoir started being released on June 17. City is considering a time of day watering ordinance and other restrictions.

Agricultural Related Effects in the Cedar/Beaver Basin

Beaver River - Beaver County
Thus far the Beaver River is flowing twice as much water as last year. The river peaked at 250 cfs June 10, but fell off to 54 cfs by June 17. When the river flow drops below 30 cfs, the city will supplement the secondary system with ground water. The city is divided into two sections for irrigation, with three days each for watering. The seventh day is for the city

parks. Minersville Reservoir (downstream from the city) is around 30% of normal storage for this time of year. Reservoirs upstream of the city, Kent's lake (60% full, 800 acre-feet) and Three Creeks (with 2,220 ac-ft) have much more water in them than last year.

Coal Creek - Iron County
Coal creek flows are currently lower than normal but much improved over last year. Peak flows occurred in mid May this year vs. mid April last year. Farmers are expecting a normal crop year. All seven irrigation companies have had some water, and three irrigation companies have water at present. Last year two companies did not get any water. Nearby well levels appear to be holding steady at present.

Enterprise Area - Washington County
Upper Enterprise is empty, lower Enterprise has 450 to 500 acre-feet stored. This will allow a supply of .3 to .4 acre-feet per ten shares. This amount should last through August. Normal allotment is 3 acre-feet per ten shares. At the end of last summer the remaining ponds in both reservoirs were poisoned to remove "shiner" fish. The Utah Fish and Wildlife Division has given up reserves in both reservoirs this year as there will not be enough water to support planting of fish.

Milford Area
Most farmers do not report any problems pumping water, although some have had to lower their wells. No water problems reported at Circle Four farms.

Minersville - Beaver County
Minersville irrigation will end up with about 7300 acre-feet, (water rights of 7,500 acre-feet). They are issuing ½ acre-feet per share in order to conserve water, as evaporation losses will consume a good portion of their storage. There will be no water for Rocky Ford Irrigation Company and possibly none for the wildlife pool. On June 17, the reservoir storage was 4,663 acre-feet of 26,500 acre-feet capacity, (18% full).

Parowan Valley - Iron County
The irrigation water in the valley is supplied from ground water, springs, canals and some small reservoirs. Some of the farmers had to lower their pumps last year - up to 20 feet. The area has had more storm water to help crops this spring, but the storage levels are lower than last year. It will be another short season for irrigators without wells.

Kanab Creek-Virgin River Basin
Despite below average precipitation throughout the year, the water supply in the Virgin/Kanab Creek Basin looks better than it did last year. At one stream gage on the Virgin River, the principal source of water for much of the population in the basin, 31% more water has been measured this year than last (see attached chart). Regarding reservoir storage, this is the first year that Sand Hollow reservoir has been used and the addition of this new reservoir nearly doubles the storage capacity on the system. This will obviously be a boon for the area, although this year, there has not been sufficient excess to fill the reservoir.

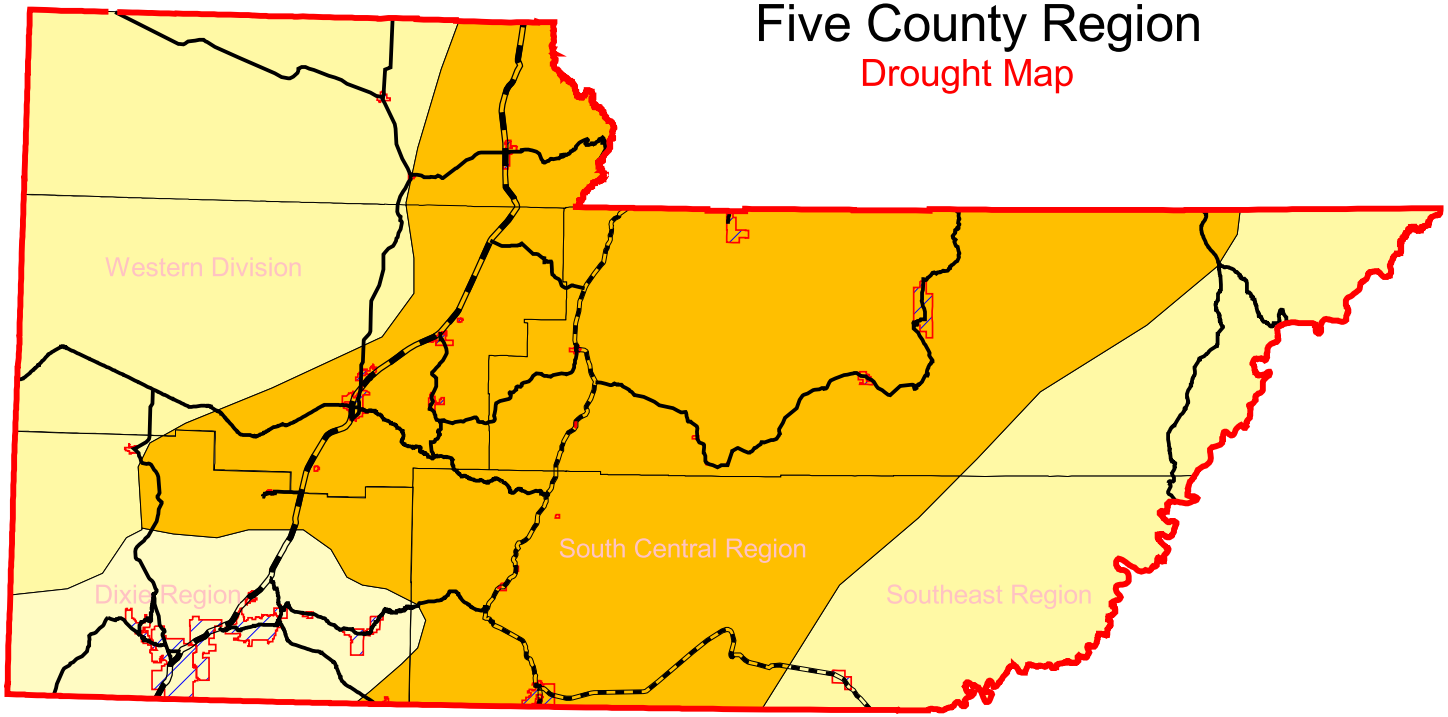
Municipal and Industrial Water Users
Drinking water supplies are holding up well and there is a general expectation that the municipal water supply will suffice to meet the demands. This expectation has been reinforced by the addition of several new wells throughout the basin, most of which are deep wells. In addition to the new sources of water, every community in the basin has a growing

conservation ethic. Most cities have implemented conservation ordinances. Some success has already been reported, for example, reports from St George are that compared with last year at this time, the residents have consumed 16% less water.

Although, in general, the outlook is hopeful for the basin, there are a few areas that will undoubtedly be in tough circumstances. Private water companies relying on shallow wells in the Cedar Mountain area will probably be out of water before the end of summer and have to truck water from Kanab as they did last year. Also, Gunlock reservoir is nearly at its conservation pool level, meaning that no more water will be able to be released. This has direct impact on agricultural irrigators who will have their last watering turn of the year this week, as well as residential users who rely on this water to irrigate their landscapes through the secondary irrigation system. The western half of St George as well as the city of Santa Clara are among those so impacted.

Five County Region

Drought Map



20 0 20 40 60 Miles

Five County's Boundary

Towns

Major Roads

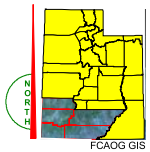
I-15

State Route

US Route

Palmer Drought Severity Index 1895 to 1995

sq. miles	Region W/ Percent of time in severe & extreme drought.
1423	Dixie 5% to 9.9%
7103	Western & Southeast 10% to 14.9%
9097	South Central 15% to 19.9%



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Problem Soils

Soil Problems in Southwestern Utah

Soil- and rock-related engineering geologic problems occur in a variety of geologic settings and are some of the most widespread and costly geologic hazards. Six types of problem soil and rock are present in southwestern Utah. The most extensive are expansive soil and rock. The majority of expansive soil problems are related to bentonitic marine shales near St. George.

Subsidence of the ground surface due to collapsible soil has caused extensive damage in and around Cedar City. Collapsible soil is common in Holocene alluvial-fan and debris-flow deposits in southwestern Utah. Soil and rock containing gypsum are also susceptible to subsidence. Ground water and introduced waters from irrigation dissolve gypsum causing subsidence.

Limestone susceptible to dissolution and subsidence occurs throughout mountains west of Sevier Lake, west of Richfield, and south of St. George. No known damage to structures has occurred from ground collapse or subsidence related to limestone karst, but because karst ground-water systems have little filtering capacity, contamination of ground water is a major concern. Piping is a common problem in fine-grained Holocene alluvium incised by streams in much of southwestern Utah. Collapse of soil pipes and subsequent erosion has damaged roads and agricultural land.

Sand dunes occur in the Escalante Desert and west of Kanab. Migration of dunes across roads and burial of structures are common problems in areas where active dunes are present.

Geologic materials with characteristics that make them susceptible to volumetric changes, collapse, subsidence, or other engineering-geologic problems are referred to as problem soil and rock. Geologic and climatic conditions in southwestern Utah provide a variety of both localized and widespread occurrences of these materials.

Six types of problem soil and rock are found in southwestern Utah: (1) expansive soil and rock with high shrink/swell potential, (2) collapsible soil, (3) gypsum and gypsiferous soil susceptible to dissolution, (4) limestone susceptible to dissolution under some hydrogeologic conditions, (5) soil subject to piping (localized subsurface erosion), and (6) active dunes. Some materials, such as expansive soil and limestone, cover large areas, whereas others, like active dunes, are of limited extent.

Geology and climate are the main factors which influence the distribution of problem soil and rock. The geologic parent material largely determines the type of problem present. For example, expansive soil is most often associated with shale, and karst dissolution features form in limestone and gypsiferous formations. Weathering and erosion are controlled by local and regional climate. A prime example of the influence of climate is collapsible soils, which are common in arid southwestern Utah, but much less common in wetter northern Utah.

Expansive Soil and Rock
Expansive soil and rock are the most common type of problem deposit in southwestern Utah. In particular, the Jurassic-age Arapien and Cretaceous-age Tropic Shales, and the Triassic-age Chinle and Moenkopi Formations are sources for expansive materials. Expansive deposits contain clay minerals that expand and contract with changes in moisture content. Clays absorb water when wetted, causing the soil or rock to expand. Conversely, as the material dries, the loss of water between clay crystals or grains causes the deposit to shrink. The most common clay mineral associated with expansive deposits in Utah is montmorillonite. Certain types of montmorillonite can swell to 2,000 times their original dry volume.

Expansive deposits are extensive around St. George, Washington, and Santa Clara. In these areas expansive clays in the Chinle Formation have been most damaging to structures. In Santa Clara, many homes and a church were damaged by expansive clays in the Chinle Formation. Common problems are cracked foundations, heaving and cracking of floor slabs and walls, and failure of wastewater disposal systems. Sidewalks and roads are particularly susceptible to damage.

Collapsible Soil
The phenomenon of hydrocompaction, which causes subsidence in collapse-prone soil, occurs in loose, dry, low density deposits that decrease in volume or collapse when saturated for the first time following deposition. Collapse occurs when susceptible soils are wetted to a depth below that normally reached by rainfall, destroying the clay-bonds between grains. Collapsible soil is present in geologically young materials such as Holocene-age alluvial-fan and debris-flow sediments, and in some windblown silts. These deposits have a loose "honeycomb" structure and high dry strength, resulting from rapid deposition and drying. When saturated, the honeycomb structure collapses and the ground surface subsides, damaging property and structures. Human activities that involve some form of water application such as irrigation, water impoundment, lawn watering, alterations to natural drainage, or wastewater disposal commonly initiate hydrocompaction.

Alluvial fans containing fine-grained deposits derived from shales, mudstones, and volcanic rocks are the most common sites for collapsible soil. Collapsible soil is present particularly near Cedar City and the Hurricane Cliffs. In Cedar City approximately $3 million in damage to public and private structures has been attributed to collapsible soil. Other areas in southwestern Utah with a potential collapsible soil problem are along mountain fronts where young alluvial-fan deposits containing fine-grained sediments are present. Climate also plays a role in the distribution of collapsible soils. Drier areas, such as the Basin and Range and Colorado Plateau provinces, provide the best conditions for development of collapsible soil.

Gypsiferous Soil and Rock
Gypsiferous deposits are subject to settlement caused by the dissolution of gypsum, which creates a loss of internal structure and volume within the deposit. Gypsum is a primary component in some rocks and the soils derived from these rocks. Gypsum in soil can also form in other ways - including as a secondary mineral deposit leached from surficial layers and concentrated lower in the soil profile or wind-blown dust, and in the St. George area by the evaporation of ground water. The most common sources for airborne gypsum are playas, on which crusts of gypsum salts form as the wetted playa surface dries during the warmer months of the year.

Gypsiferous soil and rock deposits are common in southwestern Utah, particularly along the base of the Hurricane Cliffs. Much of the gypsum is derived from erosion of gypsum-rich rock units such as the Shnabkaib Member of the Moenkopi Formation, the Carmel Formation, and the Arapien Shale. Gypsum in these deposits can cause damage to foundations, and induce land subsidence and sinkholes similar to those seen in limestone terrain. Water introduced into the subsurface for irrigation and landscaping or into wastewater-disposal systems, can cause underground solution cavities to develop, which may ultimately cause surface collapse. Gypsum is also a weak material with low bearing strength, which can cause problems when loaded with the weight of a structure. In addition, gypsum dissolved in water forms sulfuric acid and sulphate, which react with certain types of cement and weaken foundations.

Limestone and Karst Terrain

Karst terrain is characterized by closed depressions (sinkholes), caverns, and streams that abruptly disappear underground. Karst features are caused by ground and surface-water dissolution of calcareous rocks, such as limestone and dolomite. In southwestern Utah, the units most susceptible to dissolution are the Ochre Mountain, Joana, Flagstaff, and Kaibab Limestones, and the Laketown Dolomite and Notch Peak Formation. These units are found near Richfield, St. George. Fractures within the rock, frost shattering, and stream erosion also aid in the development of karst terrain.

Karst features directly affect both surface and subsurface drainage. The cavernous nature of karst terrain provides avenues for contaminants from surface or subsurface sources, such as wastewater-disposal systems, landfills, and buried gasoline tanks, to enter the ground-water system. Contaminants can spread rapidly due to the interconnected system of conduits. Cavernous subterranean openings in karst terrain often collapse, leaving sinkholes at the surface. Structures in the area may be damaged by the collapse. Although no documented occurrence of damage due to collapse has occurred in southwestern Utah, the potential for damage exists where susceptible units are present.

Most karst terrain in southwestern Utah is relict and relates to moister climates during the Pleistocene, or may have been created by ground water prior to the rock being uplifted and tilted during basin and range faulting. Under present climatic conditions, the potential for continued karst development in southwestern Utah is low, except in areas where sufficient ground water is present to cause solution weathering of limestone and dolomite.

Soils Subject to Piping

Piping is subsurface erosion by ground water that moves along permeable, noncohesive layers in unconsolidated materials and exits at a free face, usually along a stream bank or cliff that intersects the layer. Removal of fine-grained particles (silt and clay) by this process creates voids within the material that act as minute channels which direct the movement of water. As channels enlarge, water moving through the conduit increases velocity and removes more material, forming a "pipe." The pipe becomes a preferred avenue for ground-water drainage and enlarges as more water is intercepted. Increasing the size of the pipe removes support from the walls and roof, causing eventual collapse. Collapse features form at the surface above the pipes, directing even more surface water into the pipes. Eventually, continued collapse forms a gully that concentrates erosion along the line of collapse features.

Deposits susceptible to piping are common in the southwestern part of the state. Types of material susceptible to piping include fine-grained alluvium; weakly cemented, fine-grained

rock (siltstone, mudstone, and claystone), and volcanic tuff and ash. Holocene-age alluvial fill in canyon bottoms is the most common material susceptible to piping in Utah.

Piping can cause damage to roads, bridges, culverts, and any structure built over soils subject to piping. In areas where piping is common, roads are frequently damaged where they parallel stream drainages and cross-cut pipes. Road construction can contribute to the piping problem by disturbing natural runoff and concentrating water along paved surfaces, allowing greater infiltration and potential for pipes to develop. Earthfill structures such as dams may also be susceptible to piping.

Sand Dunes

Dunes are common surficial deposits in arid areas where sand derived from weathering of rock or unconsolidated deposits is blown by the wind into mounds or ridges. Dunes form downwind of source areas which may contribute a variety of different types of wind-blown material.

In areas where development encroaches on dunes, inactive or vegetated dunes may be reactivated, allowing them to migrate over roads and bury structures. Another problem is the contamination of local ground water from wastewater disposal in dunes. The uniform size of the sand grains comprising dunes makes them highly permeable. The fine sand in dunes can also clog wastewater-disposal systems. Gypsiferous dunes are an especially poor wastewater-disposal medium because they dissolve when wetted.

Dune fields are present in many areas of southwestern Utah, especially in the Escalante Desert and west of Kanab. Avoidance of dunes is the best way to prevent damage to structures. However, active dunes usually are a maintenance problem only and do not preclude development.

Conclusions

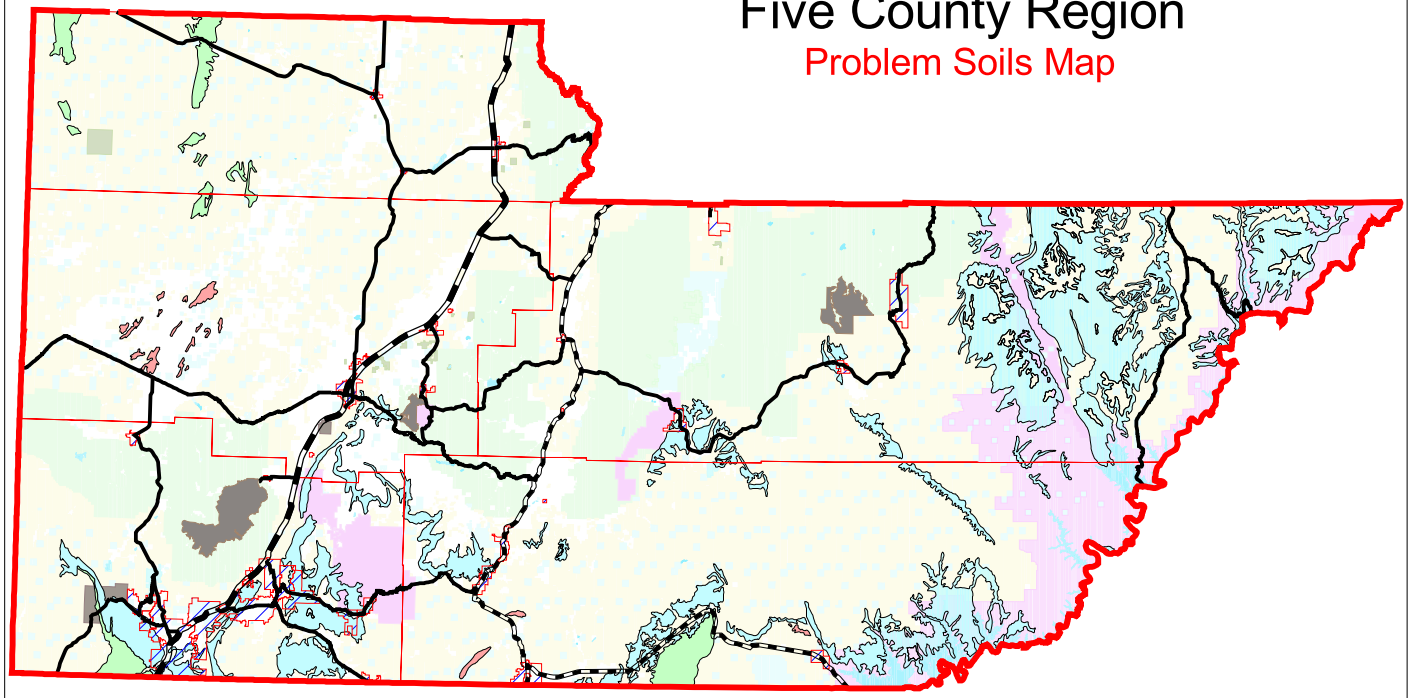
Humans have no influence on the distribution of problem soil and rock, but their activities are often adversely affected by them. As a result, urbanized areas of southwestern Utah are susceptible to damage from these deposits. As development encroaches on less suitable terrain, damage from problem soil and rock has, and will increase. Detailed geotechnical studies are needed in areas of problem soil and rock to identify and mitigate potential problems, and avoid costly corrective measures. Six types of problem soil and rock are present in southwestern Utah. Expansive soil and rock is the most extensive. Most expansive soil problems are related to bentonitic shales near St. George.

Collapsible soil has caused extensive damage in and around Cedar City. Holocene alluvial-fan and debris-flow deposits are the sources of collapsible soil in southwestern Utah. Soil and rock containing gypsum are also susceptible to subsidence. Ground water and introduced waters from irrigation dissolve gypsum causing subsidence.

Limestone susceptible to dissolution and subsidence occurs south of St. George. Structures have not been damaged by ground collapse or subsidence related to limestone karst, but because karst ground-water systems have little filtering capacity, contamination of ground water is a major concern. In fine-grained Holocene incised by streams piping is a common problem. Collapse of soil pipes and subsequent erosion has damaged roads and agricultural land. Sand dunes in the Escalante Desert and west of Kanab can migrate across roads and bury structures in areas where active dunes are present. (Excerpted from Lund, UGS unpublished information)

Five County Region

Problem Soils Map



20 0 20 40 60 Miles

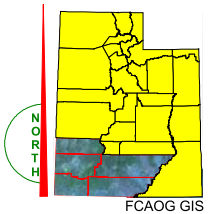
Problem Soils Classification

Expansive Soils

Dune-1

Limestone/Karst

* Note: Administrative Ownership is the background layer



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Severe Weather

FEMA Hazard Profile
Frequency: Likely
Severity: Minimal to Severe. Effects range from extreme to individual structures to moderate to many structures.
Duration: Short term, i.e. tornadoes or windstorms, to several days or more, i.e. severe snowstorms.

Tornadoes
There were 114 tornadoes reported in the State of Utah during the period between 1950 and 2002. The distribution of the twelve tornadoes reported to have occurred in the five southwestern counties of Utah during the same period 1950 through 2002 are detailed in Table 11 below:

Table 11 Number of Reported Tornadoes in the Southwestern District

Location	Number of Tornadoes Reported (1950-2002)	Percentage of Total Tornadoes Reported in State (1950-2002)
Beaver County	4	3.5%
Garfield County	1	0.9%
Iron County	5	4.4%
Kane County	0	0%
Washington County	2	1.8%
Region (all five combined)	12	10.5%

On August 11, 1999, an F2 tornado touched down in the metropolitan area of Salt Lake City. The tornado lasted ten minutes and killed one person, injured more than 80 people, and caused more than $170 million in damages. It was the most destructive tornado in Utah's history, and awakened the entire state's population to the fact that the Beehive State does experience tornadoes.

In the period between 1950 and 2002 there have been a number of injuries reported from Tornadoes statewide:

1 male on August 14, 1968
1 female on April 19, 1970
2 people on July 8, 1989
1 male on April 23, 1990
2 people on June 2, 1993
1 female on May 29, 1996
5 people (or more) on August 20, 1998
80 people (or more) on August 11, 1999
1 female on September 3, 1999

During the same period there was one reported death resulting directly from a tornado which occurred on August 11, 1999 in Salt Lake City. It should be noted that the only other reported death, the first since settlement of the area by Mormon Pioneers was the death on July 6, 1884 of a seven year-old girl, named Kitty Wells, who was killed by a tornado while

camping with her family in an area about 23 miles east of Wanship, in Summit County. There have been no reported tornadoes in Kane County and no deaths from tornadoes in Beaver, Garfield, Iron or Washington counties.

Anecdotal information is available for ten of the twelve above listed tornadoes that have occurred in the five county region:

Tornado, Kanarraville, Iron County
July 14, 1953, 1700 MST, 37 30'N, 113 15'W
A small twister hit the town of Kanarraville, Iron County. It broke limbs off trees and tore off the metal roof of a garage. It lasted ten minutes. (The day and hour of this tornado is estimated from cloudburst data and other severe weather activity in southwestern Utah.)

Tornado, northwest of Bryce Canyon, Iron County
June 16, 1967, 1400 MST, 38 00'N, 112 30'W
An airplane pilot observed a tornado about 25 to 30 miles northwest of Bryce Canyon, in Iron County. It occurred in open country and caused no reported damage.

Tornado, northeast of Milford, Beaver County
March 29, 1982, 1214 MST, 38 30'N, 112 53'W
A white tornado was observed 16 miles northeast of Milford, Beaver County, by the official weather observer at Milford. It was on the ground about three minutes. It churned up the snow covered ground and did no damage in that remote area. It moved in a northeasterly direction.

Tornado, Beryl Junction, Iron County and Washington County
May 30, 1986, 1730 MST, 37 40'N, 113 39'W
A tornado was reported by an official weather observer near Beryl Junction, Iron County. It traveled 3.5 miles and was 200 yards wide. The associated thunderstorm winds split several trees that downed power lines which in turn caused a grass fire. The tornado crossed into the northern portion of Washington County.

Tornado, east of Beaver, Beaver County
September 7, 1991, 1530 MST, 38 17'N, 112 32'W
A 30-foot wide tornado was spotted by two people. The funnel cloud lasted five to ten minutes but only touched down briefly. Since this tornado occurred in open country, it caused no damage.

Tornado, west of Beaver, Beaver County
May 21, 1992, 1115 West, 38 17'N, 112 51'W
A 45-foot wide tornado was spotted about 10 miles west of Beaver by a person driving south on I-15. After the person spotted the tornado, it lifted back into the clouds within a minute. Therefore, the total amount of time the tornado was on the ground is unknown. The tornado occurred in open country, and caused no damage.

Tornado, near St. George, Washington County
August 31, 1992, 1310 MST, 37 00'N, 113 28'W
Thunderstorms that had developed over the southwest portion of Utah produced a tornado ten miles southeast of St. George. A pilot spotted this tornado, which was about 20 yards wide and only remained on the ground for a brief period of time.

Tornado, Newcastle, Iron County
July 23, 1998, 1015 MST, 37 39'N, 113 32'W
On July 23, 1998, a tornado was observed by several people just southeast of Newcastle in Iron County. The tornado occurred between 11:15-11:25 AM, briefly touching down for a few minutes just off of State Route 56.

Tornado, 10 miles NW of Panguitch, Iron County
September 8, 2000, 1200 MST, 37 58'N, 112 28'W
At about 1:00 pm a tornado was spotted just outside of Panguitch on Highway 20 which connects US 89 to I-15. It was reported on the ground for at least five minutes in open country. No damage was reported.

Tornado, 6 miles SW of Milford, Beaver County
September 4, 2001, 1315 MST, 38 23'N, 113 00'W
A weak tornado was reported by the Beaver County Sheriff about 6 miles southwest of Milford. The tornado remained on the ground about 15 minutes before dissipating in the foothills northeast of Milford.

Lightning
According to the National Oceanic and Atmospheric Administration there have been a total of 53 reported deaths and 132 reported injuries from lightning in Utah between 1950 and 2002. See Table 12 below:

Table 12 Number of Lightening Caused Deaths

NUMBER OF LIGHTNING DEATHS IN UTAH 1950-2002 BY MONTH OF OCCURRENCE								
APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	TOTAL
3	4	6	14	16	6	2	2	53

NUMBER OF LIGHTNING INJURIES IN UTAH 1950-2002 BY MONTH OF OCCURRENCE								
APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	TOTAL
1	24	21	29	41	10	5	1	132

NUMBER OF LIGHTNING DEATHS IN UTAH 1950-2002 BY COUNTY			
Cache	2	Rich	1
Carbon	2	Salt Lake	7
Daggett	1	San Juan	6
Davis	1	Sanpete	3
Duchesne	4	Summit	3
Emery	1	Tooele	2
Garfield	**3**	Uintah	2
Grand	4	Utah	2
Iron	**1**	Wasatch	1
Juab	2	Wayne	1
Morgan	1	Weber	2
Piute	1	**STATE TOTAL**	**53**

Based upon this data, of the total number of lightning deaths in the State, 5.7% of the deaths occurred in Garfield County and 1.9% in Iron County. (See Table 1)

Table 13 Number of Lightening Caused Injuries

NUMBER OF LIGHTNING INJURIES IN UTAH 1950-2002 BY COUNTY			
Beaver	**2**	San Juan	3
Cache	7	Sanpete	1
Carbon	4	Sevier	1
Daggett	1	Summit	8
Davis	3	Tooele	10
Duchesne	7	Uintah	3
Emery	7	Utah	12
Garfield	**6**	Wasatch	3
Grand	3	**Washington**	**2**
Morgan	2	Wayne	1
Piute	1	Weber	4
Salt Lake	41	**STATE TOTAL**	**132**

Based upon this data, of the total number of lightning injuries in the State, 1.5% of the injuries occurred in Beaver County, 4.5% in Garfield County and 1.5% in Washington County.

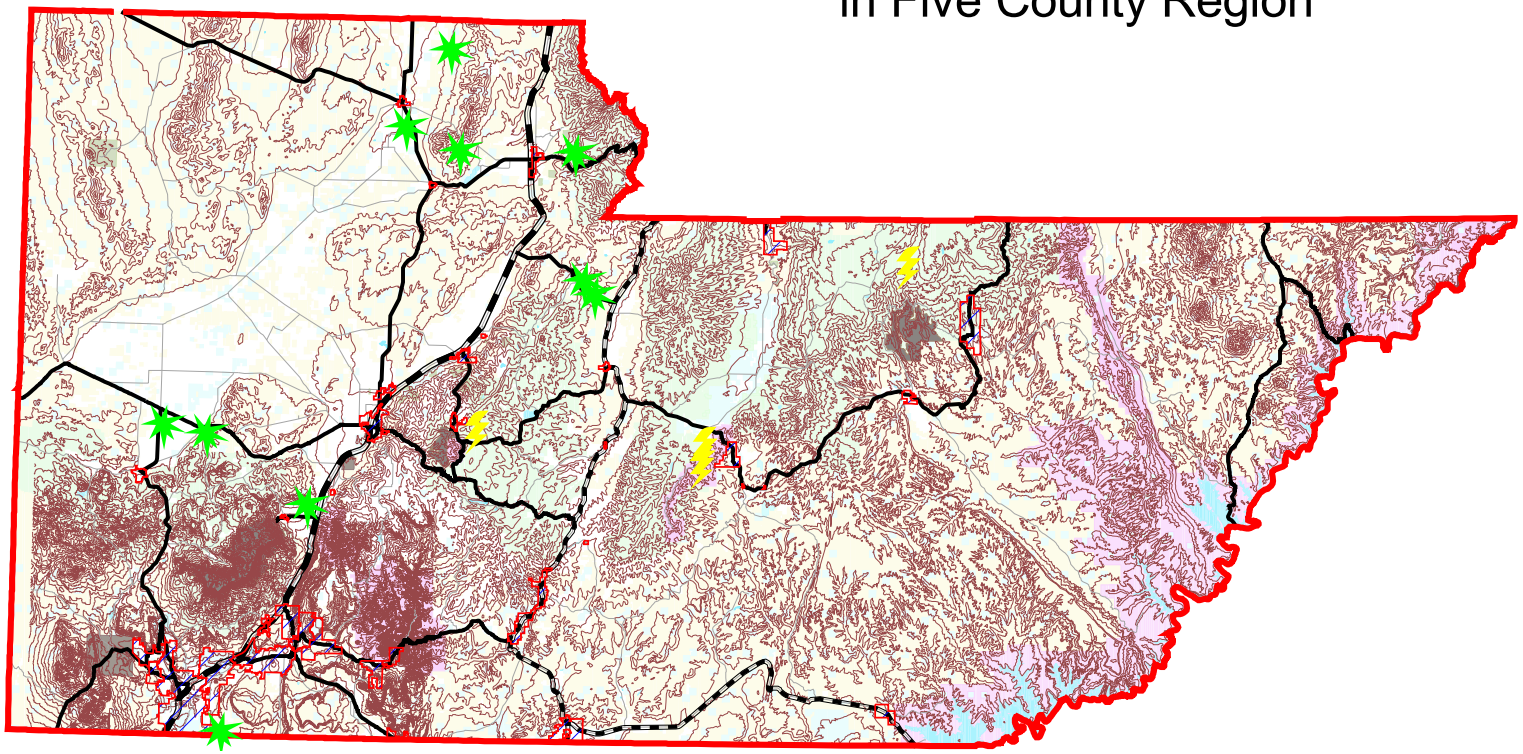
Cloudbursts

In the thirty year period between 1939 and1969, there were 836 cloudburst floods reported in Utah. Cloudburst floods which occurred in the five southwestern counties of Utah during the period 1939 through 1969 are detailed in Table 14.

Table 14 Number of Cloudburst Floods

County	Area	Number of Cloudburst Floods (1939-1969)	Percentage of Total Cloudburst Floods Occurring in State (1939-1969)
Beaver	Entire County	32	3.84%
	Unincorporated Portion of County	1	0.12%
	Beaver	6	0.72%
	Milford	9	1.05%
	Minersville	16	1.91%
Garfield	Entire County	42	5.04%
	Unincorporated Portion of County	8	0.96%
	Antimony	10	1.20%
	Cannonville	4	0.48%
	Escalante	5	0.60%
	Hatch	1	0.12%
	Henrieville	3	0.36%
	Panguitch	10	1.20%
	Tropic	1	0.12%
Iron	Entire County	39	4.68%
	Unincorporated Portion of County	2	0.24%
	Cedar City	25	3.00%
	Kanarraville	2	0.24%
	Paragonah	2	0.24%
	Parowan	8	0.96%
Kane	Entire County	28	3.36%
	Unincorporated Portion of County	3	0.36%
	Alton	3	0.36%
	Big Water (formerly Glen Canyon City)	2	0.24%
	Glendale	1	0.12%
	Kanab	14	1.68%
	Orderville (including Mount Carmel area)	5	0.60%
Washington	Entire County	35	4.20%
	Unincorporated Portion of County	9	1.08%
	Enterprise	1	0.12%
	Hurricane	2	0.24%
	Ivins	1	0.12%
	Leeds	1	0.12%
	Rockville	2	0.24%
	St. George	12	1.44%
	Santa Clara	3	0.36%
	Springdale	3	0.36%
	Washington	1	0.12%
Region	All Five Counties Combined	176	21.12%

Tornados' and Lightning Strike Deaths in Five County Region

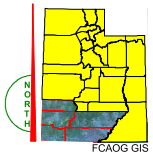


20 0 20 40 60 80 100 Miles

Tornados
LIghtning Strike Deaths
Five County Boundary
Towns

Major Roads
I-15
State Route
US Route
Contours

* Note: Administrative Ownership is the background layer



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Insect Infestation

FEMA Hazard Profile

Frequency: Low (usually in conjunction with drought whose pattern is cyclical)
Severity: Low to Moderate in most of the five counties of southwestern Utah. Severe in some portions of Beaver County, i.e. near Manderfield area north of Beaver City.
Duration: Several years or more. Usually same as normal 4 year cycle for drought

Mormon Cricket Infestation in Southwestern Utah

According to Mike Pace, Utah State University Extension Agent for Millard County, the Mormon cricket has reached legendary status in the State of Utah. This devastating insect plagued the early pioneers. Today, 150 years later, the Mormon cricket still economically devastates some parts of Utah.

Damage

The Mormon cricket is not a true cricket. The insect resembles more a lifestyle of a grasshopper. Mormon crickets are of economic importance in the fact that they destroy plants on rangeland, cropland, and vegetable gardens. Male and female Mormon crickets are large insects and can reach lengths of two and one-half inches during the adult stage. The female Mormon cricket is distinguished by the long ovipositor that also looks like a type of "stinger" located at the end of the abdomen. The male lacks this ovipositor. The Mormon cricket can be economically devastating. It has been calculated that a Mormon cricket at a density of one per square yard can consume 38 pounds of dry weight rangeland forage per acre. In Utah, the Mormon cricket destroys sagebrush, alfalfa, small grains, seeds, grasses, and vegetable crops.

Life Cycle and Characteristics

Mormon crickets hatch during the spring, and depending on elevation usually around the first few weeks of April. Young Mormon crickets are called nymphs. These nymphs develop during the spring months. They undergo seven stages of development called in-stars. It takes 60 to 90 days for the Mormon cricket to pass through these seven stages and obtain the adult stage. The female Mormon cricket lays its eggs during the summer months. The incubation of the eggs occurs during the fall and winter months. The eggs start hatching when soil temperatures reach 40 degrees Fahrenheit. The Mormon cricket cannot fly, but is still an extremely mobile insect. When the crickets are young, they do not migrate long distances. After about the fourth in-star and during the adult stage the Mormon crickets become ravenous and start banding together. Once the crickets have banded together, they begin migrating. During their migrations they destroy everything in their path. Mormon crickets are usually found migrating when skies are clear and temperatures are around 60 to 90 degrees Fahrenheit. In Utah, the crickets migrate under favorable conditions around 10:00 a.m. until about 2:00 p.m. Mormon crickets in the adult stage can cover a mile a day and up to 50 miles in a single season. During the night and during cold, wet weather, Mormon crickets clump together and can be seen clinging together on grasses and brush. They will also burrow underneath grass and brush to keep warm. The Mormon cricket is a hearty insect. They have been seen feeding when temperatures were less than 35 degrees Fahrenheit.

Control Methods
The most effective way to reduce Mormon cricket populations is to use carbaryl bait. The trade name is Sevin bait. This is usually oatmeal coated with the chemical insecticide carbaryl. The recommended application rate is 10 pounds to the acre. Using hand-held fertilizer spreaders can spread the bait or large machines that blow the poisoned grain a long distance. The idea is to apply a barrier of bait around or in front of a band of migrating crickets. Once the first wave consumes the bait they will die within a few minutes. The crickets coming from behind will eat the dead crickets causing a chain reaction of crickets being killed by the bait. Mormon crickets do not fly so they will almost always hit the barrier of poisoned bait. Many ranchers and farmers will apply the bait around the perimeter of their fields to reduce the number of crickets invading. Bait is also applied along roadsides to reduce the risk of car accidents from large numbers of crickets crossing highways. It is best to apply the bait when the crickets are still young or in the developing stages. Insecticide sprays such as Malathion could be effective against the Mormon cricket if they were sprayed during the nymphal stage. These insecticide sprays usually aren't recommended. Sevin bait is the preferred control method at this time in Utah.

Costs vary but usually average about $5 an acre for a minimum of 5,000 acres being sprayed. Some years there are government cost share programs to help spray large acres of rangeland. Usually, the land needs to border Federal or State lands to qualify for government aid. The insecticide most commonly used on rangelands is Malathion ULV applied at 8 oz. to the acre. It is important that spraying takes place early in the grasshopper’s life. The younger the grasshoppers are the better the kill rate. The best time to usually spray rangeland is the first three weeks in June. This is referred to as the "window of opportunity."

Cropland
The most profitable crops in Utah are alfalfa, corn, oats, wheat, rye, and barley. Grasshoppers concentrate in these croplands and destroy all vegetation present. This can be economically devastating for a farmer. Control on agricultural croplands is essential. As with rangelands you must determine whether there is an infestation of eight or more grasshoppers per square yard. If there is, then the two most effective control methods are ground spraying or aerial spraying. Ground spraying is usually more expensive per acre, but there is less chance of killing non target insects (bees). Aerial spraying is quick, usually less expensive, and has a high kill rate. The disadvantage is the potential damage to non-target insects. Usually, aerial spray applications are used when there are a higher number of acres to be sprayed. Malathion ULV and Dursban are two common insecticides used for grasshopper control on agricultural croplands. Justification for control depends on the crop, the crop's stage of growth, additional migration, and the type of damages being done to the crop. Grasshoppers hatch and migrate off bordering lands, and at times this is extremely frustrating to an agriculture grower trying to control grasshopper infestation. This is where the importance of communities pulling together to do a countywide spray program comes into play. The importance of government spraying of public lands bordering cropland cannot be stressed enough.

Lawns, Gardens, and Landscaping
Homes are being built on lands that have produced grasshopper populations for many years. This causes problems for the homeowner. Grasshoppers are hatching and laying eggs in the lawns and gardens. This makes it possible for the grasshoppers to hatch on the same lawn year after year. Grasshoppers are migrating out of vacant fields and low hills into the green, lawns and gardens. This results in thousands of dollars in damage to newly

planted landscapes. It is very important that communities work together in controlling grasshopper outbreaks. If one person is spraying, and neighbors are not, then the grasshoppers will just continue migrating from adjacent property. Vacant lots and fields need to be tilled in late fall to expose the eggs. Eggs are destroyed when they are exposed to the cold environment. Lawns need to be raked to also expose the eggs. Flower gardens usually have a population of eggs, so the soil should be turned over to expose the eggs. If there is an outbreak of grasshoppers on your landscape during the summer, start spraying early. Once you see that grasshoppers have invaded, even the little ones, start spraying with Dursban (chlorpyrifos) for use on turf and ornamentals, Malathion for use on turf, ornamentals and vegetables, or liquid Sevin (carbaryl) for use on turf, vegetables, and ornamentals.

Insecticide baits that use insecticide such as Sevin have not been an effective barrier against the grasshoppers in Utah. Grasshoppers fly and jump great distances and more than likely will miss the barrier of bait completely. This bait is very effective for the Mormon crickets.

Grasshopper Infestation
Grasshoppers are also a recognized problem for Utah. The extreme infestations do not occur every year, but there are grasshoppers to some extent each year. Extreme infestations seem to come in cycles of seven years and last approximately three years. Everyone needs to recognize there is a problem, and take the steps each year to combat the insects. Expose the eggs as often as possible, start spraying late spring and early summer to kill the immature grasshoppers, make your spraying programs a community effort, and keep informed on government spray programs for your area. If everyone does their part we can greatly reduce the grasshopper populations, and strive for a region free of these devastating insects.

State Response to Infestation
With the 2002 cricket and grasshopper fight not even over, the Utah Department of Agriculture and Food (UDAF) went before the Natural Resources, Agriculture and Environment Subcommittee seeking additional funds for 2003's fight. An estimated five million acres are expected to be infested during 2003, according to mid-Summer 2002 surveys by the UDAF and USDA. In 2002, more than 3.3 million acres were infested with Mormon crickets and grasshoppers in many of the state's 29 counties.

Governor Leavitt added insect infestation to a statewide disaster declaration dated April 24, 2003. 2002 was a disastrous year for Utah agriculture. Nearly every natural disaster thinkable has assaulted Utah farmers and ranchers. From drought, to insects, to frost, to high winds, virtually every grower has lost revenue because of the weather or other natural causes.

As of 2002, 3.5 million acres currently infested, centered in Beaver, Juab, Millard and Tooele counties. Five million acres are expected to be infested in 2003. The total UDAF expenses in 2002 for grasshopper/Mormon cricket survey and control were $241,000. The total state and private acres treated in 2002 was 26,000. The total acres treated were 98,500.

Drought conditions are causing crickets and grasshoppers to migrate to agricultural and populated areas. As a public safety measure in 2002 UDOT applied nearly 10,000 lbs. of bait along the sides of roadways. Funding for control in 2003 will require an estimated

$350,000 to control grasshoppers and crickets on State lands and fund cost share efforts on private lands.

USDA Designation of Utah Drought Disaster Area
In July 2003, U.S. Department of Agriculture Secretary Ann M. Veneman designated the entire state of Utah a primary natural disaster area due to drought, ***insect infestation*** and high winds. The designation came as Utah is suffering through its 5th year in a row of severe drought conditions. Water storage and stream flows in the state are approximately half of normal, and forecasted temperatures are expected to be above average with rainfall forecast to be less than normal. The federal declaration came several weeks following a formal request for assistance by Utah Governor Mike Leavitt on May 20, 2003.

Governor Mike Leavitt has stated that Utah farmers and ranchers desperately need this federal assistance. He asked Utah Commissioner of Agriculture, Cary Peterson, to help drought and insect-infested counties receive full benefit from this disaster declaration.

Utah has faced five years in a row of ever intensifying drought conditions, and is currently the driest state in the country, according to the USDA's Palmer drought index.

This designation makes farm operators in all 29 Utah counties eligible to be considered for low-interest emergency loans from the Farm Service Agency (FSA), provided eligibility requirements are met.

Insect Infestation

Vulnerability Assessment

Overall Summary of Impacts
Insect infestation in Southwestern Utah is varied in location, species of insects and severity of infestation. The Mormon cricket, so called because of the heartache it once brought early Utah settlers, is devouring acres of wheat, barley, and oats in the state. In 2003's infestation, which also affects Idaho and Nevada, might be the worst in recent history. Forests of southwestern Utah are also infested with several species of beetles and other damaging insects.

Grasshopper and Mormon cricket Infestations
The State of Utah Department of Agriculture and Food has said that no one who works for their department has seen it this bad. For the sixth year in a row an estimated 5 million to 6 million acres of farm and ranchland in Utah are infested with crickets and grasshoppers.

A statewide agricultural disaster based on the continued drought, insect infestation, and high winds was recently declared by FEMA providing help from the federal government such as low-interest loans for farmers and ranchers. According to Utah state officials crickets and grasshoppers have caused $25 million in damages from lost crops. According to the Utah Department of Agriculture, wheat, barley, oats, and alfalfa are the main crops affected by the insect infestation, with most of the damage occurring in rural and central Utah. State officials say one cricket can consume 38 pounds of forage during its lifetime.

Utah has a long and colorful history of problems with the insect dating back to the early days. When Mormon settlers attempted to harvest crops in 1848 hordes of crickets swarmed

the area destroying the crops. According to state history, failed attempts to fight the crickets sent the Mormon pioneers to their knees in prayer. Thousands of sea gulls appeared and devoured the crickets and saved the crops. On historic Temple Square in Salt Lake City visitors can see a monument to the sea gull that reads: "In grateful remembrance of the mercy of God to the Mormon Pioneers."

The largest infestation of grasshoppers in Utah in 2002 was in Millard County which neighbors Beaver County at the north of this region. 23,024 acres of BLM land in that county were infested with Grasshoppers with 11,512 acres being treated with an insecticide. Mormon cricket populations in 2003 are perhaps the largest in Utah's recorded history. Mormon crickets infestation has now extended into Beaver County reaching to near the northern city limits of Beaver City. Statewide, the acres affected by infestation of grasshoppers and Mormon crickets is shown in Table 15 below:

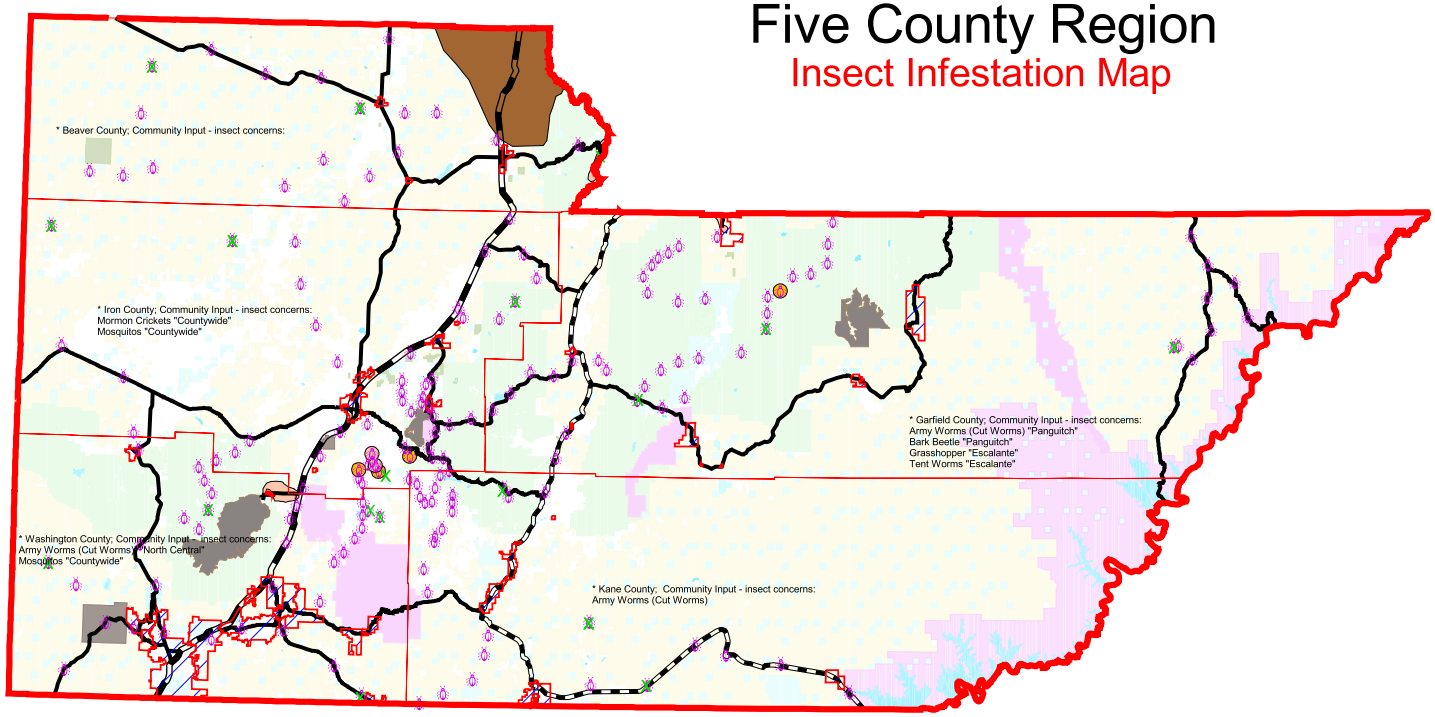
Table 15 Acres Infested by Grasshoppers and Mormon Crickets by Ownership

Adult Insects Surveyed		
Land Ownership	Acres with grasshoppers >8 per square yard	Acres with Mormon crickets
Private	524,600	478,600
State	47,300	209,550
U.S. Forest Service	50,000	100,000
U.S. BLM	242,000	1,662,550
TOTAL	863,900	2,450,650

Grasshopper Infestation in Southwestern Utah Counties		
County	Area within county infested	Total Acres Infested (2002)
Beaver County	near the Piute County line	4,043
Garfield County	within and to the southeast of Antimony Town	4,313
Iron County	East of Kanarraville	8,967
Kane	None	0
Washington	Near New Harmony	7,957
	TOTALS	25,280

Five County Region

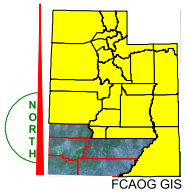
Insect Infestation Map



20 0 20 40 60 Miles

GPS Insect Density 2002
USDA fixed points 2002
Town Boundaries
Five County Boundary
County Boundaries
Mormon Cricket 2002
Grasshopper 2002 8 or more per sq. yd.
Grasshopper 2002 3 to 7 per sq. yd.
Major Roads
I-15
State Route
US Route

* Note: Administrative Ownership is the background layer



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Radon Gas

Radon Hazard in Southwestern Utah

FEMA Hazard Profile
Frequency: Likely
Severity: Low to Moderate in the five southwestern Utah counties. Locally higher in Beaver County.
Duration: Ongoing risk

Average Level of Radon
Based on a national residential radon survey completed in 1991, the average indoor radon level is 1.3 picoCuries per liter (pCi/L) in the United States. The average outdoor level is about 0.4 pCi/L.

Average Level of Radon Found in Southwestern Utah
The U.S. EPA and the U.S. Geological Survey have evaluated the radon potential in each state and developed radon zone mapping to assist state and local organizations to target their resources and to assist building code officials in deciding whether radon-resistant features are applicable in new construction. A radon zone map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location. The map below assigns each of the 29 counties in Utah to one of three zones based on radon potential. Each zone designation reflects the average short-term radon measurement that can be expected to be measured in a building without the implementation of radon control methods. The radon zone designation of the highest priority is Zone 1. All five of the counties in the southwestern region are located in Zone2 with a moderate potential for radon exposure

What's the Debate on Radon?
There is no debate about radon being a lung carcinogen in humans. All major national and international organizations that have examined the health risks of radon agree that it is a lung carcinogen. The scientific community continues to conduct research to refine our understanding of the precise number of deaths attributable to radon. EPA and the National Cancer Institute (NCI) have independently placed that number at about 15,000 lung cancer deaths each year in the United States.

A few scientists have questioned whether low radon levels, such as those found in residences, increase the risk of lung cancer because some small studies of radon and lung cancer in residences have produced varied results. Some have shown a relationship between radon and lung cancer, some have not. However, the national and international scientific communities are in agreement that all of these residential studies have been too small to provide conclusive information about radon health risks. All major scientific organizations continue to believe that approximately 10% of lung cancers in the United States -- or about 15,000 lung cancer deaths annually -- are attributable to radon.

How Do We Know Radon is a Carcinogen?
The World Health Organization (WHO) and the US Department of Health and Human Services, as well as the U.S. Environmental Protection Agency, have classified radon as a

"Class A" known human carcinogen, because of the wealth of biological and epidemiological evidence and data showing the connection between exposure to radon and lung cancer in humans.

The World Health Organization, the National Academy of Sciences and other scientific organizations agree that studies of the miners are the best scientific information for estimating radon health risks in homes. The Lubin/Boice meta-analysis paper also concludes that the miners studies are the best data source for analyzing residential radon risk. Based on the miner data, NCI has previously estimated that 15,000 people die of lung cancer from residential radon each year in the U.S.

There have been many studies conducted by many different organizations in many nations around the world to examine the relationship of radon exposure and human lung cancer. The largest and most recent of these was an international study, led by the National Cancer Institute (NCI), which examined the data on 68,000 underground miners who were exposed to a wide range of radon levels. The studies of miners are very useful because the subjects are humans, not rats, as in many cancer research studies. These miners are dying of lung cancer at 5 times the rate expected for the general population. Over many years scientists around the world have conducted exhaustive research to verify the cause-effect relationship between radon exposure and the observed increased lung cancer deaths in these miners and to eliminate other possible causes.

In addition, there is an overlap between radon exposures received by miners who got lung cancer and the exposures people would receive over their lifetime in a home at EPA's action level of 4 pCi/L, i.e., there are no large extrapolations involved in estimating radon risks in homes.

Is Radon Really a Problem?

Nearly one in fifteen homes in the U.S. is estimated to have elevated radon levels. Elevated levels have been found in every state. While radon problems may be more common in some areas, any home may have a problem. In addition, the level of radon in a nearby home or building cannot be used to predict the level of radon in your home or building. Two adjacent houses may have very different radon levels. EPA recommends that all homes below the third floor be tested for radon and that all schools are tested.

Radon Problem in Beaver County

The radon-gas hazard potential in the Beaver Basin area is one of the highest in the state according to an August 1998 news release by the Utah Geological Survey. The Basin was identified by the Utah Department of Environmental Quality as an area of concern after tests showed indoor radon levels were the highest recorded in the state. The UGS began identifying and studying areas of Utah with a high potential for radon as part of the Toxic Substances Control Act and the Indoor Radon Abatement Act of 1988. The IRAA authorized the State Indoor Radon Grant program, providing funding so states could develop and continue radon assessment and mitigation programs. Since then, the UGS has studied nine areas of the state that the DEQ identified as problematic. Those reports, including the Beaver Basin one, are available in the Department of Natural Resources Map and Bookstore, 1594 West North Temple, Salt Lake City, Utah. The publications also contain information on how to prevent radon gas from infiltrating into structures, as well as how to reduce radon levels that are already present.

According to the author of the latest report, geologist Charles E. Bishop, the radon levels in the Beaver Basin area "are well above those considered a health risk by the U.S. Environmental Protection Agency." The basin encompasses about 160 square miles in eastern Beaver County in southwestern Utah. A natural depression, the basin floor, or "fill," is comprised of sediments derived from volcanic and other rocks that have a high content of uranium. This basin-fill deposit is characterized by moderate to high permeability. Ground water depth is greater than 10 feet in most of the region, and the area is bounded by mountains that also have high uranium levels. These factors account for the elevated radon-hazard potential.

According to Mr. Bishop, radon-hazard studies are necessary "to organize and prioritize testing in existing buildings and to indicate where radon-resistant construction should be considered in new buildings. Indoor-radon levels are easily and inexpensively measured, and various methods to reduce the levels are available."

Testing for Radon
The only sure way to determine if a home has a problem with radon is to test. It is important to use an Environmental Protection Agency approved test kit.

There are two general ways to test for radon. Short-term testing uses a kit that remains in a home from two days to 90 days depending on the device. Such devices are available at a discount price from the Utah Safety Council. Long-term testing uses a kit that requires a minimum testing period of 90 days and maximum of one year. Long-term radon test kits are available through the National Radon Hotline at (800) SOS-RADON.

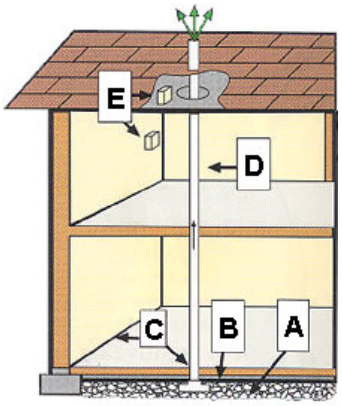
Renovating Existing Construction
Radon problems determined through testing in existing homes are fixable. Radon reduction measures can vary with radon levels, but most often the measures may cost no more than having a new hot water heater installed or having the house painted. The cost of a contractor fixing a home generally ranges from $500 to $2500, depending on the characteristics of the house and choice of radon reduction methods. For a list of EPA approved contractors in Utah, contact the Utah Safety Council; 5263 South 300 West, Suite 201; Salt Lake City, Utah 84107.

Radon-Resistant New Construction
Specific construction techniques can help block radon from entering the home. The occupants will benefit from lower radon levels in their new home. Homes constructed with radon resistance techniques are easier to upgrade if there is a need to Increase the radon reduction. If high radon levels are found, new techniques allow for easy and inexpensive installation of a fan for increased radon reduction in the home. While every new home should be tested for radon by the homeowner after occupancy, it is more cost-effective to include radon-resistant techniques while building a home, rather than installing a radon reduction system in an existing home. For Example,
materials and labor costs for radon-resistant techniques vs. retrofitting an existing home is $350 to $500 vs. $800 to $2,500, a 128% to 400% savings. Some construction companies successfully use this as a marketing advantage.

Radon-resistant Construction May Improve a Home's Energy-Efficiency
Radon-resistant construction techniques are consistent with state-of-the-art energy-efficient construction. When using these techniques, follow the Model Energy Code (or other

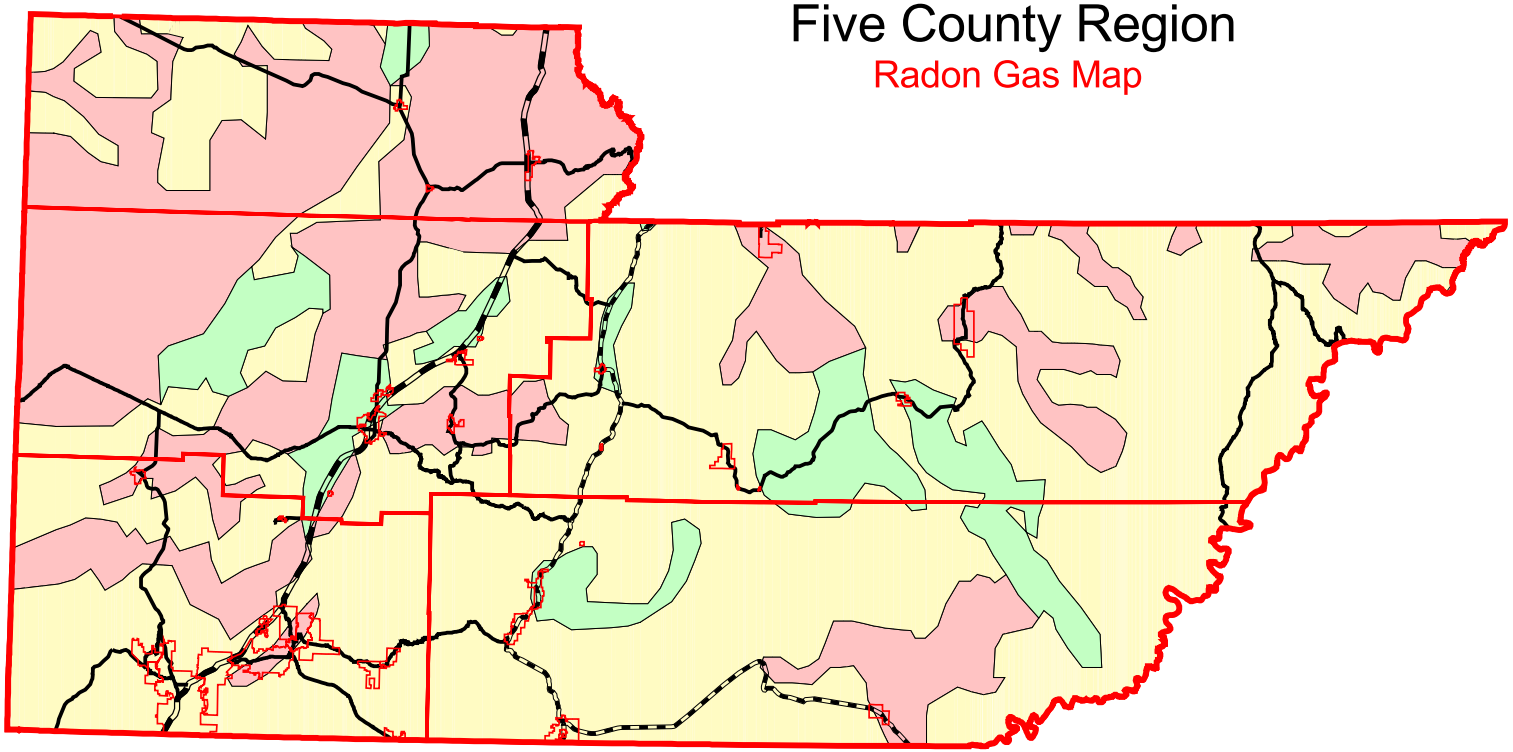
applicable energy codes) for weatherization, which will result in energy savings and lower utility bills.

What are Radon-resistant Construction Techniques?
Techniques may vary for different foundations and site requirements, but the basic elements are:

A. Gas Permeable Layer This layer is placed beneath the slab or flooring system to allow the soil gas to move freely underneath the house. In many cases, the material used is a 4-inch layer of clean gravel.	
B. Plastic Sheeting Plastic sheeting is placed on top of the gas permeable layer and under the slab to help prevent the soil gas from entering the home. In crawlspaces, the sheeting is placed over the crawlspace floor.	
C. Sealing and Caulking All openings in the concrete foundation floor are sealed to reduce soil gas entry into the home.	
D. Vent Pipe A 3- or 4-inch gas-tight or PVC pipe (commonly used for plumbing) runs from the gas permeable layer through the house to the roof to safely vent radon and other soil gases above the house.	
E. Junction Box An electrical junction box is installed in case an electric venting fan is needed later.	

Five County Region

Radon Gas Map

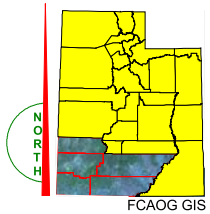


20 0 20 40 60 Miles

Counties Boundaries
Town Boundaries

Major Roads
I-15
State Route
US Route

Radon Gas Levels
High Potential
Zone 3 (More than 4 pCi/L)
Moderate Potential
Zone 2 (from 2 to 4 pCi/L)
Low Potential
Zone 1 (Less than 2 pCi/L)



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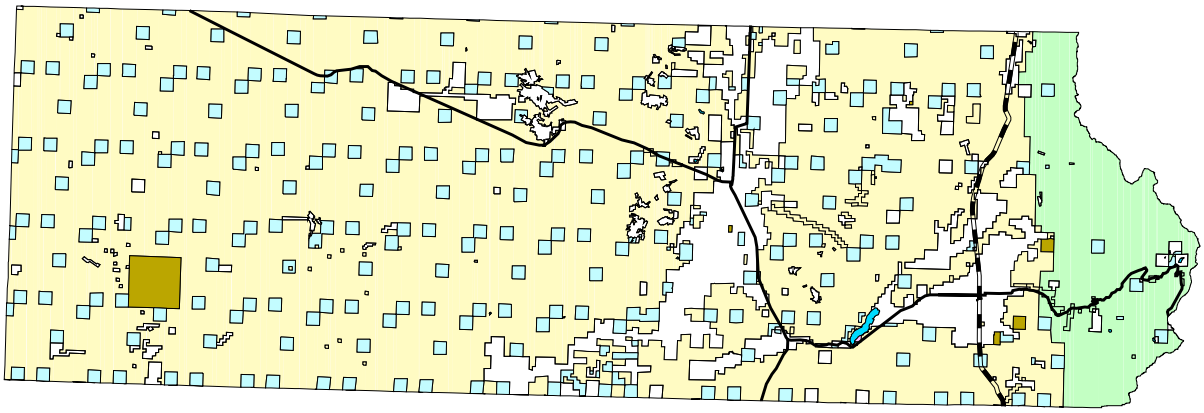
Beaver County



History

Beaver County history dates back to 1776 when Franciscan priests searched for a shorter route between missions and happened to pass through the richly abundant area now enjoyed by thousands of similar travelers each year. Father Escalante and Father Dominguez recorded in their dairy, "We found everything convenient, it being necessary to go to the arroyo for water or to its meadow for pasture." The convenience found by those priests more that 200 years ago is still here today.

Many historical sites have been preserved and maintained. The Horn Silver Mine at Old Frisco - west of Milford in the San Francisco Range - was opened in 1800 or so, and proved to be one of the richest mines in history. The ghost town of today offers an excellent day of exploration, adventure, and a reminder of the boom past.

The old Beaver County Courthouse in Beaver City, with its classical architecture has been restored and now offers tours. Beaver Historical Park, adjacent to the courthouse features a stature of Philo T. Farnsworth, the father of television.

The county has many other historical sites marked along its highways and byways, in addition to more than 100 homes listed on the national historical register. It's also the birthplace of the infamous Butch Cassidy.

Beaver City, the Beaver County seat, is located just south of the I-15 and I-70 Interchange. Beaver City proximity to some Utah cities is shown below.

Salt Lake City - 200 miles
Moab - 235 miles
Green River - 184 miles
St. George - 105 miles

The average temperature in January is 41º F, and the average July temperature is 88º F. Annual Average Precipitation is 11.7"

Development Trends

Population

Beaver County suffered from three decades of out-migration before it started growing again in the 1980s. During the1990s population growth incremented upward. From 1990 to 2000, Beaver County ‘s population grew by 29 percent. This placed Beaver County almost exactly in the middle of the rankings of Utah’s counties. This was also the largest 10 year increase, percentage-wise, since 1910. The 29 percent increase was over double the national average of 13 percent.

In the 1990s, Minersville was the fastest growing community in Beaver County, increasing by one-third (34 percent) between 1990 and 2000. Milford City’s population grew by 31 percent and Beaver City’s population grew by 23 percent. The population of the balance of the county grew by 22%. In hard numbers, Beaver City grew by 456 persons, Milford by 344, Minersville by 209 and the balance of Beaver County by 231 persons.

Labor Market Indicators

Beaver County's *non-farm* jobs dropped by 1.4 percent in 2001. "*Covered agricultural*" jobs make up a large share of Beaver County's employment base. While not usually counted because they represent only a limited share of agricultural employment in some counties, these figures provided added insight into Beaver County's economy. In the case of Beaver County, expansion in covered agricultural jobs was enough to move Beaver County's employment expansion figures up to 0.3 percent.

Most of Beaver County's major industries lost employment during 2001. Only construction, mining, trade and covered agriculture added new jobs. Only covered agriculture showed a year-over increase of more than ten jobs.

The services and transportation/communication/utilities industry job losses put the largest drag downward on the Beaver County economy. Those losses were enough to bring the unemployment rate up to 4,2 percent in 2001. That amount is still a relatively low jobless rate for a non-urban county and is below state and national averages.

Data from the 2000 U.S. Census show that Beaver County's labor force participation increased during the 1990s. A younger working age population contributed to that change, as did a rise in the number of women working outside the home. Approximately 60 percent of the children under 6 in Beaver County have both parents in the Beaver County labor force.

Construction Permits

The value of total construction permits issued in Beaver County during 2001 dropped by 35 percent. Declines in new residential building and non-residential additions/alterations/repairs produced this annual decline. New, non-residential construction actually had a slight increase during 2001.

Taxable Sales

The gross taxable sales figures reflected another economic downturn in 2001. Sales dropped by 4 percent and was the first such drop in almost ten years. Sales in the retail sector actually increased in 2001. Sales in the wholesale trade and services sector, however, declined coupled with declining capital expenditures led to this decrease in sales activity.

Wages and Income

Wages in Beaver County are relatively low, with an average monthly wage of $1,742. Beaver County ranks in the bottom third of Utah's counties. The county's average wage measured only 70 percent of the state average. This was a significant decrease from 1989 when wages were 82 percent of the state average. On a positive note, in 2001 average wages increased by more than 3 percent, just slightly ahead of inflation.

Transportation/communications/utilities are the highest-paying industry in Beaver County. Trade showed the lowest average wage because many trade jobs are part-time and low-paying.

Median family income figures in Beaver County rank well below state and national averages. In terms of per capita personal income, Beaver County ranks in the lower half of counties in the state. On a positive note, however, only 8 percent of the county population is counted among those in poverty. This is lower than both state and national averages.

Land Use

A variety of land uses are represented in Beaver County. The major land uses in Beaver County are indicative of the ownership by federal and state governments. The Bureau of Land Management (BLM) areas are used primarily for grazing, mining, recreation, and open space. Most of the forested areas in the county are contained in National Forest boundaries. The National Forest lands have multiple uses which include recreation, timber cultivation and harvest, grazing, wildlife habitat, and watersheds. Privately owned lands, which account for the smallest percentage of the total land are in Beaver County, are given to the most diverse uses.

The majority of urban land uses, including residential, commercial, industrial and public uses are located in or near the three incorporated municipalities in Beaver County: Beaver City, Milford City and the town of Minersville. Beaver City and Milford City are the County's primary centers for commerce and social activity. Beaver City is the County seat and derives a considerable portion of its income from the tourism market. Milford is a railroad and agricultural center. Minersville, and the unincorporated communities in Beaver County are primarily agricultural in character.

The Beaver County General Plan, as amended, has set goals and policies with regards to development in the County. The Land Use Element supports infill development to maintain the viability of existing developed areas. Development is encouraged to occur within tiered growth boundaries. Beaver County's policy is to encourage development close where public facilities and services are available. The General Plan also designates areas as future developing areas and those which will be provided for rural/agricultural development with appropriate land uses, at appropriate densities, and with appropriate services. The General Plan also states that the County, along with the cities and towns shall create an interlocal agreement to establish the process a process in which the County will designate areas near towns and cities as Joint Planning/Expansion Areas. The purpose of this policy is to develop plans which are consistent with those of the local entities. Beaver City, Milford City and the town of Minersville have all incorporated tier systems in their general plans in an effort to coordinate the planning efforts around their jurisdictions.

Development Activities

The following activities have occurred in beaver County during the past year. While this is not an all-inclusive listing, is indicative of the development trends occurring in Beaver County.

Schmitt Industries, whose president owns Elk Meadows Resort above Beaver, reported a net loss of $1.7 million, or 69 cents per share, for the quarter ending Feb. 28. Oregon based Schmitt makes sensitive measuring devices. Elk Meadow was unable to open this year as company President Wayne Case struggled to secure financing for the planned construction of a base village for the resort. Salt Lake Tribune, 04/15/03

Circle Four Farms announced plans to build a $20 million "waste to energy" facility that will convert swine manure into cleaner burning biodiesel fuel. If successful, Circle Four will solve about half its waste disposal problems, create more jobs in rural Utah, make more money, help clean the air and reduce the nation's dependence on foreign oil. Salt Lake Tribune, 02/23/03

The Milford Valley Memorial Hospital board decided to close the facility on February 28 after determining the debt by then would be too steep. However, the county and the special service district, which collects tax money for the hospital, plan to keep the 34bed facility open. Whatever happens, Nephi based Rural Health Management Corp. will soon cease to operate the hospital. Salt Lake Tribune 1/10/03

The decision has been made to not open Elk Meadows Resort for downhill skiing for the 2002-03 season. The lifts, grooming, half pipe and ski patrol will not be provided. The resort had to layoff most of Elk Meadows limited staff in late October citing a lack of financing to support winter operations. Salt Lake Tribune, 12/20/02

Circle Four Farms plans to build a massive new state-of-the-art waste treatment plant. The plant would process tens of millions of gallons of feces and urine excreted in the annual production of 1 million farms in Beaver and Iron counties. The "digester" would convert much of the waste into methane gas and methanol providing an additional source of income. The new process could reduce the risk of pollution and improve the air for residents living downwind from the hog farms. Salt Lake Tribune, 12/02/02

A Comfort Inn hotel recently opened in Beaver. The hotel feature 46 rooms, as well as a meeting room that can accommodate up 40 people, heated indoor pool and hot tub, exercise facility and breakfast area. Deseret News, 11/05/02

Beaver County has given conceptual approval to an additional 3,245 units at Elk Meadows Ski Resort. The resort is trying to secure funding for the linchpin of that proposed development of a 126 room, condo-style hotel known as The Inn at Mt. Holly. Salt Lake Tribune, 11/03/02

The construction crews building part of "Spread 5," Kearn River's 1.2 billion pipeline, 15 miles west of Beaver City have brought a boom of economic activity to Beaver County's businesses, especially restaurants and motels. About 420 workers, plus 40 inspectors are involved this "spread." Salt Lake Tribune, 11/2/02

Rural Utah counties preparing budgets for next year may face cutbacks in federal PILT funds. Since 1977, the federal government has provided "payment in lieu of taxes" funds to counties with large tracts of nontaxable federal land. The federal budget for 2003 has yet to be approved, and President Bush wants to cut PILT money by 23.5 percent. Utah is fifth in the nation in PILT funding, behind California. In 2002, Utah received more than $16 million. Deseret News, 10/15/02

Utah ranchers, hit hard by drought, will soon receive millions of dollars in immediate federal aid. The U.S. Department of Agriculture announced it would release $752 million in cash to relieve drought-stricken livestock in 37 states. Utah is one of seven states that has declared a statewide drought disaster, and therefore, will qualify for a large share of the money. Salt Lake Tribune, 09/20/02

Beaver County officially took control of the former Minersville Reservoir State Park as a result of the Legislature's effort to save $500,000 by shedding several smaller parks from the state's parks and recreation system. Salt Lake Tribune, 07/2/02

Critical Facilities of Beaver County

A listing of the Critical Facilities of Beaver County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 16 below:

Table 16 Critical Facilities of Beaver County

Name or Description of Asset **Beaver City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Beaver City Hospital	Beaver City	X	X		X		n/a	$8,000,000	
Beaver City Downtown Fire Station	Beaver City	X					n/a	$ 250,000	
Beaver SSD Fire Station	FCAOG CED Div.	X					7,200	$300,000	
North Creek Water Tank	Beaver City	X					n/a	$250,000	
Golf Course Water Tank	Beaver City	X					n/a	$250,000	
Bakers Canyon Water Tank	Beaver City	X					n/a	$150,000	
Jackson County Water Tank	Beaver City	X					n/a	$150,000	
Beaver Sewer Lagoons	Beaver City	X			X		n/a	$3,000,000	
Upper Canyon Hydroelectric Plant	Beaver City	X					n/a	$2,000,000	
Middle Canyon Hydroelectric Plant	Beaver City	X					n/a	$1,000,000	
Golf Course Hydroelectric Plant	Beaver City	X					n/a	$1,000,000	
Beaver Municipal Airport Facilities (Not Including runways)	Beaver City	X		X	X		n/a	$ unknown	

Name or Description of Asset **Milford City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Consideration**	**Historic/Other Consideration**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Milford Valley Memorial Hospital	Special Service District	X					n/a	$unknown	
Milford City Fire Station	Milford City	X					2,700	$179,300	
City Hall/Incl. Sheriff's Office	Milford City	X					14,671	$1,066,860	
Water Tank	Milford City	X					1.9MG	$719,670	
Milford Airport Facilities (Not including runways)	Milford City			X			4,323	$195,550	
Milford Sewer Lagoons (Equipment Only)	Milford City	X					N/A	$35,000	
Milford High School	Beaver County School District	X					7,2187	$8,600,000	

Name or Description of Asset **Minersville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Consideration**	**Historic/Other Consideration**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Minersville Town Office		X						$	
Minersville Water Tank		X						$	
Minersville Senior Citizens Center	FCAOG CED Division	X					2,200 sq. ft.	$150,000	
Minersville Medical Clinic	Special Service District	X						$	
Minersville Fire Station	FCAOG Consolidated Plan	X					900 sq. ft.	$94,500	
Water Tank		X						$	
Water Tank		X						$	
Sewer Lagoons		X						$	
Minersville K-8 School		X	X				42,000 sq. ft.	$	

Analysis of the Infrastructure of Beaver County

A listing of the Infrastructure of Beaver County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 17 below:

Table 17 Critical Infrastructure of Beaver County

Name of Town **BEAVER**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Hazard Costs in Millions**
# of Dams (High Hazard)	5	0	5	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	54	14	40	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	155.96	2.61	150.46	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	62.76	0	62.76	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	2.51	145.76	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	48.46	0	48.46	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	.01	.01	0											
Land Slides (sq miles)	49.53	0	49.53											
Problem Soils (sq miles)	88.53	0	88.53											
Volcanic Flows (sq miles)	37.04	0	37.04											
Wildfires (sq miles)	1104.8	0	1104.01											

Name of Town **MILFORD**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	5	0	5	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	54	0	40	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	155.96	1.97	150.46	0	0	0	0	0	0	0	0	.03	0	0
Railways (miles)	62.76	0	62.76	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	0	145.76	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	48.46	0	48.46	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	.01	0	0											
Land Slides (sq miles)	49.53	0	49.53											
Problem Soils (sq miles)	88.53	0	88.53											
Volcanic Flows (sq miles)	37.04	0	37.04											
Wildfires (sq miles)	1104.8	.79	1104.01											

Name of Town **MINERSVILLE**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	5	0	5	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	54	0	40	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	155.96	.92	150.46	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	62.76	0	62.76	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	0	145.76	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	48.46	0	48.46	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	.01	0	0											
Land Slides (sq miles)	49.53	0	49.53											
Problem Soils (sq miles)	88.53	0	88.53											
Volcanic Flows (sq miles)	37.04	00	37.04											
Wildfires (sq miles)	1104.8	.01	1104.01											

Unincorporated Areas of County	County Total	Towns Total	Unincorporated	FloodZone Unincorporated	Flood Zone Costs in Millions $	LandSlide Unincorporated	Land Slide Costs in Millions $	ProblemSoil Unincorporated	Problem Soil Costs in Millions $	VolcanicFlow Unincorporated	Volcanic Flow Costs in Millions $	Wildfire Unincorporated	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards
# of Dams (High Hazard)	5	0	5	0	0	1	0	0	0	0	0	6	0	0
# of Highway Bridges	54	0	40	0	0	3	15	0	0	0	0	12	0	15
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	155.96	.92	150.46	0	0	6.03	24	1.40	6	1.08	4	60	0	34
Railways (miles)	62.76	0	62.76	0	0	0	0	0	0	0	0	4.36	0	0
Utility Lines (miles)	148.27	0	145.76	0	0	8.98	.45	0	0	5.96	.23	85.8	4.29	4.97
Other Utility Lines (miles)	48.46	0	48.46	0	0	.36	.018	0	0	0	0	.73	.365	.545
HAZARDS														
Flood Zones (sq miles)	.01	0	0											
Land Slides (sq miles)	49.53	0	49.53											
Problem Soils (sq miles)	88.53	0	88.53											
Volcanic Flows (sq miles)	37.04	00	37.04											
Wildfires (sq miles)	1104.8	0	1104.01											

Wildfire

FEMA Hazard Profile
Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to structures in incorporated communities and Moderate to High to structures in unincorporated Beaver County.
Duration: Containment time varies for each fire.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire. See Table 18 below for an analysis of wildfire risk in Beaver County.

In unincorporated Beaver County there are 81 residential structures at moderate risk from wildfire. Based upon figures provided by the Beaver County Assessors Office, the market value of those structures is estimated to be $5,414,283. There are approximately 30 residential structures at high risk from wildfire. Based upon figures provided by the Beaver County Assessors Office, the market value of those structures is estimated to be $2,004,390. There are 2 commercial structures in unincorporated Beaver County in a moderate risk area with an estimated market value of $790,645.

Based upon the average household size of 2.93 persons, in unincorporated Beaver County, from the 2000 U.S. Census, there are approximately 325 persons at risk from wildfire. This is 25.33% of the 1,283 population of unincorporated Beaver County.

In Milford City there is one residential structure at moderate risk from wildfire. Based upon figures provided by the Beaver County Assessors Office, the market value of that structure is estimated to be $49,979. There are approximately 5 residential structures in Milford City at high risk from wildfire. Based upon figures provided by the Beaver County Assessors Office, the market value of those structures is estimated to be $197,605. Based upon the average household size of 2.95 persons, in Milford City, from the 2000 U.S. Census, there are approximately 15 persons at risk from wildfire. This is 1.03% of the 1,451 population of Milford City.

Number of People and Buildings/Structures Impacted by Wildfire

Table 18 Analysis of Wildfire Risk in Beaver County

Beaver City - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	902	0	0%	$62,438,492	$0	0%	2,454	0	0%
Commercial	131	0	0%	$19,143,467	$0	0%	N/A	N/A	N/A
Total	1033	0	0%	$ 81,581,959	$0	0%	2,454	0	0%

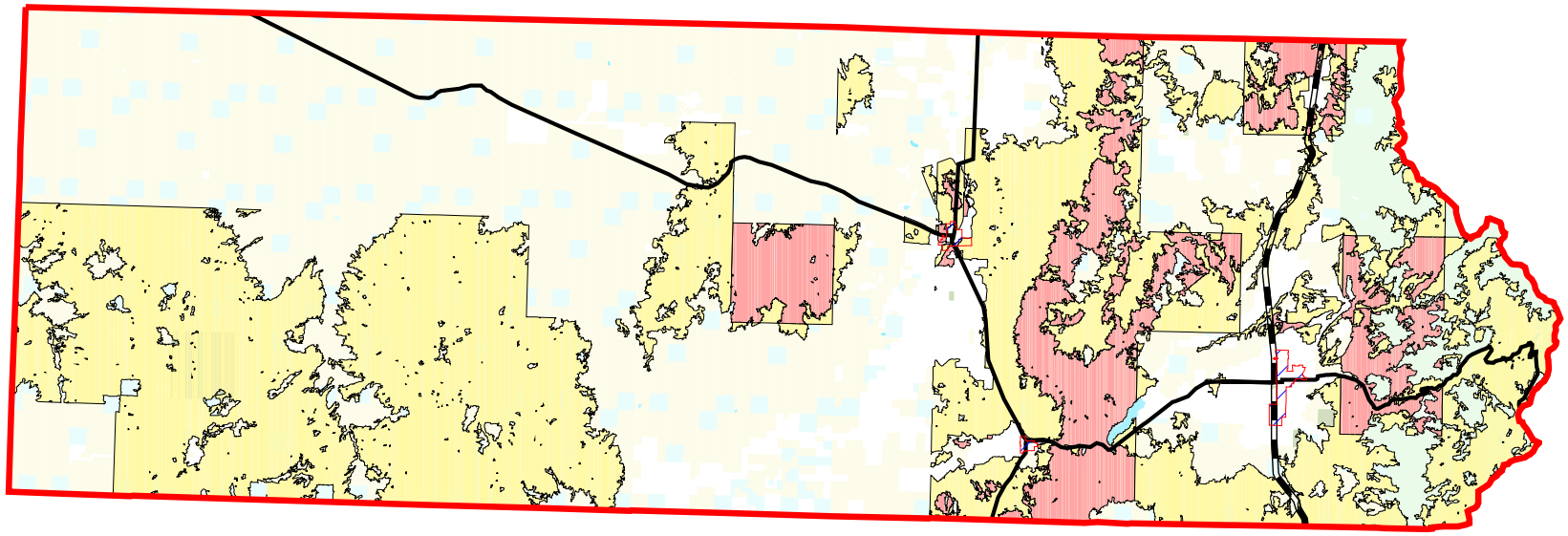
Milford City – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	527	5	0.94%	$26,339,047	$247,584	0.94%	1,451	15	1.03%
Commercial	51	0	0%	$13,161,122	$0	0%	N/A	N/A	N/A
Total	578	5	0.86%	$39,500,169	$247,584	0.62%	1,451	15	1.03%

Minersville Town - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	269	0	0%	$16,661,010	$0	0%	817	0	0%
Commercial	12	0	0%	$824,648	$0	0%	N/A	N/A	N/A
Total	281	0	0%	$17,485,658	$0	0%	817	0	0%

Unincorporated Beaver County areas - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	764	111	14.52%	$51,068,106	$7,415,088	14.52%	1,283	325	25.33%
Commercial	20	2	10.00%	$2,343,392	$790,645	33.73%	N/A	N/A	N/A
Total	784	113	14.41%	$72,097,792	$8,205,733	11.38%	1,283	325	25.33%

Beaver County

Wildfire Map



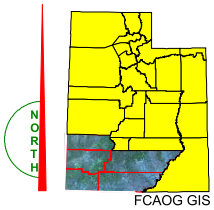
8 0 8 16 24 Miles

County Boundary
Town Boundary
Major Roads
I-15
State Route

Fire Danger Categories W/ sq. miles

Extreme	.02
High	203.64
Moderate	901.14

* Note: Administrative Ownership is the background layer



Five County Association of Governments July 2003 Ed Dickie

FCAOG GIS uses information & data from many different sources, which may be of differing accuracy and which have been integrated to provide a planning context. These products should be used only for the purpose they were intended. For specific data source information, please contact FCAOG GIS.

435-673-3548 email edickie@fcaog.state.ut.us

Landslide

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified and mapped residential and commercial structures at potential risk from landslide. See Table 19 below for an analysis of landslide risk in Beaver County.

In unincorporated Beaver County there are approximately 12 residential structures in the Elk Meadows 12 residential structures in the Elk Meadows area at potential risk from landslide. Based upon figures provided by the Beaver County Assessors Office, the market value of those structures is estimated to be $1,222,474.

Based upon the average household size of 2.93 persons, in Beaver County, from the 2000 U.S. Census, there are approximately 35 persons at risk from landslide.

Number of People and Buildings/Structures Impacted by Landslide

Table 19 Analysis of Landslide Risk in Beaver County

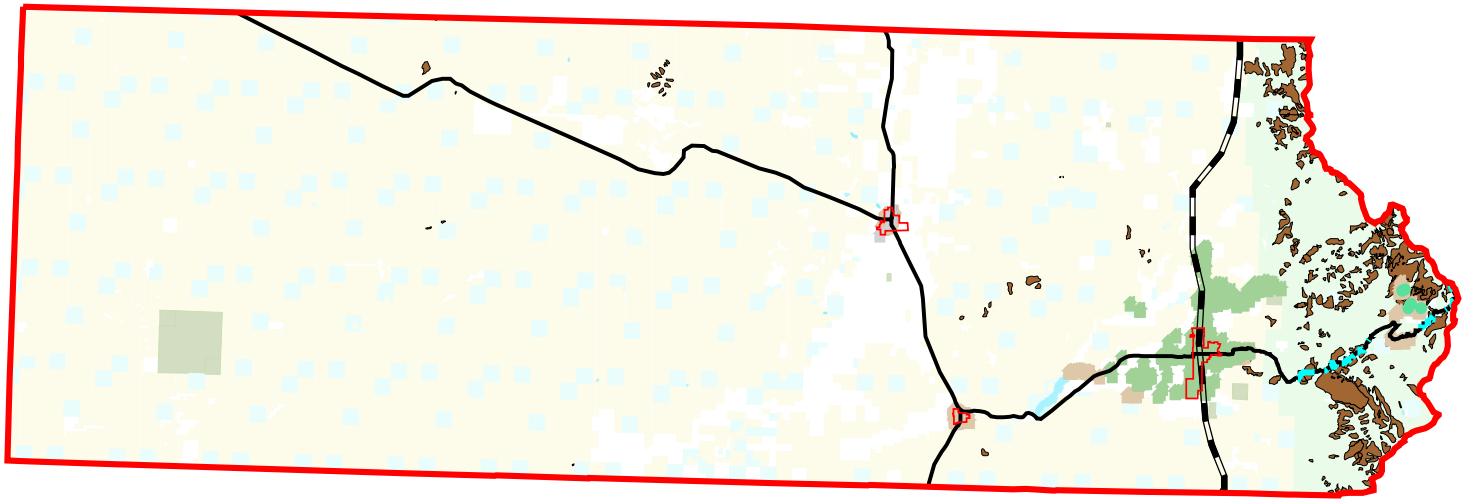
Beaver City – Problem Soils/Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	902	0	0%	$62,438,492	$0	0%	2,454	0	0%
Commercial	131	0	0%	$19,143,467	$0	0%	N/A	N/A	N/A
Total	1033	0	0%	$ 81,581,959	$0	0%	2,454	0	0%

Milford City – Problem Soils/Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	527	0	0%	$26,339,047	$0	0%	1,451	0	0%
Commercial	51	0	0%	$13,161,122	$0	0%	N/A	N/A	N/A
Total	578	0	0%	$39,500,169	$0	0%	1,451	0	0%

Minersville Town - Problem Soils/Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	269	0	0%	$16,661,010	$0	0%	817	0	0%
Commercial	12	0	0%	$824,648	$0	0%	N/A	N/A	N/A
Total	281	0	0%	$17,485,658	$ 0	0%	817	0	0%

Unincorporated Beaver County areas – Problem Soils/Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	764	12	1.57%	$69,754,400	$1,070,400	1.53%	1,283	35	2.73%
Commercial	20	2	10%	$2,343,392	$790,645	33.74%	N/A	N/A	N/A
Total	784	14	1.79%	$72,097,792	$1,861,045	2.58%	1,283	35	2.73%

Beaver County
Landslide Map

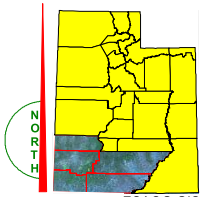


10 0 10 20 Miles

Beaver County Boundary
Towns
Landslides

Major Roads
County Road
Interstate
State Route

* Note: Administrative Ownership is the background layer



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Five County Association of Governments August 2003 Ed Dickie

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Earthquake

HAZUS MH Earthquake Vulnerability Assessment for Beaver County

See Table 20 below for an estimate of earthquake casualties.

Table 20 Earthquake Casualties Risk in Beaver County

Casualties	Nighttime –Minor	48
	Nighttime –Major	1
	Nighttime -Fatalities	2
	Daytime –Minor	45
	Daytime –Major	1
	Daytime- Fatalities	3
	Commute –Minor	40
	Commute –Major	1
	Commute-Fatalities	2

Number of People and Buildings/Structures Impacted by Earthquake

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 21 below lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage in Beaver County.

Table 21 Building Damage from Moderate to Complete by Count

Category	Number of Structures	Total Cost in millions of dollars **
Residential	198	51.86
Commercial	5	8.74
Industrial	0	0.94
Totals	1,081*	63.00**

*Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Table 22 Damage to Critical facilities from Moderate to Complete

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	1	0	0
Schools	5	2	0	0
EOCs	0	0	0	0
Police Stations	2	2	0	0
Fire Stations	1	0	0	1

Debris Removal –Table 23 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 23 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	41
Loads (25 tons per load)	1,640

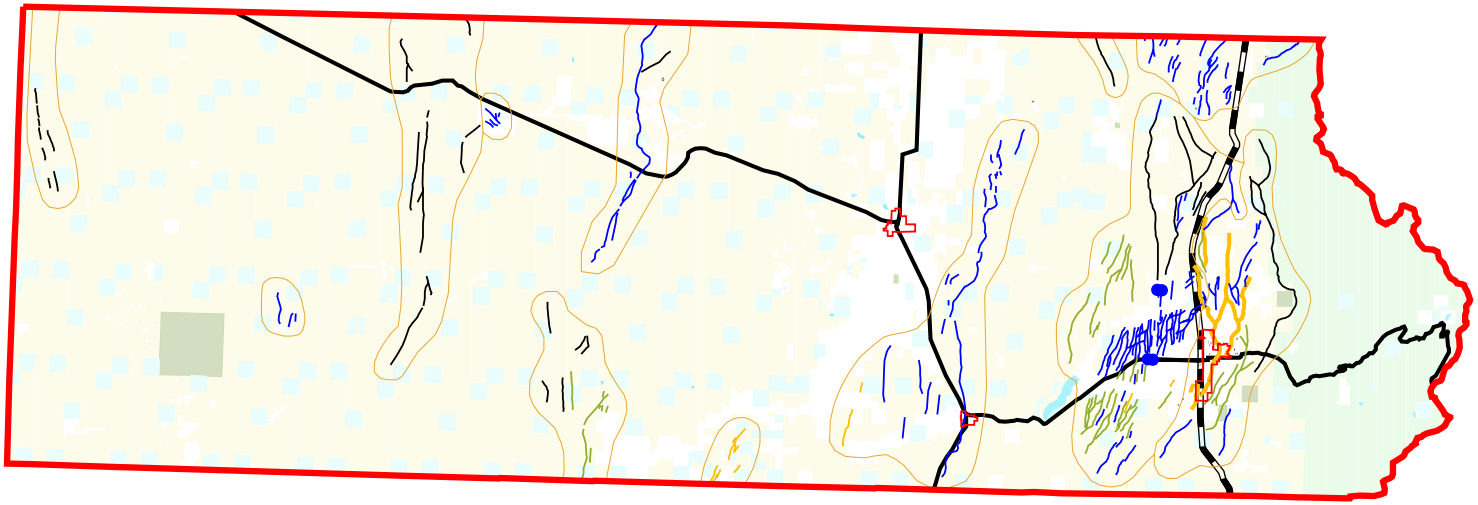
Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 24 below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 24 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete HAZUS MH run performed by the Utah Division of Emergency Services and Homeland Security is available at the Five County Association of Governments.

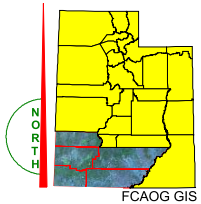
Beaver County
Earthquake Map



6 0 6 12 18 Miles

County Boundaries
Towns
Major Roads
I-15
State Route
US Route
Fault Groups
Folds
Fault Lines
123 = Latest Quaternary (<15,000 years)
124 = Latest Quaternary (<15,000 years)
133 = Late Quaternary (<130,000 years)
134 = Late Quaternary (<130,000 years)
144 = Mid to Late Quaternary (<750,000 years)
154 = Quaternary (<1,600,000 years)

* Note: Administrative Ownership is the background layer



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Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

Based upon review of available data, in Beaver City there are two residential structures located in a Floodplain (A Zone). Based upon an average value of residential structures in Beaver County, the market value of those two structures is approximately $138,752. Based an average household size (U.S. Census Bureau, Census 2000) of 2.84 per household, there are approximately 6 persons at risk from floodplains. See Table 25 below for an analysis of flood risk in Beaver County.

Number of People and Buildings/Structures Impacted by Floodplains

Table 25 Analysis of Flood Risk in Beaver County

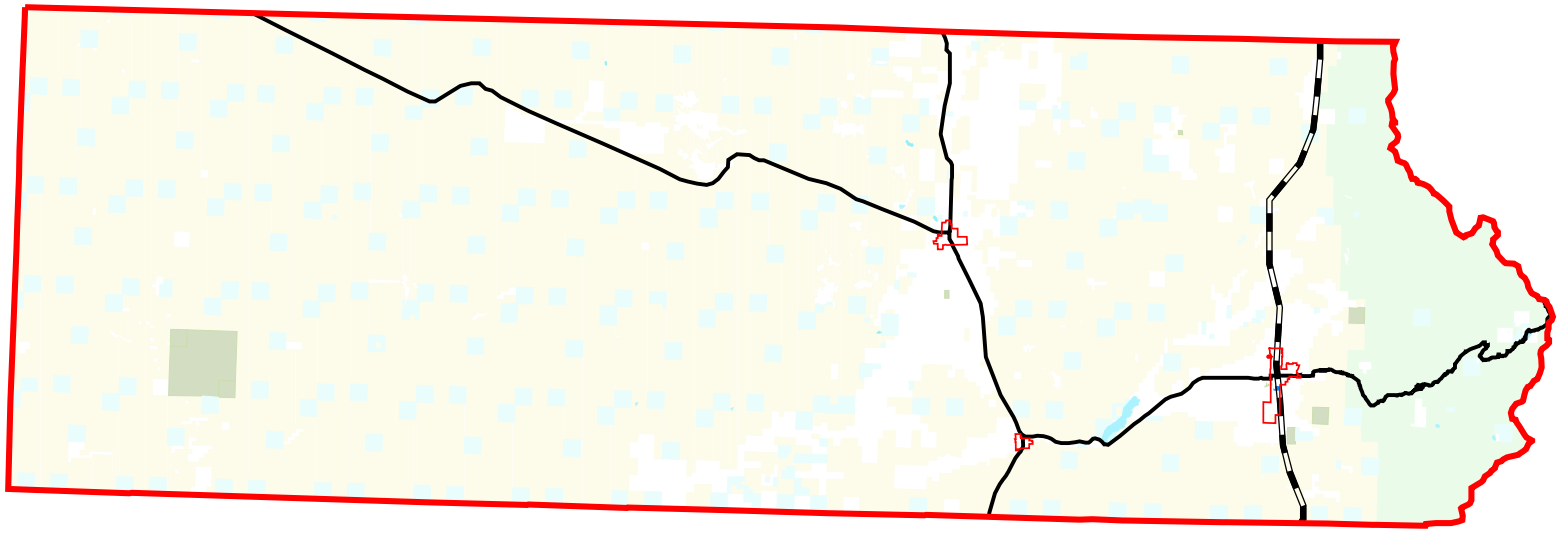
Beaver City – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	902	2	0.22 %	$62,438,492	$138,752	0.22%	2,454	6	0.24%
Commercial	131	0	0%	$19,143,467	$0	0%	N/A	N/A	N/A
Total	1033	2	0.19 %	$ 81,581,959	$138,752	0.17%	2,454	6	0.24%

Milford City – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	527	0	0%	$26,339,047	$0	0%	1,451	0	0%
Commercial	51	0	0%	$13,161,122	$0	0%	N/A	N/A	N/A
Total	578	0	0%	$39,500,169	$0	0%	1,451	0	0%

Minersville Town - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	269	0	0%	$16,661,010	$0	0%	817	0	0%
Commercial	12	0	0%	$824,648	$0	0%	N/A	N/A	N/A
Total	281	0	0%	$17,485,658	$ 0	0%	817	0	0%

Unincorporated Beaver County areas – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	764	0	0%	$69,754,400	$0	0%	1,283	0	0%
Commercial	20	0	0%	$2,343,392	$0	0%	N/A	N/A	N/A
Total	784	0	0%	$72,097,792	$0	0%	1,283	0	0%

Beaver County
Floodzone Map



10 0 10 20 Miles

County Boundary

Towns

Major Roads

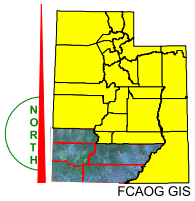
County Road

Interstate

State Route

Floodzone A (Digitized from FEMA Floodzone Maps)

* Note: Administrative Ownership is the background layer



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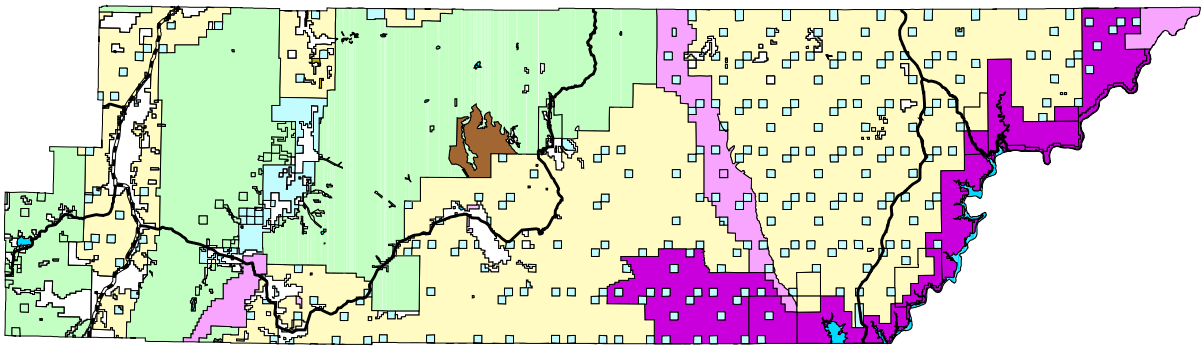
Garfield County



History

After the occupation of Central Mexico by Spaniards in 1514, several exploratory trips were made to the north. Marco de Niza, accompanied by three priests and others, made a successful trip and returned to interest Coronado - then President of New Spain - in this area. He then dispatched expeditions into this and surrounding regions.

Garcia Lopez de Gardenas was undoubtedly the first man to see any part of the Colorado Canyon. Many expeditions followed; and on July 29, 1776, a party headed by Silvestre Valdez Escalante made a memorable trip. From the descriptions, left by that party, their route is easily traced. Their records give the first information about the part of Garfield County near Cannonville, Boulder, and Escalante. On September 26th, they reached the Colorado River; and after 12 days' search, a point was found where a crossing was made. This spot has since been known as "The Crossing of the Fathers".

So far as is known, Father Escalante was the first white man to traverse Southern Utah and the only explorer to enter Glen Canyon before Powell's memorable trip nearly a century later. Major J. W. Powell, a scientific explorer, was engaged by the Smithsonian Institute in 1867-69 to explore Western Colorado and Eastern Utah; and due to his several expeditions, we have much geographical knowledge of this area.

Thompson, one of Powell's associates, describes eastern Garfield County with this statement: "A large portion of this area is naked sandstone rock, traversed in all directions by perfect labyrinth of narrow gorges, sometimes seeming to cross each other, but finally uniting in a principal one....the Colorado."

In 1870 Southeastern Utah, comprising about a quarter of the state, was unknown land. Powell had marked the course of the Colorado, but found no feasible route leading from it except those already known. Explorations by scouts of the Mormon Church had resulted in locating small tracts of irrigatable land at the east base of the high plateaus, along the Paria River, and at places south of the Colorado Canyons. Paria was founded in 1871; Cannonville and Escalante in 1875. Paria (Pah-water, reah-deer) on the Paria River is the oldest settlement in South Central Utah. Paria, Adairville, Rockhouse, Georgetown and Clifton have been abandoned because of the scarcity of water and the destruction by floods. Only three county communities exist in this area today - Cannonville, Tropic and Henrieville.

The Mormon expeditions played an important role in the exploration and settling of this area, and a study of Church records tell of early settlers and their experiences here. Most notable is the trek of a group of 200 men, women and 50 children, with 200 horses and 1,000 cattle, who left Iron County and crossed Garfield County. This expedition was in search of a shorter route to San Juan County. After reaching the rim of the canyon of the Colorado River, one of Utah's greatest pioneering feats was accomplished. Rocks were blasted away, wagons, and cattle and pioneers laboriously made their way to the bottom of the Colorado, where the river crossing was made in February. Even today, to view the "Hole in the Rock" where the crossing was made, makes one realize that this feat would seem an utter impossibility.

In 1880, another site to cross the Colorado was located to satisfy the need for a more convenient crossing of the river. The spot selected is known as Hite. For many years a ferry was operated there. A bridge now connects the roads on each side of the Colorado River. About 50 miles downstream from Hite a ferry crosses the river to connect Garfield and San Juan Counties.

Garfield county is an area fabulously wealthy in scenic beauty, providing the nature lover, explorer, geologist, prospector, and historian with a great challenge to read and understand the character of mother nature.

The largest employer in Garfield County include hotel and lodging places of Ruby's Inn incorporated. Governmental agencies including the Garfield County School District, Garfield County, Garfield Memorial Hospital, the Motor Vehicle Division, and the National Park Service are also among the major employers.

Private land ownership in Garfield is small as a percentage of total land in the County. See table 26 below:

Table 26 Garfield County Land Ownership

Land Ownership:	Acres	County Percentage
BLM	1,450,391	43.0
Forest Service	1,045,974	31.0
National Park Service	434,147	12.9
Bureau of Reclamation	39,007	1.1
Utah State Trust Lands	269,614	8.0
Private Lands	133,584	4.0
Totals	3,372,717	100

Panguitch, the Garfield County seat is centrally located to many National Parks and metropolitan areas in the West.

Denver, Colorado - 516
Grand Canyon North Rim - 145
Grand Canyon South Rim - 280
Helena, Montana - 719
Jackson, Wyoming - 511
Las Vegas, Nevada - 234
Monument Valley - 369
Page, Arizona - 139
St. George, Utah - 115
Salt Lake City, Utah - 236
Yellowstone National Park - 531
Zion National Park - 73

The average temperature in January is 24º F, and the average July Temperature is 66º F. Annual Average Precipitation is 10.3".

Development Trends

The national recession and the aftereffects of September 11, 2001 took a definite swipe at Garfield County's tourism-dependent economy during late 2001 and 2002. Jobs took a hit and correspondingly, unemployment rates hitched up a notch. Other economic indicators

fared poorly, too. Construction values dropped and gross taxable sales showed the first decrease in more than a decade.

Population

After experiencing net out-migration in the 1950s and 1960s, Garfield County has typically shown population growth rates hovering between the state and national averages. In the most current decade, Garfield County's population grew 19 percent—a rate lower than more than half of Utah's counties. Still, Garfield County population growth outpaced the national 13-percent growth rate. However, population estimates for 2001 alone suggest that Garfield County once again experienced out-migration.

In the 1990s, Garfield County population grew fastest in Antimony. Escalante showed not net change in population while Henrieville lost a few residents. Panguitch added the highest number of new residents between 1990 and 2000. However, most population growth occurred outside the major townships.

Demographics

One of the more noticeable changes over the past decade was the increase in Garfield County's Hispanic population. In 1990, 1.5 percent of the county's population was Hispanic. By 2000, that share had increased to 2.3 percent. Still, Garfield County remains much less racially and ethnically diverse than the state and the nation. Only 6 percent of the county's population is nonwhite or Hispanic compared to 31 percent nationally and 15 percent in Utah. Over the past 10 years, Garfield County retained its larger-than-average share of the population. The county's share of "seniors" (14 percent) measures substantially above both the Utah (9 percent) and U.S. (12 percent) shares. On the other hand, Garfield County still shows a higher percentage of the population under the age of 18 than does the nation. This population distribution means Garfield County has a small proportion of working-age adults "supporting" its seniors and children. Only 53 percent of the county's population was between the ages of 18 and 65 compared to 62 percent nationally.

Over the last decade, household size decreased slightly from an average of 3.00 persons to 2.92 persons. Nevertheless, Garfield County families are more likely than Utah or U.S. families to be headed by a married couple. Female-headed families with children also make up a smaller share of Garfield County families than in the state or the nation.

In terms of 2000 educational attainment, 86 percent of the county's adults (over 25 years of age) have graduated from high school—an improvement from 1990, but still below the state average. Not surprisingly for a nonurban area, Garfield County also showed a smaller share of college graduates than the state and nation. Nevertheless, 20 percent of the county's adults have at least a college degree—a higher-than average rate for a nonurban county.

The Labor Market

In 2001, Garfield County saw its job totals drop by 1.6 percent. Job growth boomed in 1999 only to face a bust in the wake of recession and decreased travel after the events in September 11, 2001. Both Utah and the United States were still experiencing job growth during 2001. Garfield County typically follows the trend of Utah and U.S. job growth—with higher peaks and lower valleys. However, not every industry suffered job losses. In fact, construction and transportation/communications/utilities employment showed healthy improvements. Even trade and government showed some expansion.

Yet during 2001, Garfield County experienced a net decrease of roughly 30 jobs. Declines in services industry employment, which includes hotels and motels, was the primary impetus behind Garfield County's overall employment decline. The job losses did take their toll in a decidedly higher unemployment rate. During 2001, Garfield County's unemployment rate reached 9.2 percent - the highest level in six years. Because of the seasonal nature of Garfield County's economy which leaves many workers unemployed during the "off season," Garfield County's jobless rate remains perennially high. During 2001, Garfield County showed the second highest jobless rate in the state.

Data from Census 2000 shows that Garfield County's labor force participation increased during the 1990s. This change was probably due to a rise in the proportion of women who work outside the home. Mothers are certainly working more. Almost 70 percent of children under six in Garfield County have both parents in the labor force.

Wages and Income

As in many non-urban areas, wages in Garfield County are relatively low. With an average monthly wage of $1,575 in 2001, Garfield County ranks in the bottom fourth of Utah's counties. The county's average wage measured only 64 percent of the state average. And, this figure has trended downward since the late 80s when Garfield County's average wage measured 74 percent of the state average. Moreover, in 2001, wages increased by less than 2 percent— not even enough to keep up with sluggish inflation.

Mining is the highest-paying industry in the county—but this industry employs very few workers. In comparison with statewide industries, mining, transportation/communications/utilities and government workers' wages most closely approximate their Utah counterparts. This industry typically pays between 80 and 85 percent of the state average. Trade showed the lowest average wage because many trade jobs are part-time and low-pay. Measures of income (which includes interest income, rental income, business income, government payments such as Social Security and welfare, as well as wages) show a similar picture. Median family income ($40,200) ranks well below state ($51,000) and national ($50,000) averages. And in terms of per capita personal income, Garfield County again ranks in the bottom fourth of the state. Yet, surprisingly, only 8 percent of Garfield County's population is considered to be living in poverty—lower than both state and national averages. The poverty rate dropped dramatically from 15 percent in 1990 to only 8 percent in 2001.

Other indicators

Construction values took a nosedive during 2001 dropping 43 percent when compared to 2000. Every construction category showed a drop with home building dropping by almost one fifth. However, commercial/nonresidential building slowdown proved most dramatic with an 87-percent decrease.

The gross taxable sales figures added to the sense of economic malaise. In comparison to 2000, sales in 2001 dropped by 9 percent—the first decline in more than a decade. This decline wasn't focused in just one area. Nearly all sales categories showed marked sales declines.

Conclusions

All in all, recession and September 11, 2001 took a bite out of Garfield County's economy. Jobs dropped, unemployment went up, construction slowed and sales dropped. However,

preliminary indicators suggest that better years ahead for tourism in Utah than in many areas which should translate to a healthier Garfield County economy.

Critical Facilities of Garfield County

A listing of the Critical Facilities of Garfield County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 27 below:

Table 27 Critical Facilities of Garfield County

Name or Description of Asset **Antimony Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Antimony Fire Station	Town	X					data unavail.	$unknown	
Antimony School	Garfield County School District	X					2,767 sq. ft.	$249,638	
Water Tank	Town	X					data unavail.	$unknown	

Name or Description of Asset **Boulder Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Boulder Fire Station	Boulder Town	X					data unavail.	$unknown	
Boulder School	Boulder Town	X					data unavail.	$unknown	
Boulder Town Hall	Boulder Town	X					data unavail.	$unknown	
Water Tank	Boulder Town	X					data unavail.	$unknown	

Name or Description of Asset **Cannonville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Cannonville Town Office/ Medical Clinic		X					data unavail.	$unknown	

Name or Description of Asset **Escalante City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Escalante Clinic	Escalante City	X	X		X		1,620 sq. ft.	$75,000	
Escalante Fire Station	Escalante City	X					2,800 sq. ft.	$ 200,000	
Escalante Police Station/Library	Escalante City	X					4,900 sq. ft.	$75,000	
Escalante Community Center	Escalante City	X					7,400 sq. ft.	$100,000	
Escalante City Office	Escalante City	X					6,650 sq. ft.	$100,000	
Escalante High School	Escalante City	X					42,000 sq. ft.	$3,897,600	
Airport (Not including runways)	Escalante City	X					2,000 sq. ft.	$75,000	
Water Tank	Escalante City	X					1MG	$750,000	Problem Soils

Name or Description of Asset **Hatch Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Hatch Fire Station	Hatch Town	X					data not avail.	$unknown	
Hatch Town Hall	Hatch Town	X					data not avail.	$unknown	
Water Tank	Hatch Town	X					250,000 gallons	$unknown	

Name or Description of Asset **Henrieville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Henrieville Fire Station	FCAOG Consolidated Plan	X					4,800 sq. ft.	$480,000	
Henrieville		X					data	$unknown	

Town Hall							unavail.		
Water Tank		X					data unavail.	$unknown	

Name or Description of Asset **Panguitch City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Garfield Memorial Hospital	Garfield Memorial Hospital (IHC)	X	X		X		34,118 sq. ft.	$9,000,000	
Panguitch Fire Station	Panguitch City	X					13,200 sq. ft.	$ 550,000	
Panguicth High School	Garfield County School District	X					58,000 sq. ft.	$5,382,400	
Panguitch Airport (Including runways)	Panguitch City	X		X			n/a	$2,500,000	
Water Tank	Panguitch City	X					0.5MG	$400,000	
Water Tank	Panguitch City	X					0.5MG	$400,000	
Water Tank	Panguitch City	X					0.5MG	$400,000	
Panguitch Sewer Lagoons (including pump station)	Panguitch City	X					450 sq. ft. pump station	$2,500,000	
Television Translator	Panguitch City	X					300 sq. ft.	$100,000	
County Courthouse	Garfield County	X				X	not avail.	$unknown	
County Road Shed	Garfield County	X					not. Avail.	$unknown	

Name or Description of Asset **Tropic Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Tropic Fire Station/Town Hall	Tropic Town	X					4,800 sq. ft.	$ 480,530	Floodplain, Soils
Bryce Valley High School	Tropic Town	X					53,000 sq. ft.	$4,918,400	Soils
Water Tank	Tropic Town	X						$ Value not avail. - not insured	Floodplain, Soils
Water Tank	Tropic Town	X						$ Value not avail. - not insured	Floodplain, Soils

Tropic Sewer Lagoons		X			X			$ unknown - not insured	Floodplain

Analysis of Infrastructure in Garfield County

A listing of the Infrastructure of Garfield County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 28 below

Table 28 Critical Infrastructure of Garfield County

Name of Town **Panguitch**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	1	52	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	2.19	231.84	.12	.50	0	0	0	0	0	0	0	0	.50
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	.76	196.58	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	46.57	.27	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	2.94	1041.9											
Volcanic Flows (sq miles)	32.86	0	32.86											
Wildfires (sq miles)	1448.38	.11	1422.3											

Name of Town **Antimony**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	2	52	0	0	0	0	0	0	0	0	1	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	2.06	231.84	0	0	0	0	0	0	0	0	1.64	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	4.43	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	0	196.58	.17	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	46.57	.07	35.96											
Land Slides (sq miles)	415.62	.28	415.26											
Problem Soils (sq miles)	1045.20	0	1041.9											
Volcanic Flows (sq miles)	32.86	0	32.86											
Wildfires (sq miles)	1448.38	6.73	1422.3											

Name of Town **Boulder**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	0	52	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	9.10	231.84	0	0	0	0	0	0	0	0	4.32	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	1.36	196.58	0	0	0	0	.46	.023	0	0	.91	.046	.069
HAZARDS														
Flood Zones (sq miles)	46.57	0	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	0	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	12.83	1422.3											

Name of Town **Cannonville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	0	52	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	.40	231.84	.50	2	0	0	0	0	0	0	0	0	2
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	0	196.58	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	46.57	.001	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	.01	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	.01	1422.3											

Name of Town **Escalante**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	1	52	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	1.73	231.84	0	0	0	0	0	0	0	0	.39	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	2.02	196.58	0	0	0	0	0	0	0	0	.82	.041	.041
HAZARDS														
Flood Zones (sq miles)	46.57	.26	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	.33	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	.56	1422.3											

Name of Town **Hatch**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	0	55	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	.95	231.84	.23	1	0	0	0	0	0	0	0	0	1
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	.44	196.58	.30	.015	0	0	0	0	0	0	.08	.036	.186
HAZARDS														
Flood Zones (sq miles)	46.57	.09	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	0	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	.03	1422.3											

Name of Town **Henrieville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	0	55	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	.46	231.84	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	0	196.58	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	46.57	.02	35.96											
Land Slides (sq miles)	415.62	0	415.26											
Problem Soils (sq miles)	1045.20	.02	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	0	1422.3											

Name of Town **Tropic**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Coasts in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	57	1	52	0	0	0	0	0	0	0	0	0	1	0
# of Tunnels	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	253.54	4.28	231.84	.22	0	1.15	5	1.65	7	0	0	2.56	0	13
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	203.43	2.27	196.58	.42	.021	0	0	1.02	.051	0	0	2.27	.114	.645
HAZARDS														
Flood Zones (sq miles)	46.57	.70	35.96											
Land Slides (sq miles)	415.62	.27	415.26											
Problem Soils (sq miles)	1045.20	0	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	5.85	1422.3											

Unincorporated Areas of County	**County Total**	**Towns Total**	**Unincorporated**	**FloodZone Unincorporated.**	**Flood Zone Costs in Millions $**	**LandSlide Unincorporated**	**Land Slide Costs in Millions $**	**ProblemSoil Unincorporated**	**Problem Soil Costs in Millions $**	**VolcanicFlow Unincorporated**	**Volcanic Flow Costs in Millions $**	**Wildfire Unincorporated**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	4	0	4	0	0	1	0	0	0	0	0	21	0	0
# of Highway Bridges	57	1	52	1	5	1	5	3	15	1	5	14	0	60
# of Tunnels	2	0	2	0	0	0	0	0	0	0	0	2	0	0
Major Roads (miles)	253.54	4.28	231.84	12.5	50	4	16	15.8	62	0	0	95.6	0	128
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	96.46	0	92.03	4.05	.203	1.15	.056	6.53	.327	5.96	.300	47.5	2.38	3.266
Other Utility Lines (miles)	203.43	2.27	196.58	6.62	.331	6.69	.335	9.10	.455	2.23	.112	102	5.08	6.313
HAZARDS														
Flood Zones (sq miles)	46.57	.70	35.96											
Land Slides (sq miles)	415.62	.27	415.26											
Problem Soils (sq miles)	1045.20	0	1041.9											
Volcanic Flows (sq miles)	32.86	00	32.86											
Wildfires (sq miles)	1448.38	26.11	1422.3											

Wildfire

FEMA Hazard Profile

Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to structures in incorporated communities and Moderate to High to structures in unincorporated Garfield County.
Duration: Containment time varies for each fire.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire. See Table 29 below for an analysis of wildfire risk in Garfield County.

In unincorporated Garfield County there are approximately 166 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $10,961,604. There are also 18 residential structures at high risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $1,180,855. Based upon the average household size of 2.92 persons, in unincorporated Garfield County, from the 2000 U.S. Census, there are approximately 537 persons at risk in unincorporated Garfield County from wildfire. This is 51.14% of the 1,050 population of unincorporated Garfield County.

There is one commercial structure in unincorporated Garfield County identified to be in a moderate or high risk area. Based upon figures provided by the Garfield County Assessors Office, the market value of that structure is estimated to be $128,010.

In the town of Antimony there are 16 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of that structure is estimated to be $682,744. There are approximately 47 persons (38.52% of the Town's population) at moderate risk from wildfire.

In the town of Boulder there are 7 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $408,519. There is one commercial structure in the town of

Boulder at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of that structure is estimated to be $266,342. There are approximately 19 persons (10.55% of the Town's population) at moderate risk from wildfire.

In Escalante City there are 6 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $309,846. There are approximately 16 persons (1.95% of the City's population) at moderate risk from wildfire. There are 4 residential structures at high risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $206,051. There are approximately 11 persons (1.34% of the Town's population) at high risk from wildfire.

In the town of Hatch there are 5 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of that structure is estimated to be $682,744. There are approximately 16 persons (12.59% of the Town's population) at moderate risk from wildfire.

In Panguitch City there are 4 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of that structure is estimated to be $239,772. There are approximately 12 persons (0.73% of the City's population) at moderate risk from wildfire.

In the town of Tropic there are 10 residential structures at moderate risk from wildfire. Based upon figures provided by the Garfield County Assessors Office, the market value of those structures is estimated to be $604,804. There are approximately 32 persons (6.29% of the Town's population) at moderate risk from wildfire.

Number of People and Buildings/Structures Impacted by Wildfire

Table 29 Analysis of Wildfire Risk in Garfield County

Antimony – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	77	16	20.77%	$3,285,707	$682,744	20.77%	122	47	38.52%
Commercial	3	0	0%	$627,060	$0	0%	N/A	N/A	N/A
Total	80	16	20.00%	$3,912,767	$682,744	17.44%	122	47	38.52%

Boulder – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	100	7	7.00%	$5,835,985	$408,519	7.00%	180	19	10.55%
Commercial	3	1	33.33%	$799,027	$266,342	33.33%	N/A	N/A	N/A
Total	103	8	7.76%	$6,635,012	$674,861	10.17%	180	19	10.55%

Cannonville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	67	0	0%	$3,135,106	$0	0%	148	0	0%
Commercial	2	0	0%	$646,462	$0	0%	N/A	N/A	N/A
Total	69	0	0%	$3,781,568	$0	0%	148	0	0%

Escalante - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	370	10	2.70%	$19,107,312	$515,897	2.70%	818	27	3.30%
Commercial	32	0	0%	$3,103,084	$0	0%	N/A	N/A	N/A
Total	402	10	2.48%	$22,210,396	$515,897	2.32%	818	27	3.30%

Hatch - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	84	5	5.95%	$3,672,260	$218,499	5.95%	127	16	12.59%
Commercial	12	0	0%	$1,736,934	$0	0%	N/A	N/A	N/A
Total	96	5	5.20%	$5,409,194	$218,499	4.03%	127	16	12.59%

Henrieville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	76	0	0%	$3,479,598	$0	0%	159	0	0%
Commercial	2	0	0%	$24,058	$0	0%	N/A	N/A	N/A
Total	78	0	0%	$3,503,656	$0	0%	159	0	0%

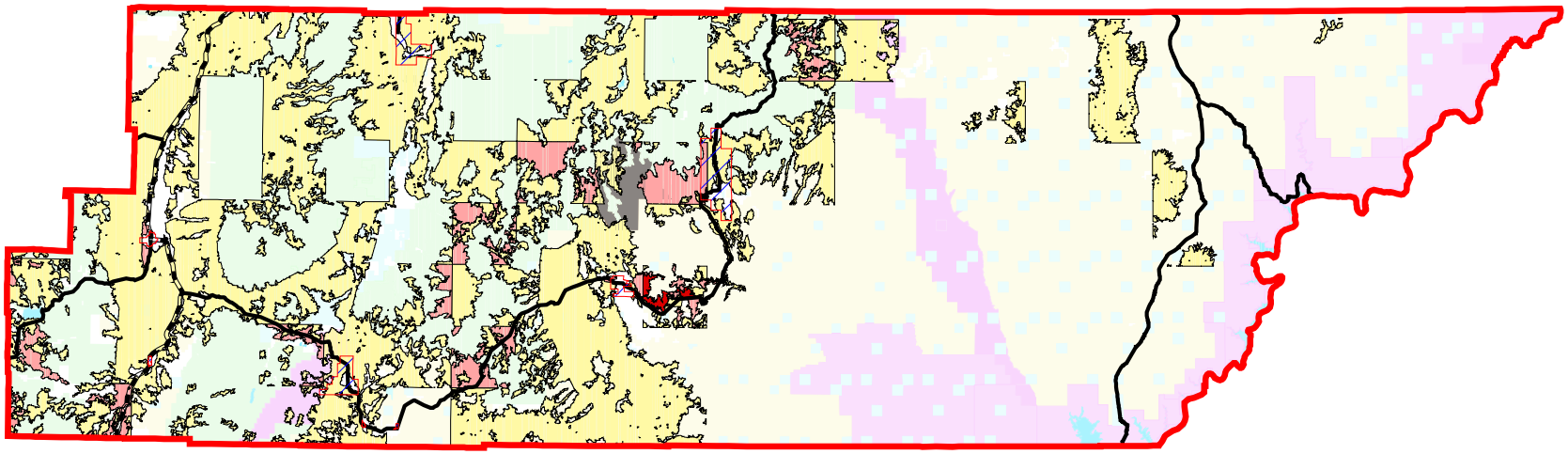
Panguitch - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	613	4	0.65%	$36,888,093	$239,772	0.65%	1,623	12	0.73%
Commercial	62	0	0%	$7,914,526	$0	0%	N/A	N/A	N/A
Total	281	0	0%	$44,802,619	$239,772	0.53%	1,623	12	0.73%

Tropic - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	192	10	5.20%	$11,630,849	$604,804	5.20%	508	32	6.29%
Commercial	18	0	0%	$2,784,009	$0	0%	N/A	N/A	N/A
Total	210	10	4.76%	$14,414,858	$604,804	4.19%	508	32	6.29%

Unincorporated Garfield County areas - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,221	184	15.06%	$80,627,223	$12,142,459	15.06%	1,050	537	51.14%
Commercial	27	1	3.70%	$3,459,742	$128,010	3.70%	N/A	N/A	N/A
Total	1,248	185	14.82%	$84,086,965	$12,270,469	14.59%	1,050	537	51.14%

Garfield County

Wildfire Map



20 0 20 40 Miles

County Boundary

Town Boundary

Major Roads

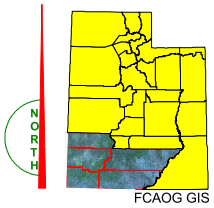
I-15

State Route

Fire Danger Categories W/ sq. miles

Extreme	5.03
High	125.46
Moderate	1317.89

* Note: Administrative Ownership is the background layer



Five County Association of Governments July 2003 Ed Dickie

FCAOG GIS uses information & data from many different sources, which may be of differing accuracy and which have been integrated to provide a planning context. These products should be used only for the purpose they were intended. For specific data source information, please contact FCAOG GIS.

435-673-3548 email edickie@fcaog.state.ut.us

Landslides

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified areas at risk from landslide residential and commercial structures at risk from landslide. See Table 30 below for an analysis of landslide risk in Beaver County

According to the available data, there are no residential structures at risk from landslide in any of the incorporated communities or in unincorporated Garfield County. The same data also indicates that there are no commercial structures at risk from landslide in the county.

Number of People/Buildings Impacted by Landslides

Table 30 Analysis of Landslide Risk in Garfield County

Antimony – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	77	0	0%	$3,285,707	$0	0%	122	0	%
Commercial	3	0	0%	$627,060	$0	0%	N/A	N/A	N/A
Total	80	0	0%	$3,912,767	$0	0%	122	0	%
Boulder – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	100	0	0%	$5,835,985	$0	0%	180	0	%
Commercial	3	0	0%	$799,027	$0	0%	N/A	N/A	N/A
Total	103	0	0%	$6,635,012	$0	0%	180	0	%

Cannonville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	67	0	0%	$3,135,106	$0	0%	148	0	%
Commercial	2	0	0%	$646,462	$0	0%	N/A	N/A	N/A
Total	69	0	0%	$3,781,568	$0	0%	148	0	%

Escalante - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	370	0	0%	$19,107,312	$0	0%	818	0	%
Commercial	32	0	0%	$3,103,084	$0	0%	N/A	N/A	N/A
Total	402	0	0%	$22,210,396	$0	0%	818	0	%

Hatch - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	84	0	0%	$3,672,260	$0	0%	127	0	%
Commercial	12	0	0%	$1,736,934	$0	0%	N/A	N/A	N/A
Total	96	0	0%	$5,409,194	$0	0%	817	0	0%

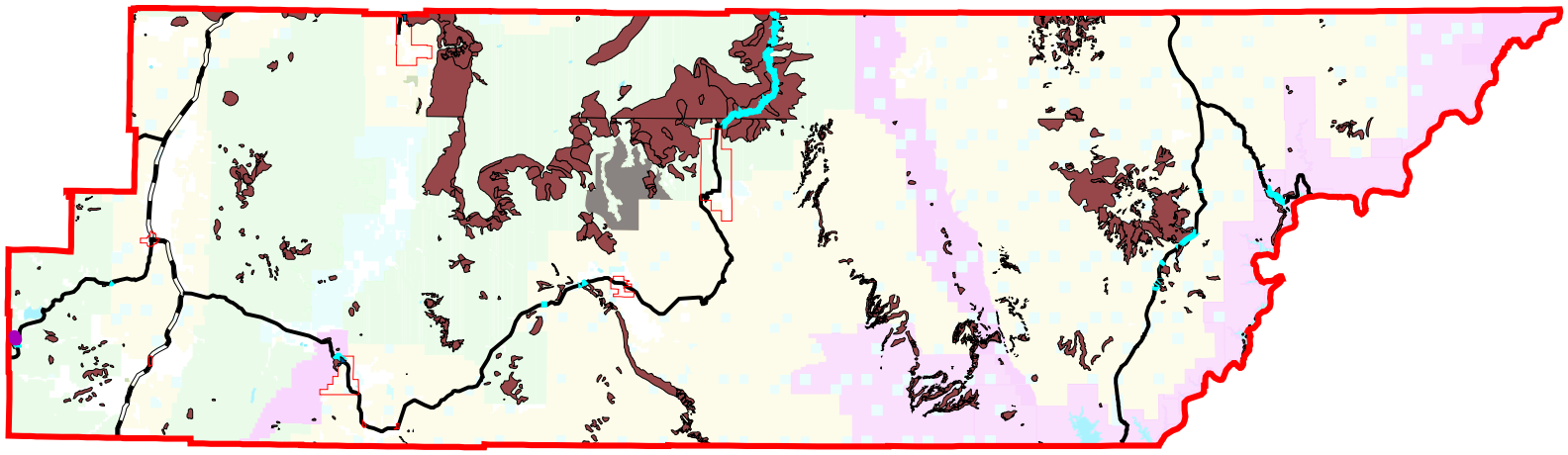
Henrieville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	76	0	0%	$3,479,598	$0	0%	159	0	%
Commercial	2	0	0%	$24,058	$0	0%	N/A	N/A	N/A
Total	78	0	0%	$3,503,656	$0	0%	159	0	%

Panguitch - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	613	0	0%	$36,888,093	$0	0%	1,623	0	%
Commercial	62	0	0%	$7,914,526	$0	0%	N/A	N/A	N/A
Total	281	0	0%	$44,802,619	$0	0%	1,623	0	%

Tropic - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	192	0	0%	$11,630,849	$0	0%	508	0	%
Commercial	18	0	0%	$2,784,009	$0	0%	N/A	N/A	N/A
Total	210	0	0%	$14,414,858	$0	0%	508	0	%

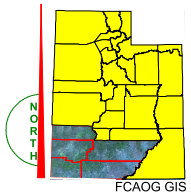
Unincorporated Garfield County areas - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,221	0	0%	$80,627,223	$0	0%	1,050	0	%
Commercial	27	0	0%	$3,459,742	$0	0%	N/A	N/A	N/A
Total	1248	0	0%	$84,086,965	$0	0%	1,050	0	%

Garfield County
Landslide Map



20 0 20 40 Miles

Kane County Boundary
Towns
Landslides
Major Roads
State Route
US Route
* Note: Administrative Ownership is the background layer



Five County Association of Governments August 2003 Ed Dickie

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Earthquake

Assessing Vulnerability and Overall Summary of Impacts

HAZUS MH Earthquake Vulnerability Assessment

See Table 31 below for an estimate of earthquake casualties.

Table 31 Earthquake Casualties Risk in Beaver County

Casualties	Nighttime –Minor	51
	Nighttime –Major	1
	Nighttime -Fatalities	2
	Daytime –Minor	50
	Daytime –Major	2
	Daytime- Fatalities	3
	Commute –Minor	51
	Commute –Major	2
	Commute-Fatalities	3

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 32 below lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 32 Building Damage from Moderate to Complete by Count

Category	Number of Structures	Total Cost in millions of dollars **
Residential	333	58.47
Commercial	59	20.92
Industrial	0	0.47
Totals	1,346*	80.96**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Table 33 Damage to Critical facilities from Moderate to Complete

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	1	0	0
Schools	10	3	0	0
EOCs	0	0	0	0
Police Stations	2	2	0	0
Fire Stations	1	0	0	1

Debris Removal –Table 34 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 34 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	53
Loads (25 tons per load)	2,120

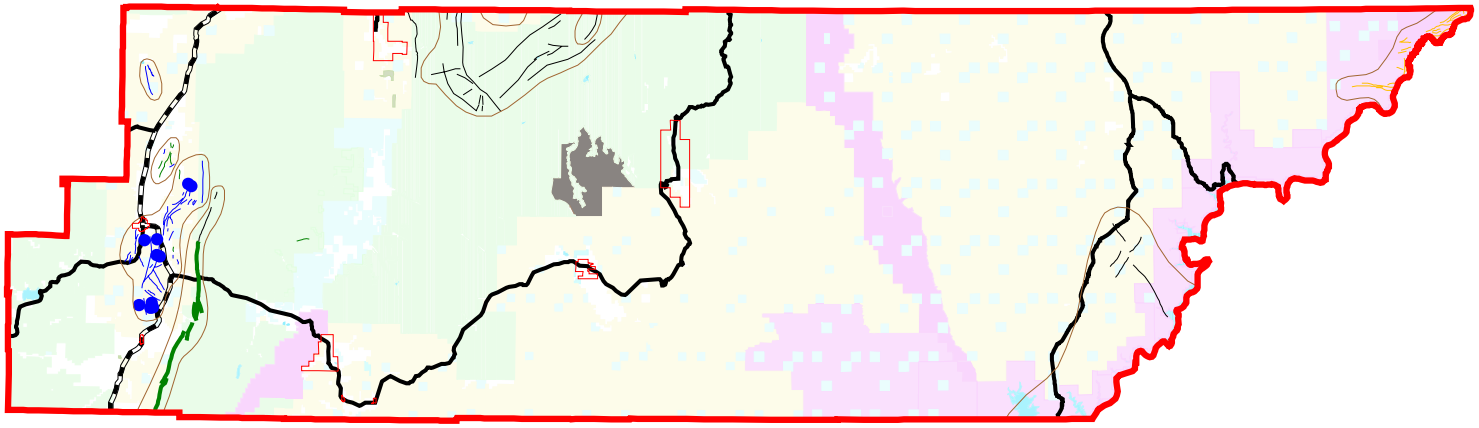
Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 35 below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 35 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete HAZUS MH run performed by the Utah Division of Emergency Services and Homeland Security is available at the Five County Association of Governments.

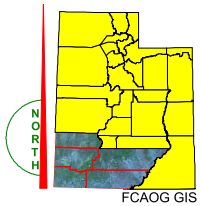
Garfield County
Earthquake Map



10 0 10 20 30 Miles

County Boundaries
Towns
Major Roads
I-15
State Route
US Route
Fault Groups
Folds
Fault Lines
123 = Latest Quaternary (<15,000 years)
124 = Latest Quaternary (<15,000 years)
133 = Late Quaternary (<130,000 years)
134 = Late Quaternary (<130,000 years)
144 = Mid to Late Quaternary (<750,000 years)
154 = Quaternary (<1,600,000 years)

* Note: Administrative Ownership is the background layer



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Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Garfield County

Number of People and Buildings/Structures Impacted by Floodplains

The Five County Association of Governments GIS, utilizing available floodplain data, has identified residential and commercial structures located within the 100-year floodplain (A Zone). See Table 36 for an analysis of flood risk in Garfield County.

Based upon review of available data, in the town of Antimony there are 4 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $170,686. Based an average household size (U.S. Census Bureau, Census 2000) of 2.95 persons per household in Antimony, there are approximately 12 persons at risk from floodplains.

Based upon review of available data, in Escalante City there are 4 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in Escalante City, the market value of those 4 structures is approximately $206,565. Based an average household size (U.S. Census Bureau, Census 2000) of 2.69 persons per household in Escalante City, there are approximately 11 persons at risk from floodplains.

Based upon review of available data, in Panguitch City there are 62 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in Panguitch City, the market value of those 62 structures is approximately $3,730,932. Based an average household size (U.S. Census Bureau, Census 2000) of 3.05 persons per household in Panguitch City, there are approximately 189 persons at risk from floodplains.

Based upon review of available data, in the town of Hatch there are 26 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $1,136,651. Based an average household size (U.S. Census Bureau, Census 2000) of 3.10 persons per household in Hatch, there are approximately 81 persons at risk from floodplains.

Based upon review of available data, in the town of Tropic there are 22 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $1,332,701. Based an average household size (U.S. Census Bureau, Census 2000) of 3.18 persons per household in Tropic, there are approximately 70 persons at risk from floodplains.

Based upon review of available data, in unincorporated Garfield County there are 64 residential structures located in a Floodplain (A Zone). Sixty-two of these structures are located in unincorporated areas surrounding or near to Panguitch City. The other two structures are located just south of the town of Hatch. Based upon an average market value of residential structures in unincorporated Garfield County, the market value of those structures is approximately $4,226,610. Based an average household size (U.S. Census Bureau, Census 2000) of 2.92 persons per household in Garfield County, there are approximately 187 persons at risk from floodplains.

Table 36 Analysis of Flood Risk in Garfield County

Antimony – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	77	4	5.19%	$3,285,707	$170,686	5.19%	122	12	9.83%
Commercial	3	0	0%	$627,060	$0	0%	N/A	N/A	N/A
Total	80	4	5.00%	$3,912,767	$170,686	4.36%	122	12	9.83%

Boulder – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	100	0	0%	$5,835,985	$0	0%	180	0	0%
Commercial	3	0	0%	$799,027	$0	0%	N/A	N/A	N/A
Total	103	0	0%	$6,635,012	$0	0%	180	0	0%

Cannonville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area

Residential	67	0	0%	$3,135,106	$0	0%	148	0	0%
Commercial	2	0	0%	$646,462	$0	0%	N/A	N/A	N/A
Total	69	0	0%	$3,781,568	$0	0%	148	0	0%

Escalante - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	370	4	1.08%	$19,107,312	$206,565	1.08%	818	11	1.34%
Commercial	32	0	0%	$3,103,084	$0	0%	N/A	N/A	N/A
Total	402	4	0.99%	$22,210,396	$220,998	0.99%	818	11	1.34%

Hatch - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	84	26	30.95%	$3,672,260	$1,136,651	30.95%	127	81	63.78%
Commercial	12	0	0%	$1,736,934	$0	0%	N/A	N/A	N/A
Total	96	26	27.08%	$5,409,194	$1,136,651	21.01%	127	81	63.78%

Henrieville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	76	0	0%	$3,479,598	$0	0%	159	0	0%
Commercial	2	0	0%	$24,058	$0	0%	N/A	N/A	N/A
Total	78	0	0%	$3,503,656	$0	0%	159	0	0%

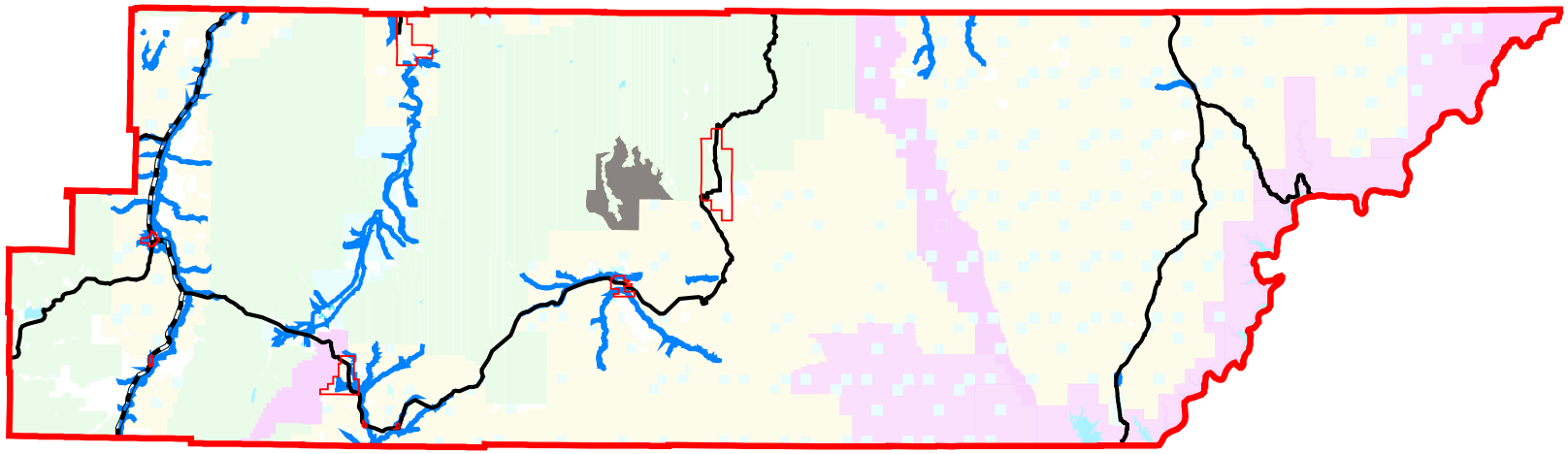
Panguitch - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	613	62	10.11 %	$36,888,093	$3,730,932	10.11%	1,623	189	11.64%
Commercial	62	0	0%	$7,914,526	$0	0%	N/A	N/A	N/A
Total	675	62	9.18%	$44,802,619	$3,730,932	8.32%	1,623	0	11.64%

Tropic - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	192	22	11.45%	$11,630,849	$1,332,701	11.45%	508	70	13.78%
Commercial	18	4	22.22%	$2,784,009	$618,668	22.22%	N/A	N/A	N/A
Total	210	26	12.38%	$14,414,858	$1,951,369	13.53%	508	70	13.78%

Unincorporated Garfield County areas - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,221	64	5.24%	$80,627,223	$4,226,160	5.24%	1,050	187	17.81%
Commercial	27	0	0%	$3,459,742	$0	0%	N/A	N/A	N/A
Total	1,248	64	5.12%	$84,086,965	$4,226,160	5.02%	1,050	187	17.81%

Garfield County

Floodzone Map



20 0 20 40 Miles

County Boundary

Towns

Major Roads

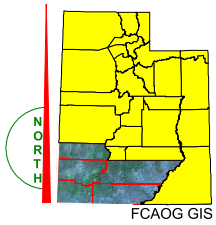
County Road

Interstate

State Route

Floodzone A (Digitized from FEMA Floodzone Maps)

* Note: Administrative Ownership is the background layer



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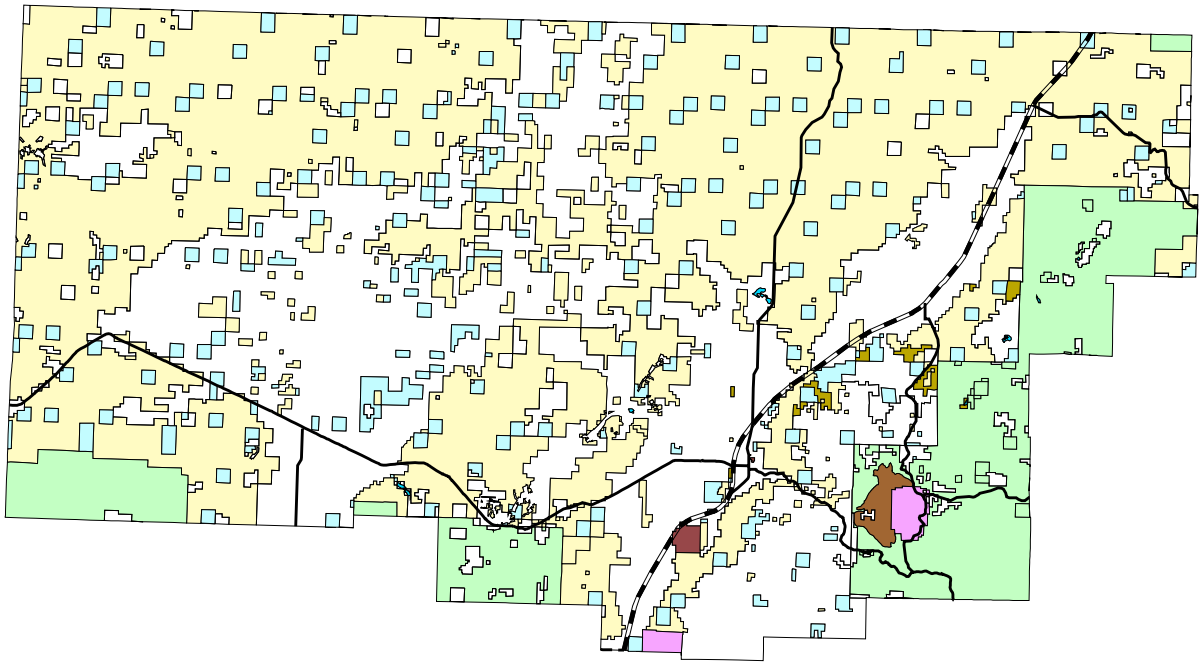
Iron County



History

When Iron County was first established in 1850, it included land in what is now Nevada on the west and part of Colorado on the east. In February 1882 more than half of the eastern domain was organized as Garfield County. Today, the county is bordered on the north by Beaver County, on the south by Washington County, on the east by Kane and Garfield Counties and on the west by the State of Nevada.

Ages ago, geologists say that nature, in one tremendous convulsion or a series of quakes, wrenched the valley floor away from the high plateaus country, some 20 miles south and east, dropping it to a level of 6000 feet. This left the mammoth plateau, as it is called, at an elevation of 10,000 to 11,000 feet and climaxed at Brian Head Peak, some 12,000 feet above sea level.

The several canyons and ridges, cut by the process of erosion, leading downward off the mammoth to the valley floor below, are incomparable in their beauty. Streams of water, grasslands, trees, small lakes and rainbow-colored cliff formations make up a paradise for the fistherman, hunter, hiker or casual visitor.

The Mammoth Plateau comprises hundreds of meadow and forest lands. It slopes gently downward toward the Panguitch Lake and Highway 89 on the east, to Zion National Park area on the south, and on the west breaks sharply downward some 3500 feet in glorious monolithic cliff formations of pink, red, orange, white and all other colors of the rainbow. This and a wide adjoining area of grass and forest land has been set aside by the Federal Government as Cedar Breaks National Monument.

Highway 143 leaves Parowan and makes a semicircle up to Brian Head and Cedar Breaks and down Cedar Canyon to Cedar City for the most rewarding hour drive anyone could take. It makes its way up scenic Parowan Canyon onto the Mammoth Plateau "up on top" where the road skirts the rim of Cedar Breaks National Monument and down to Cedar City. If one has several hours to relax and view beautiful scenery, he may travel up the canyons. The first left-hand fork contains one of the finest of forest camp grounds. This is adjacent to such points of interest as Noah's Ark and Jacob's Well, the Grand Castle with the Grim Old Giants guarding it, Alum Cove and the Walls of Jericho. Second left-hand canyon and Main Canyon also lead upward to the Mammoth Plateau and have fishing streams, grass lands, giant pine and quaking aspen, deer and smaller wildlife throughout the area.

Parowan, the Iron County seat is located along the I-15 corridor. Parowan proximity to some other Utah cities is shown below

Salt Lake City - 238 miles
Moab - 273 miles
Green River - 221 miles
St. George - 68 miles

The average temperature for the county seat, Parowan, in January is 42º F, and the average July temperature is 90º F. Annual Average Precipitation is 10". The temperatures in other communities in Iron County vary somewhat, however, the town of Brian Head is much cooler winter and summer due to its mountainous location.

Development Trends

Despite feeling the effects of the national slowdown, Iron County managed to end 2000 in a healthy state. The county did lose employment in the “goods-producing industries”. However, the best county-level indicator of economic wellbeing, growth in non-farm jobs, showed moderate expansion, unemployment remained low, construction picked up slightly, and sales increased. However, as the national slowdown continues, Iron County will be susceptible to economic deterioration.

Population

For most of the last half-century, population growth in Iron County has mirrored state expansion rates. That trend ended in the 1990s when the population of Iron County exploded. Just how fast was the population growth? Figures from Census 2000 tell us that roughly 33,800 individuals lived in Iron County during 2000. That represents a 63% decade increase in population. In fact, Iron County was the third fastest growing county in Utah during the 1990s. Iron County’s had a 63% expansion in population versus a 30% growth in Utah’s population between 1990 and 2000. And, the U.S. expansion measured a mere 13% while Enoch experienced the most rapid population boom between 1990 and 2000 (almost 80%). Cedar City continued to attract the most new residents. Brian Head was the slowest growing community in the county with a population increase of only 8%. One of the most interesting trends was the rapid population growth outside the county’s major townships.

Demographics

One of the more startling changes the Census revealed was an increase in Iron County’s Hispanic population. In 1990, less than 2% of the county’s population was Hispanic. By 2000, that share had increased to more than 4%. Still, Iron County has not become a hotbed of diversity. Only 9% of the county’s population is nonwhite or Hispanic compared to 31% nationally. Unlike many communities, Iron County has not seen a significant aging of its population. Census data shows that 9% percent of the county’s population is over the age of 65—less than the 10% registered in 1990. Iron County’s population is indeed heavy on the young side. Roughly 31% of the population is 18 years old or younger compared to 26% nationally. On the other hand, Iron County’s population distribution is fairly similar to Utah’s except for a bulge in the college-age population. That fact is hardly surprising given the presence of Southern Utah University.

Iron County’s household size has decreased slightly over the 1990s. However, Iron County families are more likely than Utah or U.S. families to be headed by a married couple. Moreover, only 7% of the county’s families are headed by women with children compared to 8% in Utah and 11% nationally.

The Labor Market

With annual job growth of 3.1% during 2000, Iron County surpassed the employment expansion rates of both Utah and the United States. Iron County accomplished this feat despite losing employment in all of its goods producing industries—mining, manufacturing, and construction. Most of the county’s 430 net new jobs were created in services—in particular, business services. Government was the only other major producer of new jobs during 2000. The university and local government generated most of these new public sector positions.

The manufacturing industry lost more than 100 jobs. Keeping in mind that these 2000 figures do not include the O’Sullivan plant closure in January 2001. In other words, expect

manufacturing figures to worsen. Construction employment dropped by almost 60 positions. Iron County has experienced a very tight labor market for several years. The increase early in 2001 may actually help ease a difficult labor market situation for employers seeking new workers.

Wages and Income

Along with the decline in Iron County goods producing jobs another flaw appears on the economic horizon. However, this flaw is one of long-standing rather than a recent event. Like many counties outside the sphere of the Wasatch Front, Iron County suffers from lower-than-average wages. In 2000, the county's average monthly non farm wage ($1,629) measured only 68% of the state average. And, this percentage measured at its lowest in more than a decade. Currently, Iron County's average monthly wage places it in the bottom third when all Utah counties are ranked. Despite a larger-than-average manufacturing sector, Iron County wages remain low. The abundance of a young college-age workforce fosters these low wages. Even the expanding economy works to keep wages low—particularly when the new jobs are in services or retail trade. When new firms enter the area or expand, they often hire at the bottom of their pay scales. In addition, the average Iron County worker's wages grew by only 1% during 2000. This means average wage growth didn't even keep pace with inflation. However, not all forms of compensation can be measured in dollars. Obviously, many workers are willing to forgo higher wages to enjoy the quality of life in the county.

Transportation/Communications/Utilities is the highest-paying industry in the county. Trade and services have the lowest average wages because many are part-time and low-pay. All Iron County industries show lower average wages than Utah. With wages at 96% of the state average, transportation/communications/utilities wages most closely approximate the state's figures. Measures of income (which includes interest income, rental income, business income, government payments such as Social Security and welfare, as well as wages) show a similarly dismal picture. Moreover, median household income figures rank below state and national averages. In terms of per capita personal income, Iron County again ranks in the bottom one-third of counties. Not surprisingly, Iron County estimates of poverty (16%) register higher than the averages for both Utah and the United States.

Other indicators

Construction bolstered Iron County's economic position during 2000. Residential permit values rose to the highest level since 1995, and the number of permits issued actually increased. Permitting data shows that the majority of residential growth is still occurring in Cedar City. However, sizeable expansion is appearing outside the county's major cities and towns. Nonresidential construction received a nice boost from the construction of the retail and public-sector buildings. The value of commercial building grew by more than 50% between 1999 and 2000 and marks the highest level since 1992. Growth in sales has proved fairly erratic in Iron County over the past decade. In 2000, the county produced a very mediocre expansion rate of 3.3%. All in all, Iron County's economy continued to hold its own during 2000. Moreover, it did this despite losing a substantial number of jobs. However, Iron County has already felt the effects of the national downturn and will do so in the future. In addition, lower-than-average wages continue to characterize the area.

Critical Facilities of Iron County

A listing of the Critical Facilities of Iron County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 37 below:

Table 37 Critical Facilities of Iron County

Name or Description of Asset **Brian Head Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Brian Head Clinic/Medical Facility	Private Facility (Not under town ownership)	X					un-known	$unknown	Wildfire, Landslide
Brian Head Fire Station	Brian Head Town	X					2,800 sq. ft.	$406,000	Wildfire, Landslide
Brian Head Police Station	Brian Head Town	X					1,500 sq. ft.	$220,000	Wildfire, Landslide
Brian Head Town Hall	Brian Head Town	X					7,600 sq. ft.	$970,000	Wildfire
Brian Head Million Gallon Water Tank	Brian Head Town	X					1MG	$1,100,000	Wildfire, Landslide
Brian Head Half Million Water Tank	Brian Head Town	X					0.5MG	$550,000	Landslide
Brian Head Salt Pile Water Tank	Brian Head Town	X					0.4MG	$450,000	Wildfire, Landslide
Brian Head Redwood Water Tank	Brian Head Town	X					0.3MG	$400,000	Landslide

Name or Description of Asset **Cedar City City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Cedar City Regional Airport (including Runways)	Cedar City	X		X			7,500 sq. ft.	$75,000,000	Floodplain
Canyon View High School	Cedar City	X					230,000 sq. ft.	$21,344,000	Floodplain
Southern Utah University	Cedar City	X		X		X	Multiple campus buildings	$value of facilities not readily available	

Cedar High School	Cedar City	X					146,886 sq. ft.	$13,631,020	
Valley View Medical Center	Cedar City	X	X	X	X		95,000 sq. ft.	$data not readily available	
Cedar City Fire Station	Cedar City	X					7,850 sq. ft.	$750,000	
Cedar City Fire Station #2	Cedar City	X					4,650 sq. ft.	$525,000	
Cedar City Office Building	Cedar City	X					32,000 sq. ft.	$4,500,000	
4 Water Tanks	Cedar City	X					2.2MG	$650,000	
5 Water Tanks	Cedar City	X					1.9MG	$600,000	
2 Water Tanks	Cedar City	X					1.0MG	$550,000	
Sewer Treatment Facility	Cedar City	X			X		40 acres	$12,500,000	
Heritage Center	Cedar City	X					20,000 sq. ft.	$8,500,000	
Water Wells	Cedar City	X	X	X			9 wells	$1,500,000	

Name or Description of Asset **Enoch Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Enoch Town Hall/Community Center	Enoch City	X					4,242 sq. ft.	$200,000	
Enoch Elementary School	Enoch City	X	X				53,471 sq. ft.	$4,824,153	
Concrete Water Tank	Enoch City	X					2MG	$1,000,000	
Steel Water Tank	Enoch City	X					2MG	$200,000	

Name or Description of Asset **Kanarraville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Kanarraville	Kanarraville Town	X					4,000	$100,000	

Fire Station							sq. ft.		
Water Tanks (two tanks)	Kanarraville Town	X					0.38MG	$350,000	Floodplain

Name or Description of Asset **Paragonah Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Paragonah Fire Station	Paragonah Town	X					2,026 sq. ft.	$104,000	Floodplain
Paragonah Town Hall	Paragonah Town	X					673 sq. ft.	$37,000	Floodplain
Paragonah Water Tank #1	Paragonah Town	X					0.2MG	$120,000	
Paragonah Water Tank #2	Paragonah Town	X					0.06MG	$50,100	

Name or Description of Asset **Parowan Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Parowan Medical Clinic		X						$	
Parowan Medical Clinic		X						$	
Parowan Fire Station		X						$	
Parowan Police Station		X						$	
Parowan Sewer Lagoons		X			X			$	
Parowan High School		X						$	
Parowan Elementary School		X	X					$	
Parowan Municipal Airport		X		X				$	

Analysis of the Infrastructure of Iron County

A listing of the Infrastructure of Iron County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 38 below:

Table 39 Critical Infrastructure of Iron County

Name of Town **Parowan**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	4	47	3	45	0	0	0	0	0	0	2	0	45
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	238.48	2.36	217.78	.63	3	0	0	0	0	0	0	.66	0	3
Railways (miles)	133.91	0	130.78	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	244.66	0	237.47	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	186.85	0	178.18	0	0	.24	.012	0	0	0	0	.25	.012	.025
HAZARDS														
Flood Zones (sq miles)	53.29	.24	46.35											
Land Slides (sq miles)	145.37	.84	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	0	55.47											
Wildfires (sq miles)	1349.44	1.85	1340											

Name of Town **Brian Head**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	0	47	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	238.48	2.38	217.78	0	0	.92	4	0	0	0	0	1.79	0	4
Railways (miles)	133.91	0	130.78	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	244.66	0	237.47	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	186.85	.38	178.18	0	0	.16	.008	0	0	0	0	.04	.002	.010
HAZARDS														
Flood Zones (sq miles)	53.29	0	46.35											
Land Slides (sq miles)	145.37	2.25	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	0	55.47											
Wildfires (sq miles)	1349.44	2.77	1340											

Name of Town **Cedar City**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	38	47	19	245	0	0	0	0	0	0	0	0	245
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	238.48	14.60	217.78	3.78	15	0	0	.36	1.5	0	0	5.6	0	16.5
Railways (miles)	133.91	3.13	130.78	1.66	4	0	0	0	0	0	0	0	0	4
Utility Lines (miles)	244.66	7.19	237.47	2.41	.12	0	0	0	0	0	0	2.7	.135	.255
Other Utility Lines (miles)	186.85	7.10	178.18	3.44	.17	0	0	0	0	0	0	2.51	.126	.296
HAZARDS														
Flood Zones (sq miles)	53.29	4.23	46.35											
Land Slides (sq miles)	145.37	.06	142.25											
Problem Soils (sq miles)	66.60	.08	66.52											
Volcanic Flows (sq miles)	55.50	.01	55.47											
Wildfires (sq miles)	1349.44	4.21	1340											

Name of Town **Enoch**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	0	47	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	244.66	1.36	217.78	0	0	0	0	0	0	0	0	.11	0	0
Railways (miles)	133.91	0	130.78	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	0	237.47	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	186.85	1.19	178.18	0	0	0	0	0	0	0	0	.22	.011	.011
HAZARDS														
Flood Zones (sq miles)	53.29	0	46.35											
Land Slides (sq miles)	145.37	0	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	00	55.47											
Wildfires (sq miles)	1349.44	.49	1340											

Name of Town **Kanarraville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	0	47	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	244.66	0	217.78	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	133.91	0	130.78	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	0	237.47	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	186.85	0	178.18	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	53.29	.01	46.35											
Land Slides (sq miles)	145.37	0	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	00	55.47											
Wildfires (sq miles)	1349.44	.12	1340											

Name of Town **Paragonah**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	12	0	9	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	89	0	47	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	244.66	0	217.78	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	133.91	0	130.78	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	148.27	0	237.47	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	186.85	0	178.18	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	53.29	.24	46.35											
Land Slides (sq miles)	145.37	0	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	.02	55.47											
Wildfires (sq miles)	1349.44	.08	1340											

Unincorporated Area of County	County Total	Towns Total	Unincorporated	FloodZone Unincorporated	Flood Zone Costs in Millions $	LandSlide Unincorporated	Land Slide Costs in Millions $	ProblemSoil Unincorporated	Problem Soil Costs in Millions $	VolcanicFlow Unincorporated	Volcanic Flow Costs in Millions $	Wildfire Unincorporated	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards
# of Dams (High Hazard)	12	0	9	1	0	2	0	1	0	0	0	10	0	0
# of Highway Bridges	89	0	47	2	20	0	0	2	20	0	0	24	0	40
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	244.66	0	217.78	2.58	10	5.61	22	2.68	11	.55	2	102	0	45
Railways (miles)	133.91	0	130.78	6.33	15.2	0	0	1.2	2.9	0	0	117	468	486
Utility Lines (miles)	148.27	0	237.47	3.77	.19	16	.80	3.36	.17	2.95	.15	114	5.7	7.01
Other Utility Lines (miles)	186.85	0	178.18	3.39	.17	7.32	.37	0	0	2.53	.13	60.5	3.02	3.68
HAZARDS														
Flood Zones (sq miles)	53.29	.24	46.35											
Land Slides (sq miles)	145.37	0	142.25											
Problem Soils (sq miles)	66.60	0	66.52											
Volcanic Flows (sq miles)	55.50	.02	55.47											
Wildfires (sq miles)	1349.44	9.44	1340											

Wildfire

FEMA Hazard Profile
Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to moderate or high for structures in incorporated communities and Moderate to High to structures in unincorporated Iron County. Varies by location.
Duration: Containment time varies for each fire.

Assessing Vulnerability

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire. See Table 39 for an analysis of wildfire risk in Iron County.

In Brian Head there are 129 residential units in a moderate wildfire risk area with an estimated market value of $9,330,248. This is 10.76% of the residential units in the town. There are 29 businesses in Brian Head at moderate risk from wildfire. The market value of these structures, as provided by the Iron County Assessors office is $4,879,891. This is 100% of the commercial structures in Brian Head. According to available data, there are no residential or commercial structures at high or extreme risk from wildfire in Brian Head.

In Cedar City there are approximately112 residential units in a moderate wildfire risk area with an estimated market value of $12,191,088. This is 2.21% of the residential units in the city. There are approximately 129 residential units in a high wildfire risk area with an estimated market value of $14,041,521. This is 2.55% of the residential units in the city. There are approximately 540 residential units in an extreme wildfire risk area with an estimated market value of $58,757,399. This is 10.67% of the residential units in the town. There are approximately 90 businesses in Cedar City at moderate risk from wildfire. There are approximately 2,397 persons (11.67% of the City's population) at risk from wildfire. There are approximately 21 businesses in Cedar City at high risk from wildfire. There are approximately 110 businesses in Cedar City at extreme risk from wildfire. The market value of these structures, estimated from information provided by the Iron County Assessors office is $85,915,821. This is 68.84% of the commercial structures in Cedar City.

In Enoch there is one residential unit in a moderate wildfire risk area with an estimated market value of $79,635. This is 0.08% of the residential units in the city. There are 6 residential units in a high wildfire risk area with an estimated market value of $477,810. This is 0.51% of the residential units in the city. There are 6 residential units in an extreme wildfire risk area with an estimated market value of $477,810. This is 0.51% of the residential units in the city. There are approximately 47 persons (1.35% of the City's population) at risk from wildfire.

In Kanarraville there are 5 residential units in a high wildfire risk area with an estimated market value of $328,948. This is 3.20% of the residential units in the town. There are approximately 13 persons (4.18% of the town's population) at risk from wildfire.

In Paragonah there are 43 residential units in a moderate wildfire risk area with an estimated market value of $2,809,593. This is 19.19% of the residential units in the town. There are approximately 129 persons (27.40% of the town's population) at risk from wildfire.

In Parowan there are 17 residential units in a moderate wildfire risk area with an estimated market value of $1,227,024. This is 1.40% of the residential units in the city. There are approximately 48 persons (1.87% of the City's population) at risk from wildfire. There are 2 businesses in Parowan City at moderate risk from wildfire. The market value of those structures, estimated from information provided by the Iron County Assessors office is $216,063. This is 2.35% of the commercial structures in Parowan City.

In unincorporated Iron County there are 142 residential structures at moderate risk from wildfire. Based upon figures provided by the Iron County Assessors Office, the market value of those structures is estimated to be $9,978,908. There are 123 residential structures at high risk from wildfire. Based upon figures provided by the Iron County Assessors Office, the market value of those structures is estimated to be $8,643,702. There are 6 residential structures at extreme risk from wildfire. Based upon figures provided by the Iron County Assessors Office, the market value of those structures is estimated to be $421,644. Based upon the average household size of 3.11 persons, in Iron County, from the 2000 U.S. Census, there are approximately 843 persons at risk from wildfire. This is 13.33% of the 6,321 population of unincorporated Iron County. There are 13 commercial structures in unincorporated Iron County identified to be in a moderate wildfire risk area. The estimated value of those structures is $4,345,484. There are 7 commercial structures in unincorporated Iron County identified to be in a high wildfire risk area. The estimated value of those structures is $2,339,876. There are 7 commercial structures in unincorporated Iron County identified to be in an extreme wildfire risk area. The estimated value of those structures is $2,339,876.

Number of People/Buildings Impacted by Wildfire

Table 39 Analysis of Wildfire Risk in Iron County

Brian Head – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,198	129	10.76%	$86,648,357	$9,330,248	10.76%	118	277*	234.74%
Commercial	29	29	100%	$4,876,891	$4,876,891	100%	N/A	N/A	N/A
Total	1,227	158	12.87%	$91,525,248	$14,207,139	15.52%	118	277	234.74%

* The number of rental units in a wildfire risk area is far greater than the number of permanent residences. The number of persons at risk is calculated as a percentage of the town's population, regardless of ownership/renter status.

Cedar City – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	5,057	781	15.44%	$550,453,426	$84,990,008	15.44%	20,527	2,397	11.67%
Commercial	321	221	68.84%	$124,805,087	$85,915,821	68.84%	N/A	N/A	N/A
Total	5,378	1,002	18.63%	$675,258,513	$170,905,847	25.30%	20,527	2,397	11.67%

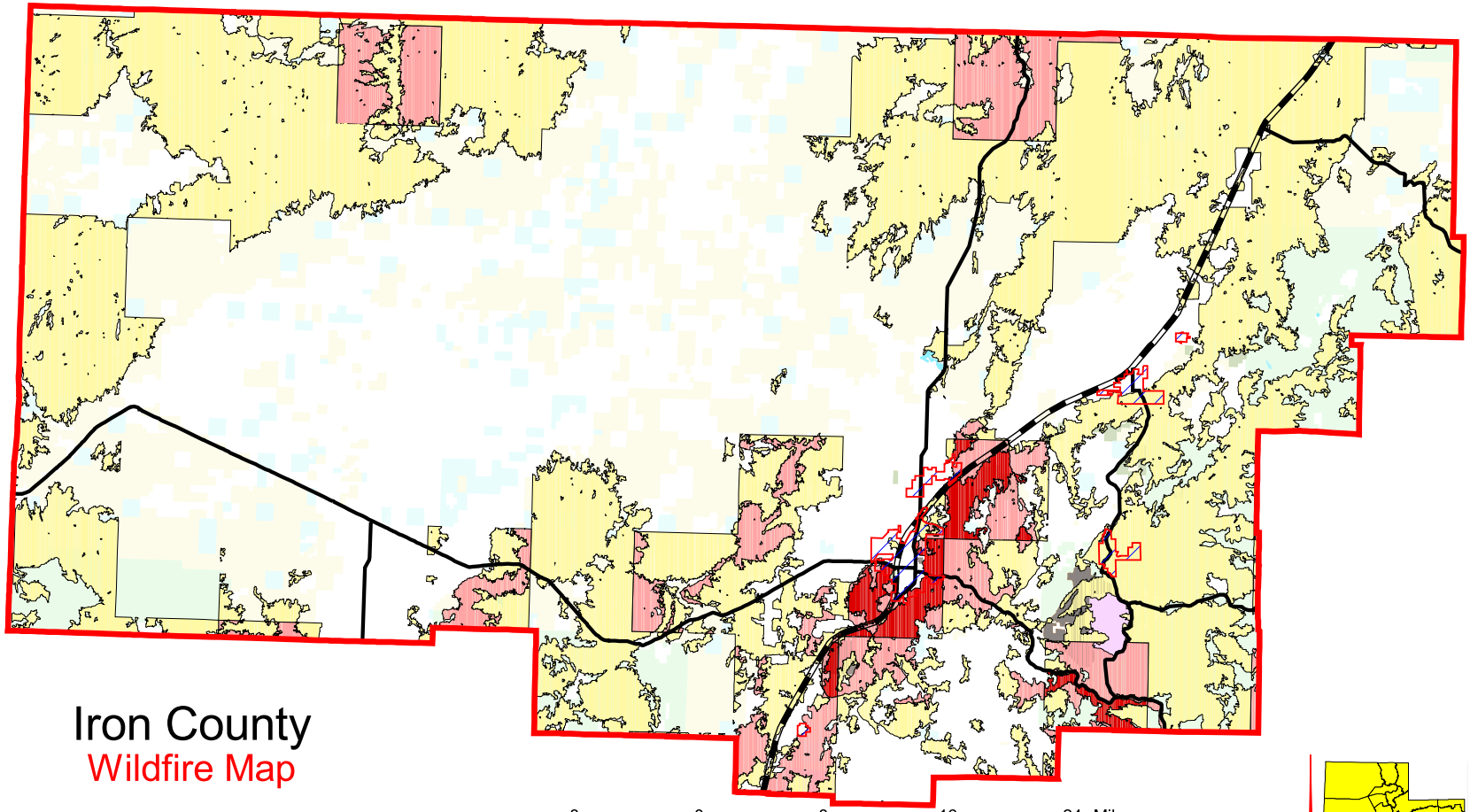
Enoch - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,162	13	1.11%	$92,536,283	$1,027,152	1.11%	3,467	47	1.35%
Commercial	7	0	28.57%	$765,812	$0	0%	N/A	N/A	N/A
Total	1,169	13	1.11%	$93,302,095	$1,027,152	1.10%	3,467	47	1.35%

Kanarraville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	156	5	3.20%	$10,279,649	$328,948	3.20%	311	13	4.18%
Commercial	3	0	0%	$90,361	$0	0%	N/A	N/A	N/A
Total	159	5	3.14%	$10,370,010	$328,948	3.17%	311	13	4.18%

Paragonah - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	224	43	19.19%	$14,640,927	$2,809,593	19.19%	470	129	27.4%
Commercial	1	0	0%	$32,807	$0	0%	N/A	N/A	N/A
Total	225	43	19.11%	$14,673,734	$2,809,593	19.14%	470	129	27.4%

Parowan - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,208	17	1.40%	$87,644,593	$1,227,024	1.40%	2,565	48	1.87%
Commercial	85	2	2.35%	$9,194,192	$216,063	2.35%	N/A	N/A	N/A
Total	1,293	19	1.46%	$96,838,785	$1,443,087	1.49%	2,565	48	1.87%

Unincorporated Iron County - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,275	271	8.27%	$230,148,114	$19,033,249	8.27%	6,321	843	13.33%
Commercial	388	27	6.95%	$129,696,289	$9,013,892	6.95%	N/A	N/A	N/A
Total	3,663	298	8.13%	$368,253,819	$28,047,141	7.61%	6,321	843	13.33%



Iron County
Wildfire Map

Five County Association of Governments July 2003 Ed Dickie

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435-673-3548 email edickie@fcaog.state.ut.us

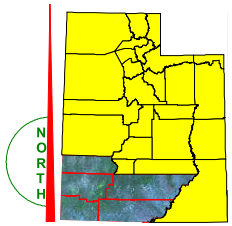
8 0 8 16 24 Miles

County Boundary
Town Boundary
Major Roads
I-15
State Route
US Route

Fire Danger Categories W/ Acres

Extreme	931.20
High	516.30
Moderate	12,672.49

* Note: Administrative Ownership is the background layer



FCAOG GIS

Landslides

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified areas at risk from landslide residential and commercial structures at risk from landslide. See Table 40 for an analysis of landslide risk in Iron County.

According to the available data, there are 64 residential structures at risk from landslide in unincorporated Iron County. This is 1.95% of the residential units in unincorporated Iron County. The market value of those structures is estimated to be $4,497,550.

There are 67 residential structures at risk from landslide in Brian Head. This is 5.59% of the residential units in Brian Head. The market value of those structures is estimated to be $4,845,943.

There are 22 residential structures at risk from landslide in Cedar City. This is 0.43% of the residential units in Cedar City. The market value of those structures is estimated to be $2,394,695.

Available data indicates that there appears to be no commercial structures at risk from landslide in Iron County.

Number of People/Buildings Impacted by Landslides

Table 40 Analysis of Landslide Risk in Iron County

Brian Head – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,198	67	5.59 %	$86,648,357	$4,845,943	5.59%	118	144*	122%
Commercial	29	0	0%	$4,876,891	$0	0%	N/A	N/A	N/A
Total	1,227	67	5.46 %	$91,525,248	$4,845,943	5.29%	118	144	122%

* The number of rental units in a landslide risk area is greater than the number of permanent residences. The number of persons at risk is calculated as a percentage of the town's population, regardless of ownership/renter status.

Cedar City – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	5,057	22	0.43%	$550,453,426	$2,394,695	0.43%	20,527	67	0.33%
Commercial	321	0	0%	$124,805,087	$0	0%	N/A	N/A	N/A
Total	5,378	22	0.41%	$ 675,258,513	$2,394,695	0.35%	20,527	67	0.33%

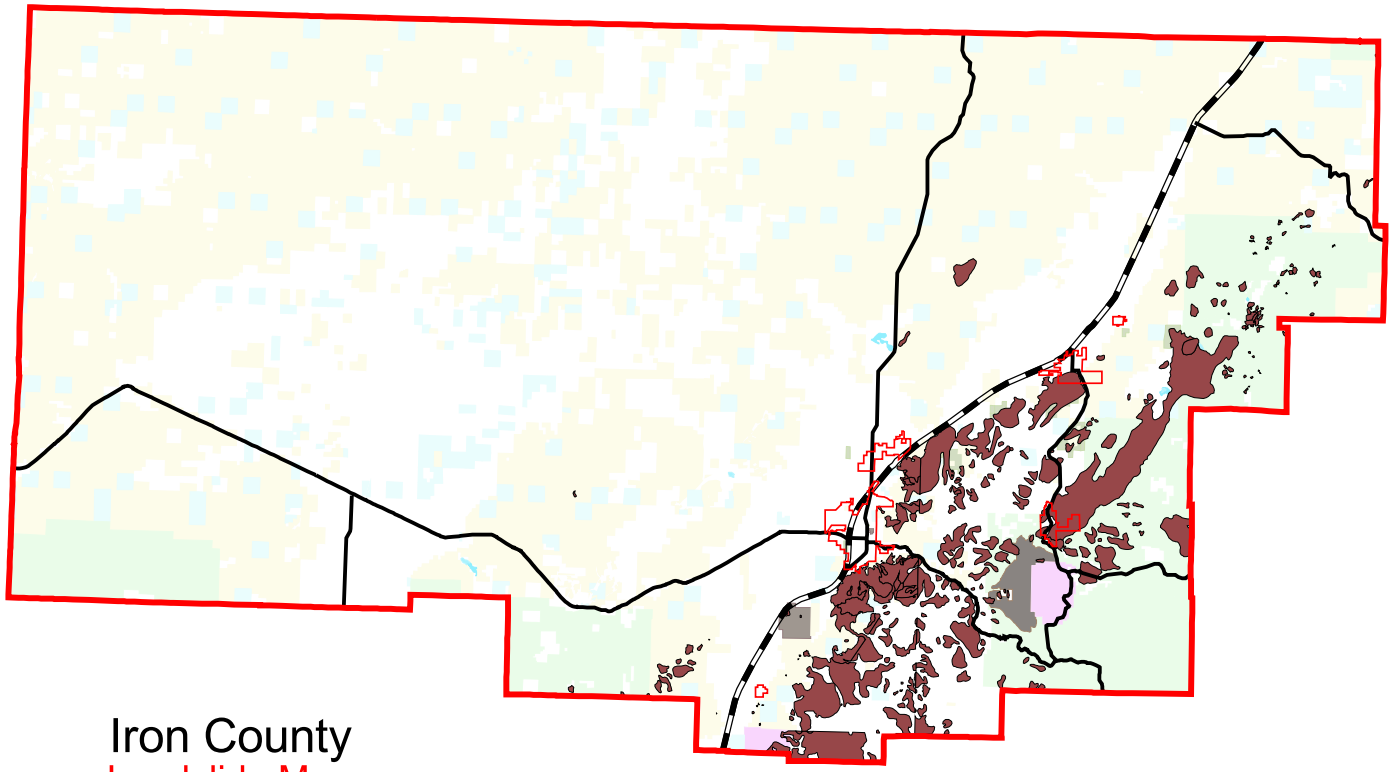
Enoch - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,162	0	0%	$92,536,283	$0	0%	3,467	0	0%
Commercial	7	0	0%	$765,812	$0	0%	N/A	N/A	N/A
Total	1,169	0	0%	$ 93,302,095	$0	0%	3,467	0	0%

Kanarraville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	156	0	0%	$10,279,649	$0	0%	311	0	0%
Commercial	3	0	0%	$90,361	$0	0%	N/A	N/A	N/A
Total	159	0	0%	$10,370,010	$0	0%	311	0	0%

Paragonah - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	224	0	0%	$14,640,927	$0	0%	470	0	0%
Commercial	1	0	0%	$32,807	$0	0%	N/A	N/A	N/A
Total	225	0	0%	$14,673,734	$0	0%	470	0	0%

Parowan - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,208	26	2.15%	$87,644,593	$1,886,390	2.15%	2,565	74	2.88%
Commercial	85	0	0%	$9,194,192	$0	0%	N/A	N/A	N/A
Total	1,293	26	2.01%	$96,838,785	$1,886,390	1.95%	2,565	74	2.88%

Unincorporated Iron County - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,275	64	1.95%	$230,148,114	$4,497,550	1.95%	6,321	199	3.15%
Commercial	388	0	0%	$129,696,289	$0	0%	N/A	N/A	N/A
Total	3,663	64	1.74%	$368,253,819	$4,497,550	1.22%	6,321	199	3.15%



Iron County
Landslide Map

10 0 10 20 Miles

Five County Association of Governments August 2003 Ed Dickie

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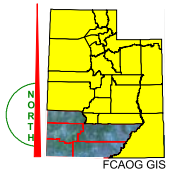
435-673-3548 email edickie@fcaog.state.ut.us

Kane County Boundary
Towns
Landslides
Major Roads
State Route
US Route
* Note: Administrative Ownership is the background layer



FCAOG GIS

Earthquake

Assessing Vulnerability and Overall Summary of Impacts

HAZUS MH Earthquake Vulnerability Assessment

See Table 41 below for an estimate of earthquake casualties.

Table 41 Earthquake Casualties Risk in Iron County

Casualties	Nighttime –Minor	344
	Nighttime –Major	9
	Nighttime -Fatalities	17
	Daytime –Minor	302
	Daytime –Major	11
	Daytime- Fatalities	21
	Commute –Minor	321
	Commute –Major	11
	Commute-Fatalities	20

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 42 below lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 42 Building Damage from Moderate to Complete by Count

Category	Number of Structures	Total Cost in millions of dollars **
Residential	998	324.36
Commercial	84	83.10
Industrial	5	13.02
Totals	5,803*	436.67**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Table 43 Damage to Critical Facilities from Moderate to Complete

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	1
Schools	14	3	0	0
EOCs	0	0	0	0
Police Stations	3	0	0	0
Fire Stations	4	2	0	0

Debris Removal –Table 44 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 44 –Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	289
Loads (25 tons per load)	11,560

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 45 below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

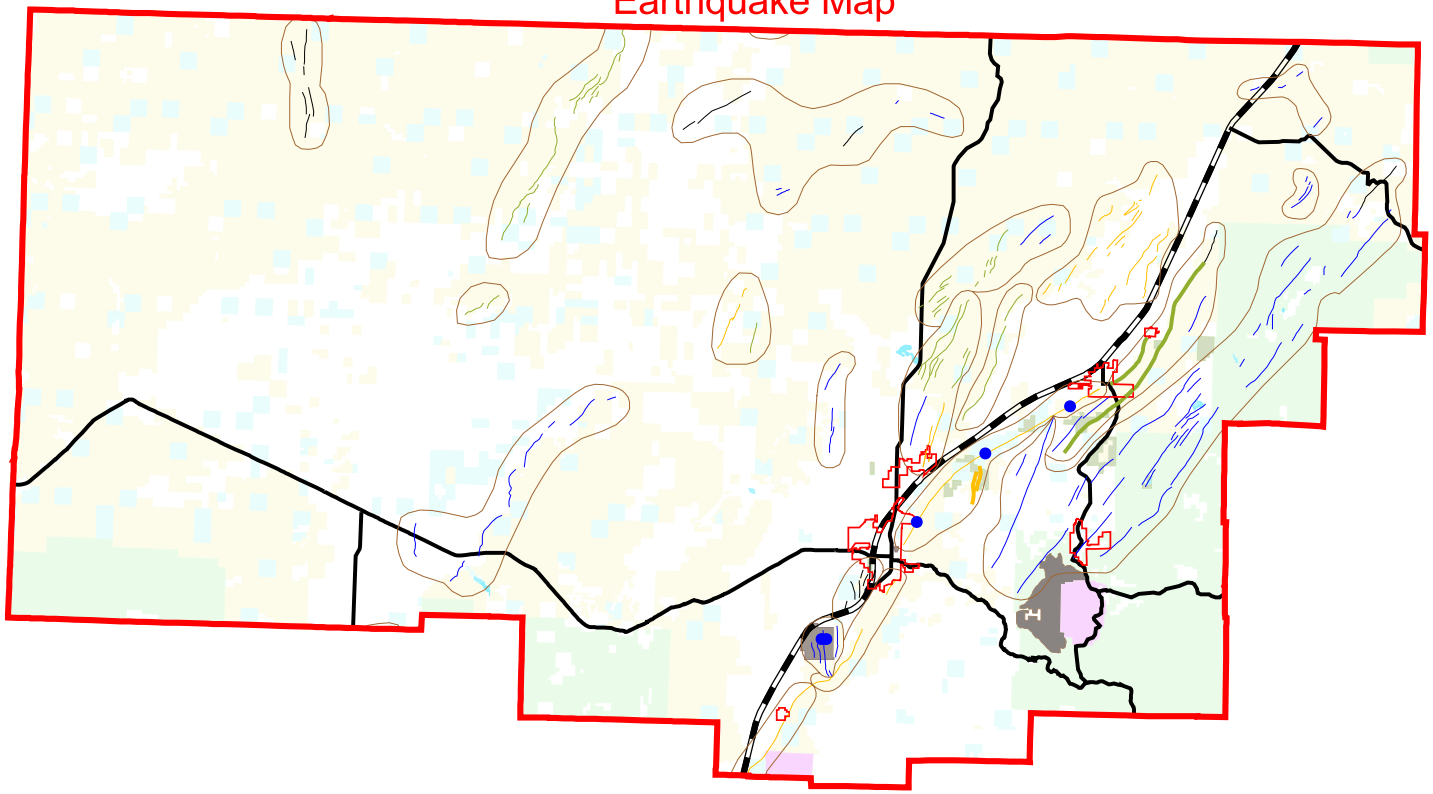
Table 45 –Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	3
People Displaced	3
Value Exposed (thousand $)	126

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete HAZUS MH run performed by the Utah Division of Emergency Services and Homeland Security is available at the Five County Association of Governments.

Iron County

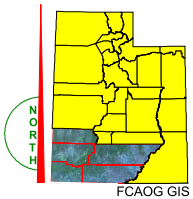
Earthquake Map



6 0 6 12 18 Miles

County Boundaries
Towns
Major Roads
I-15
State Route
US Route
Fault Groups
Folds
Fault Lines
123 = Latest Quaternary (<15,000 years)
124 = Latest Quaternary (<15,000 years)
133 = Late Quaternary (<130,000 years)
134 = Late Quaternary (<130,000 years)
144 = Mid to Late Quaternary (<750,000 years)
154 = Quaternary (<1,600,000 years)

* Note: Administrative Ownership is the background layer



FCAOG GIS

Five County Association of Governments September 2003 Ed Dickie

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Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available floodplain data, has identified residential and commercial structures located within the 100-year floodplain (A Zone). See Table 46 for an analysis of landslide risk in Iron County.

Based upon review of available data, in Cedar City there are 596 residential structures located in a floodplain (A Zone). These structures located in floodplains account for 11.78% of the residential structures in Cedar City. Based upon an estimated average market value of residential structures in the city, the market value of these structures is approximately $64,874,479. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.07 persons per household in Cedar City, there are approximately 1,830 persons at risk from floodplains. There are approximately 66 businesses located in a floodplain. The estimated market value of those structures is $25,660,859.

Based upon review of available data, in the town of Paragonah there are 147 residential structures located in a floodplain (A Zone). These structures located in floodplains account for 65.62% of the residential structures in Paragonah. Based upon an estimated average market value of residential structures in the town, the market value of these structures is approximately $9,608,108. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.01 persons per household in Paragonah, there are approximately 442 persons at risk from floodplains. There is one business located in a floodplain. The estimated market value of that structure is $32,807.

Based upon review of available data, in Parowan City there are 33 residential structures located in a floodplain (A Zone). These structures located in floodplains account for 2.73% of the residential structures in Parowan. Based upon an estimated average market value of residential structures in the city, the market value of these structures is approximately $2,394,264. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.84 persons per household in Parowan, there are approximately 94 persons at risk from floodplains. There are two businesses located in a floodplain. The estimated market value of those structures is $216,333.

Based upon review of available data, in Unincorporated Iron County there are 102 residential structures located in a floodplain (A Zone). These structures located in floodplains account for 3.11% of the residential structures in unincorporated Iron County. Based upon an estimated average market value of residential structures in the unincorporated portion of Iron County, the market value of these structures is approximately $7,167,971. Based upon an average household size (U.S. Census Bureau, Census 2000) of

3.11 per household in Iron County, there are approximately 317 persons at risk from floodplains.

Number of People and Buildings/Structures Impacted by floodplains

Table 46 Analysis of Flood Risk in Iron County

Brian Head – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,198	0	0%	$86,648,357	$0	0%	118	0*	0%
Commercial	29	0	0%	$4,876,891	$0	0%	N/A	N/A	N/A
Total	1,227	0	0%	$91,525,248	$0	0%	118	0	0%

Cedar City – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	5,057	596	11.78 %	$550,453,426	$64,874,479	11.78%	20,527	1,830	8.91%
Commercial	321	66	20.56 %	$124,805,087	$25,660,859	20.56%	N/A	N/A	N/A
Total	5,378	662	12.30 %	$ 675,258,513	$90,535,338	13.40%	20,527	1,830	8.91%

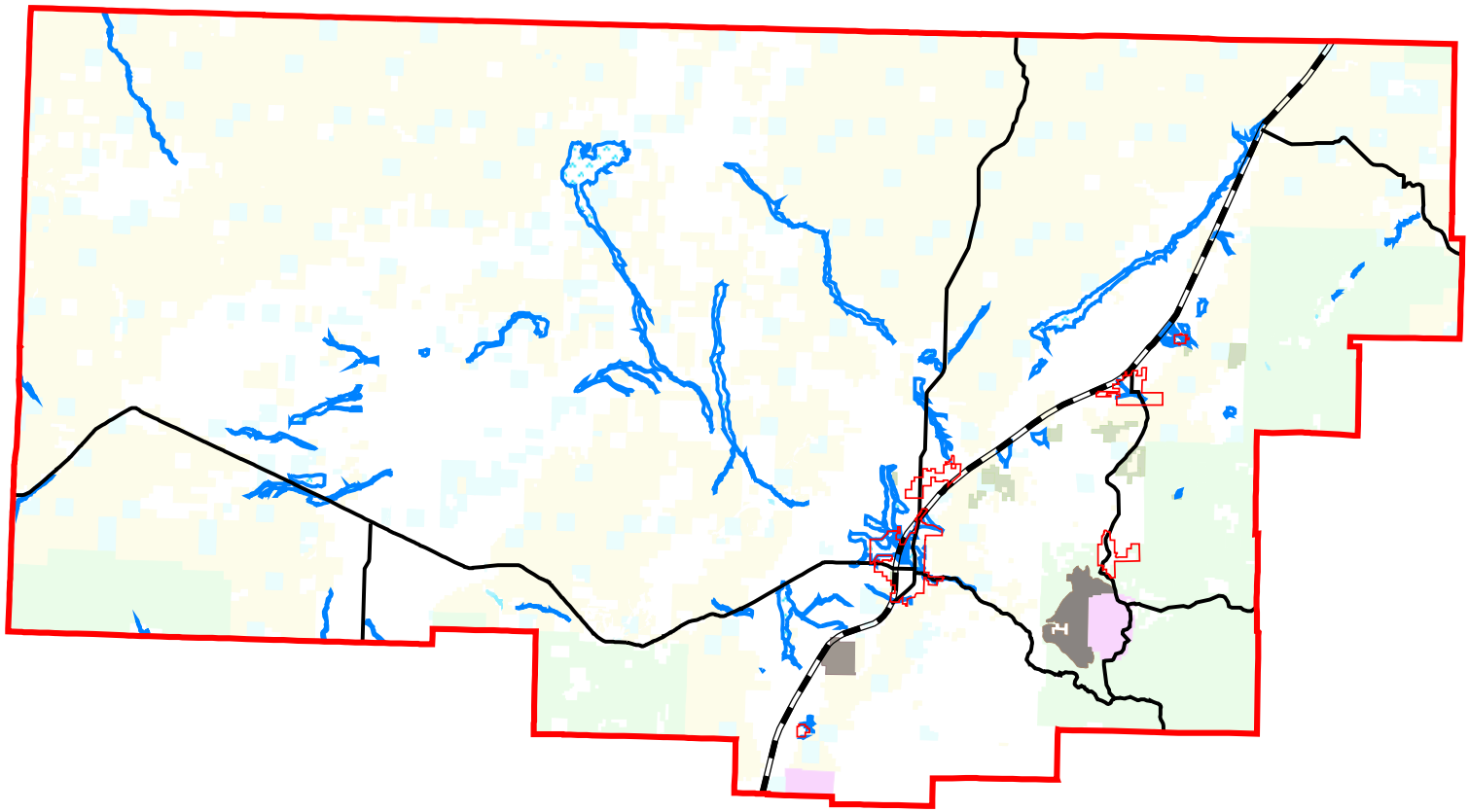
Enoch - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,162	0	0%	$92,536,283	$0	0%	3,467	0	0%
Commercial	7	0	0%	$765,812	$0	0%	N/A	N/A	N/A
Total	1,169	0	0%	$ 93,302,095	$0	0%	3,467	0	0%

Kanarraville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	156	0	0%	$10,279,649	$0	0%	311	0	0%
Commercial	3	0	0%	$90,361	$0	0%	N/A	N/A	N/A
Total	159	0	0%	$10,370,010	$0	0%	311	0	0%

Paragonah - Floodplain									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	224	147	65.62%	$14,640,927	$9,608,108	65.52%	470	442	94.04%
Commercial	1	1	100%	$32,807	$32,807	100%	N/A	N/A	N/A
Total	225	148	65.77%	$14,673,734	$9,640,915	65.70%	470	442	94.04%

Parowan - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,208	33	2.73%	$87,644,593	$2,394,264	3.06%	2,565	94	3.66%
Commercial	85	2	2.35%	$9,194,192	$216,333	2.35%	N/A	N/A	N/A
Total	1,293	35	2.70%	$96,838,785	$2,610,597	2.69%	2,565	94	3.66%

Unincorporated Iron County - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,275	102	3.11%	$230,148,114	$7,167,971	3.11%	6,321	317	5.01%
Commercial	388	0	0%	$129,696,289	$0	0%	N/A	N/A	N/A
Total	3,663	102	2.78%	$368,253,819	$7,167,971	1.94%	6,321	317	5.01%



Iron County
Floodzone Map

10 0 10 20 Miles

Five County Association of Governments September 2003 Ed Dickie

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County Boundary

Towns

Major Roads

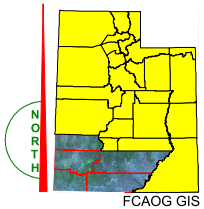
County Road

Interstate

State Route

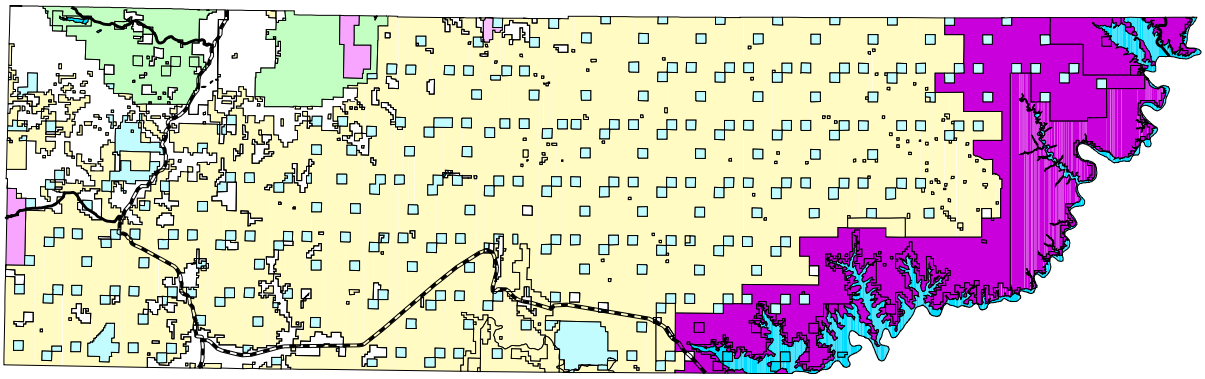
Floodzone A (Digitized from FEMA Floodzone Maps)

* Note: Administrative Ownership is the background layer



FCAOG GIS

Kane County



History

Kane County encompasses an area of 3,904 square miles. The county seat of Kane County is Kanab. The county is named after Thomas L. Kane, an influential supporter of the Church of Jesus Christ of Latter Day Saints. The other cities/towns in Kane County include Alton, Big Water, Glendale and Orderville. The economy is principally driven by tourism and services. Several of the points of interest in Kane County include Lake Powell, Coral Pink Sand Dunes, the Old Paria movie sets, Navajo Lake, and Hole-in-the Rock, accessible from near Escalante in Garfield County.

The high desert landscape of Kane County is located within the Colorado Plateau geographical province. Lake Powell, created by Glen Canyon Dam, on the Colorado River forms the county's eastern border. The northwest corner of the county is forested.

Inhabiting the County during prehistoric times were Indian dwellers that were part of the Anasazi Culture. Archaeologists have recorded hundreds of sites on Fifty Mile Mountain within the Glen Canyon National Recreation Area, but few have been excavated because of their remoteness. Historic Indian groups are primarily Southern Paiute.

Several towns, including Kanab, were settled in the mid-1860s, but later abandoned. Kanab was resettled in 1870 by Levi Stewart and others. This was done at the request of LDS Church President Brigham Young. In March 1874, Brigham Young encouraged the formation of a United Order at Orderville. United Orders were organized in many Utah communities, including Kanab, but the Orderville experiment in communal living was more successful and survived than any of the others. Orderville thus was unique among Utah towns. By the 1880s, however, the United Order of Orderville was dissolved.

During the nineteenth and early twentieth centuries a majority of the county's residents were either farmers or raised livestock. In 1922, when the movie Deadwood Coach with actor Tom Mix was filmed in Kane County, the Parry brothers of Kanab led in the development of lodging, food, and other services for film crews. By the 1930s Kanab was became known as "Little Hollywood" because so many films were shot there.

The 1920s and 1930s also saw Kanab become a tourist center for visitors to Bryce Canyon, Zion, and Grand Canyon national parks. During the construction of Glen Canyon Dam near Page, Arizona, which began in 1956, Kanab's population doubled and the economy boomed. The creation of Lake Powell, one of Utah's major recreational sites, brought new service industries connected with boating and fishing to the area, especially the Bullfrog Basin marina in the extreme northeast corner of the county.

Development Trends

Population

After suffering from out-migration during the 1960s, Kane County has typically experienced faster than average population expansion. However, in the 1990s, Kane County’s growth slowed. Between 1990 and 2000, Kane County’s population grew by 17 percent—placing it in the bottom-third of Utah’s counties. During the 1990s, population grew fastest outside the major townships. In fact, Kanab showed the slowest population expansion of all. Even though Kanab’s growth rate appeared low between 1990 and 2000, it still showed the largest net increase in population because of its size. With almost 3,600 residents, Kanab is

by far the largest city in Kane County. The next largest Town, Orderville, shows only about 600 residents. With only 1.6 persons per square mile, Kane County is one of the least densely populated counties in the state. In comparison to the United States, Kane County's population is much more youth-heavy and at the same time, has a higher share of retirement age people. When compared to the Utah age distribution, Kane County appears much older. The county shows a heavy concentration of residents over the age of 45. The percentage of Kane County's population over the age of 65 registers substantially higher than that of the state or the nation. Both the state of Utah and Kane County have a high share of young people and children compared to the national average. With a higher than average share of "seniors" and young people, Kane County's share of "working-age" population (18 to 65 years old) is much smaller than both the Utah and U.S. figures. Kane County's population is less diverse than either Utah's or the nation's. In 2000, only 5 percent of the population was Hispanic or Nonwhite. In the decade of the 1990s, the most eye-catching change in the county's race/ethnic distribution was the substantial growth in Kane County's Hispanic population. Between 1990 and 2000, Kane County's average household size decreased from 2.98 persons to 2.67 persons. Kane County families are more likely to have a married couple at their head than the state or national averages. Kane County also showed a noticeably smaller percentage of female-headed families with children under 18 years of age. Kane County's share of high school graduates increased between 1990 and 2000 and registers significantly higher than the national average. The share of individuals with a college degree almost doubled in Kane County between 1990 and 2000.

Labor Market Indicators

Lately, most of Kane County's indicators have taken an economic roller coaster ride. However, their clues suggest a less than robust business sector. Job growth (or lack thereof) has shown the most volatility in 2003. However, a huge job dip occurred in early 2002 at more than 6 percent. Then the pendulum took a swing back up to almost 6 percent growth in July 2002. But, by the end of third quarter 2002, the county barely eked out positive growth.

Data for September 2002, shows year over employment expansion of only 0.2 percent. That represents a net gain of less than 10 positions. Many more industries lost jobs than gained them. Retail trade and accommodations/food services took the largest employment hits. Local government (which includes the school district) also showed a significant employment decline.

On the positive side, construction and recreation added enough jobs to offset the declines in other industries. Moreover, the announcement that a major bank will be locating a customer service center in the county should prop up employment numbers.

In comparison to the vacillations in job growth, unemployment rates in the county seem almost stable. True, the rates have had their ups and downs, but they've kept to a fairly narrow corridor between 3 and 4 percent. The February 2003 rate measured only 3.9 percent noticeably below the state and national averages. So, while the job market has gone through some wild fluctuations, most workers have been able to find employment.

Construction Permits

Construction permitting also has varied widely from quarter to quarter. However, the Utah Department of Workforce Services expects that behavior from this particular industry. The final quarter of 2002 ended with an 87 percent year to year increase. However, this last minute construction rush wasn't enough to keep the whole year in the black. Annual 2002 figures show a slight 8 percent decline in authorized construction values.

A decrease in the number of authorized new homes proved the main culprit behind construction's slight 2002 drop. New dwelling unit permits dropped 18 percent in comparison to 2001 and the value of those permits slipped by about 12 percent. But, while Kane County residents might not be building new homes, they are remodeling and making additions to their existing houses. Almost $1.3 million in home renovations was approved a 75 percent increase over 2001.

Nonresidential construction surged ahead in 2002. Values rose almost 20 percent. Larger projects included one public building and one retail store.

Taxable Sales

Kane County continued to experience difficulty in the sales arena. In the past two years, gross taxable sales have increased in only two quarters. Third quarter 2002 didn't depart from that path. Sales dropped 6 percent in comparison to an already poor third quarter 2001. Sales in retail trade were particularly sluggish but a decline in services and wholesale trade sales pushed the overall sales rate into negative territory.

Land Use

Major emphasis in developing the original Kane County Master Plan was necessarily placed on planning facilities to accommodate the growth in numbers of people visiting part of the county where comparatively few people had traveled until the Glen Canyon Dam was under construction between 1956 and 1964.

The county has a wealth of the mineral resources. The oil, gas, coal and uranium resources are manifestly documented. Of lesser impact are copper, magnesium, lead, gold, and silver all of which are deposited throughout the entirety of the county. Development of these resources is controlled by the land use restrictions of the land owners, in most cases the United States government.

The cattle industry has been a mainstay of the economy of Kane County. Through federal mismanagement of the land resources and the general economy, the cattle industry has become less impactual. For this segment of the economy to survive it must be revitalized to meet growing consumer needs. It must be allowed to prosper to enhance the depressed economy of Kane County.

The 4,373 square miles, or approximately 3,798,720 acres of land in Kane County makes it larger than the states of Rhode Island, Delaware, and the District of Columbia combined, and almost as large as the entire state of Connecticut. The sheer size of this area requires effective planning and administration if the future land use developments are to be in the best interest of the general public as well as private individuals.

Of this entire area, only 218 square miles are private deeded lands. The remainder is controlled by the State of Utah (487 square miles) and the Federal Government (3,718 square miles) through the agency of the Bureau of Land Management, the U.S. Forest Service, and the National Park Service.

Kane County is a land rich in natural beauty, natural resources, and great potential. It is also a land that has been "found" by the tourists as well as by the geologists, miners, and developers. The role of the people in Kane County is in preserving those areas that are important while working to develop those resources that can be in a responsible manner.

Development Activities

The following activities have occurred in Kane County during the past year. While this is not an all-inclusive listing, is indicative of the development trends occurring in Kane County.

The Utah Permanent Community Impact Board awarded a $105,000 loan to Glendale for the reconstruction 1.1 miles of streets. Salt Lake Tribune, 4/7/03

The Lake Powell ferry service between Bullfrog Marina and Hall's Crossing resumed. The ferry service was suspended March 3 to allow docks to be relocated to Hobie Cat Beach at Bullfrog. Salt Lake Tribune, 3/30/03

Salt Lake based Zion Bank announced it will create a second customer service center in Kanab. Designed to handle operations if the bank's main facility in West Valley city were knocked out, the Kanab center will add 40 new jobs this year, with a total of 70 jobs expected within three years. The service center jobs will pay between $9 and $10 an hour. Deseret News, 3/22/03

Kanab is considering selling its city owned power system to GarKane, the rural electrical cooperative in south central Utah. If the Kanab City Electric Distribution System sells, the city would seek a franchise arrangement. The city is also considering opening the sale to other potential buyers. Salt Lake Tribune, 3/18/03

The Utah School and Institutional Trust Lands Administration received a donation of 400 acre feet of water rights in Kane County from AMCA Coal Leasing Inc., a subsidiary of ANDALEX Resources, Inc. no longer needs the water since the demise of its plans for coal mining on the Kaparowits Plateau, which became part of the Grand Staircase Escalante Monument in 1996. Salt Lake Tribune, 2/26/03

Construction began on the 190 seat Crescent Moon Theater in Kanab. The theater will be home to a western music and variety show six nights a week during the May-October tourist season. Salt Lake Tribune, 2/2/03

The Board of Business and Economic Development approved Industrial Assistance Fund incentives to a financial services company that may create 70 new jobs in Kane County. The name of the business was not disclosed, but the financial company is considering plans to open a customer service center in Kanab. Deseret News, 1/18/03

The Kanab Fire Department received a $58,000 grant from the Federal Emergency Management Agency for fire operations and firefighter safety programs. Salt Lake Tribune, 10/10/02

Utah ranchers, hit hard by drought, were scheduled to receive millions of dollars in immediate federal aid. The U.S. Department of Agriculture announced it would release $752 million in cash to relieve drought stricken livestock in 37 states. Utah is one of seven states that has declared a statewide drought disaster, and therefore, qualified for a large share of the money. Salt Lake Tribune, 09/20/02

Big Water received $250,000 in grants and loans from the Community Impact Board to pave seven miles of streets. Salt Lake Tribune, 8/8/02

Plans are under way in Glendale for a second co op store along U.S. 89 that will display wares of local artists and craftmakers. The Long Valley Co op, through the Utah Heritage Highway 90 alliance, received a $15,000 grant from the U.S. Forest Service to open the Apple Valley facility. Salt Lake Tribune, 7/20/02

The Kanab City Library has received an $11,010 grant from the Bill and Melinda Gates Foundation. The library must use these funds to expand public access to computers and the internet. Salt Lake Tribune, 6/27/02

Critical Facilities of Kane County

A listing of the Critical Facilities of Kane County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 47:

Table 47 Critical Facilities of Kane County

Name or Description of Asset **Alton Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Alton Fire Station	Claren Heaton	X						$	
Alton Town Hall/Community Center	Claren Heaton	X						$	
Water Tank	Claren Heaton	X						$	
Water Tank	Claren Heaton	X						$	
Water Tank	Claren Heaton	X						$	

Name or Description of Asset **Big Water Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Big Water Fire Station	Big Water	X					Data Unavail.	$unknown	
Big Water School		X	X				30,000 sq. ft.	$1,600,000	
Big Water Town Hall/Community Center		X					Data Unavail.	$unknown	
Water Tank		X					Data Unavail.	$	
Microwave Phone/ITS Site		X					Data Unavail.	$	

Name or Description of Asset **Glendale Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Glendale Town Hall/Community Center		X					data unavail.	$unknown	Floodplain
Glendale Fire Station		X					data unavail.	$unknown	Floodplain
Water Tank		X					data unavail.	$unknown	
Water Tank		X					data unavail.	$unknown	
Water Tank		X					data unavail.	$unknown	

Name or Description of Asset Kane County	Sources Of Information	Critical Facility	Vulnerable Populations	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value (Estimated)	Located in Hazard Area
Kane County Hospital	Kanab City	X					42,780 sq. ft.	$6,000,000	
Kanab Fire Station	Kanab City	X					6,150 sq. ft.	$600,000	
Kanab (Ranchos) Fire Station	Kanab City	X					1,820 sq. ft.	$110,000	
Kanab Police Station	Kanab City	X					1,500 sq. ft.	$95,000	
Kanab Elementary School	Kane County School District	X	X				60,000 sq. ft	$4,800,000	
Kanab Intermediate School	Kane County School District	X					42,000 sq. ft.	$4,500,000	
Kanab High School	Kane County School District	X					80,000 sq. ft.	$9,000,000	
Kanab Community Center	Kanab City	X					4,200 sq. ft.	$300,000	
Kanab Airport (value of buildings only)	Kanab City	X		X			10,888 sq. ft. total (3 buildings)	$250,000	
Kanab Sewer Lagoons	Kanab City	X			X		100 acres	$value unavailable	
Water Tank #1	Kanab City	X					1.5MG	$1,500,000	
Water Tank #2	Kanab City	X					1.5MG	$1,500,000	
Water Tank #3	Kanab City	X					1.0MG	$1,000,000	
Water Tank #4	Kanab City	X					1.0MG	$1,000,000	

Name or Description of Asset **Orderville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Orderville Town Hall	FCAOG	X					not avail.	$unknown	
Orderville Fire Station	FCAOG	X					not avail.	$unknown	
Valley Elementary School	Kane County School District	X	X				not avail.	$unknown	
North Water Tank	FCAOG	X					not avail.	$unknown	Problem Soils
East Water Tank	FCAOG	X					not avail.	$unknown	

Analysis of Infrastructure in Kane County

A listing of the Infrastructure of Garfield County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 48 below

Name of Town **Kanab**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	22	1	17	1	5	0	0	0	0	0	0	0	0	5
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	149.59	5.60	128.20	.82	3.28	0	0	0	0	0	0	0	0	3.28
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	46.32	0	46.19	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	131.21	0	127.84	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	155.65	.46	153.34											
Land Slides (sq miles)	224.12	.02	223.85											
Problem Soils (sq miles)	445.65	0	443.09											
Volcanic Flows (sq miles)	32.83	0	32.68											
Wildfires (sq miles)	1013.31	.60	1000											

Name of Town **Alton**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0		0	0	0
# of Highway Bridges	22	0	17	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	149.59	0	128.20	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	46.32	0	46.19	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	131.21	0	127.84	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	155.65	0	153.34											
Land Slides (sq miles)	224.12	0	223.85											
Problem Soils (sq miles)	445.65	0	443.09											
Volcanic Flows (sq miles)	32.83	0	32.68											
Wildfires (sq miles)	1013.31	.01	1000											

Name of Town **Big Water**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	22	0	17	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	149.59	3.9	128.20	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	46.32	.13	46.19	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	131.21	0	127.84	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	155.65	.35	153.34											
Land Slides (sq miles)	224.12	0	223.85											
Problem Soils (sq miles)	445.65	.001	443.09											
Volcanic Flows (sq miles)	32.83	00	32.68											
Wildfires (sq miles)	1013.31	13.31	1000											

Name of Town **Glendale**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0	1	0	0	0
# of Highway Bridges	22	2	17	1	5	0	0	0	0	0	0	1	5	10
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	149.59	7.49	128.20	1.51	6	0	0	0	0	0	0	4.79	0	6
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	46.32	0	46.19	.92	.046	0	0	0	0	0	0	0	0	.046
Other Utility Lines (miles)	131.21	3.37	127.84	0	0	0	0	0	0	0	0	2.01	.100	.100
HAZARDS														
Flood Zones (sq miles)	155.65	.48	153.34											
Land Slides (sq miles)	224.12	.18	223.85											
Problem Soils (sq miles)	445.65	0	443.09											
Volcanic Flows (sq miles)	32.83	.15	32.68											
Wildfires (sq miles)	1013.31	5.82	1000											

Name of Town **Orderville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	22	4	17	4	20		0	1	5	0	0	3	0	25
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	149.59	7.49	128.20	2.27	9	0	0	2.26	9	0	0	4.03	0	18
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	46.32	0	46.19	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	131.21	0	127.84	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	155.65	1.02	153.34											
Land Slides (sq miles)	224.12	.08	223.85											
Problem Soils (sq miles)	445.65	2.55	443.09											
Volcanic Flows (sq miles)	32.83	00	32.68											
Wildfires (sq miles)	1013.31	6.76	1000											

Unincorporated Area of County	County Total	Towns Total	Unincorporated	Flood Zone Unincorporated	Flood Zone Costs in Millions $	Land Slide Unincorporated	Land Slide Costs in Millions $	Problem Soil Unincorporated	Problem Soil Costs in Millions $	Volcanic Flow Unincorporated	Volcanic Flow Costs in Millions $	Wildfire Unincorporated	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards
# of Dams (High Hazard)	0	0	0	0	0	0	0	0	0	0	0	3	0	0
# of Highway Bridges	22	4	17	4	20	0	0	1	5	0	0	6	0	25
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	
Major Roads (miles)	149.59	7.49	128.20	5.07	20	2.05	8	10.5	42	3.97	16	50.3	0	86
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	
Utility Lines (miles)	46.32	0	46.19	1.56	.078	0	0	2.31	.12	0	0	5.11	20.5	21.35
Other Utility Lines (miles)	131.21	0	127.84	0	0	1.04	52k	18.5	.93	0	0	43.3	2.16	4.123
HAZARDS														
Flood Zones (sq miles)	155.65	1.02	153.34											
Land Slides (sq miles)	224.12	.08	223.85											
Problem Soils (sq miles)	445.65	2.55	443.09											
Volcanic Flows (sq miles)	32.83	00	32.68											
Wildfires (sq miles)	1013.31	13.31	1000											

Wildfire

FEMA Hazard Profile

Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to structures in incorporated communities and Moderate to High to structures in unincorporated Kane County.
Duration: Containment time varies for each fire.

Assessing Vulnerability

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire. See Table 49 below for an analysis of wildfire risk in Kane County.

In unincorporated Kane County there are 91 residential structures at moderate risk from wildfire. Based upon figures provided by the Kane County Assessors Office, the market value of those structures is estimated to be $2,101,653. There are 8 residential structures at high risk from wildfire. Based upon figures provided by the Kane County Assessors Office, the market value of those structures is estimated to be $183,023. Based upon the average household size of 2.67 persons, in Kane County, from the 2000 U.S. Census, there are approximately 264 persons residing full or part time in a structure at moderate or high risk from wildfire. This is 26.93% of the 980 population of unincorporated Kane County. There are approximately 243 persons at moderate risk of wildfire. There are approximately 21 persons at high risk of wildfire.

In the town of Glendale there are 43 residential units in high wildfire risk area with an estimated market value of $2,786,200. This is 27.92% of the residential units in the town. There are approximately 132 persons (37.16% of the Town's population) at high risk from wildfire.

In Kanab City there are 5 residential units in a moderate wildfire risk area with an estimated market value of $400,341. This is 0.35% of the residential units in the city. There are approximately 13 persons (0.36% of the City's population) at risk from wildfire.

In the town of Orderville there are 11 residential units in a moderate wildfire risk area with an estimated market value of $662,693. This is 4.43% of the residential units in the city. There are approximately 34 persons (5.70% of the town's population) at moderate risk from wildfire. There are 60 residential units in a high wildfire risk area with an estimated market value of $3,613,342. This is 24.19% of the residential units in the city. There are approximately 184 persons (30.87% of the City's population) at risk from wildfire.

Number of People/Buildings Impacted by Wildfire

Table 49 Analysis of Wildfire Risk in Kane County

Alton - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	57	0	0%	$2,957,595	$0	0%	134	0	0%
Commercial	1	0	0%	$1,136,763	$0	0%	N/A	N/	N/A
Total	58	0	0%	$4,094,358	$0	0%	134	0	0%

Big Water – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	274	0	0%	$12,996,303	$0	0%	417	0	0%
Commercial	33	0	0%	$6,418,007	$0	0%	N/A	N/A	N/A
Total	307	0	0%	$19,414,310	$0	0%	417	0	0%

Glendale - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	154	43	27.92%	$9,979,229	$2,786,200	27.92%	355	132	37.18%
Commercial	10	0	0%	$705,510	$0	0%	N/A	N/A	N/A
Total	164	43	26.21%	$10,684,739	$2,786,200	26.07%	355	132	37.18%

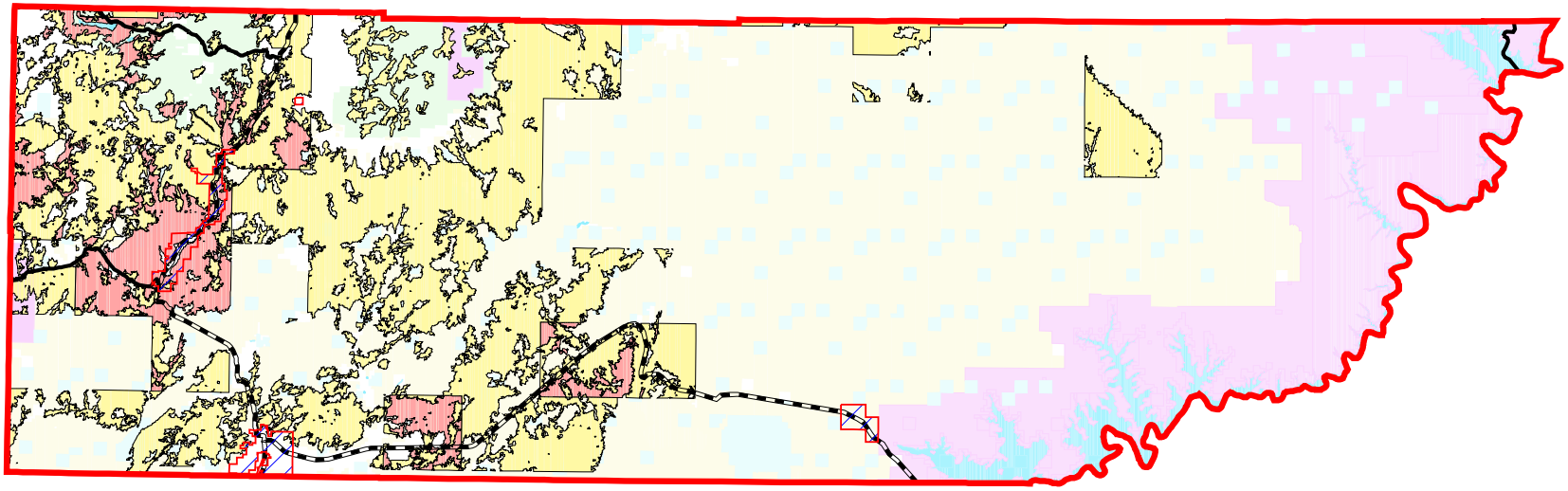
Kanab - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1426	5	0.35%	$114,383,283	$400,341	0.35%	3564	13	0.36%
Commercial	145	0	0%	$31,714,052	$0	0%	N/A	N/A	N/A
Total	1571	5	0.31%	$146,097,335	$400,341	0.27%	3564	13	0.36%

Orderville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	248	71	28.62%	$14,940,725	$4,276,035	28.62%	596	218	36.57%
Commercial	31	0	0%	$5,564,571	$0	0%	N/A	N/A	N/A
Total	279	71	25.44%	$20,505,296	$4,276,035	20.85%	596	218	36.57%

Unincorporated Kane County areas - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2624	99	3.77%	$60,601,537	$2,284,677	3.77%	980	264	26.93%
Commercial	68	0	0%	$26,671,445	$0	10.30%	N/A	N/A	N/A
Total	2692	99	3.67%	$87,272,982	$2,284,677	2.61%	980	264	26.93%

Kane County

Wildfire Map



20 0 20 40 Miles

Kane County Boundary

Towns

Fire Zones W/sq. miles

High 177.19

Moderate 836.12

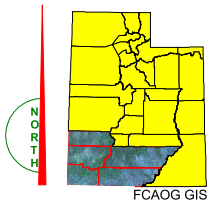
Major Roads

I-15

State Route

US Route

* Note: Administrative Ownership is the background layer



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Landslides

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified areas at risk from landslide residential and commercial structures at risk from landslide. See Table 50 for an analysis of landslide risk in Kane County.

According to the available data, there is one residential structure at risk from landslide in unincorporated Kane County. This is 0.03% of the residential units in unincorporated Kane County. The market value of this structure is estimated to be $23,095.

There are 11 residential structures at risk from landslide in Orderville. This is 4.43% of the residential units in Orderville. The market value of those structures is estimated to be $661,874.

Available data indicates that there appears to be no commercial structures at risk from landslide in Kane County.

Number of People/Buildings Impacted by Landslides

Table 50 Analysis of Landslide Risk in Kane County

Alton - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	57	0	0%	$2,957,595	$0	0%	134	0	0%
Commercial	1	0	0%	$1,136,763	$0	0%	N/A	N/	N/A
Total	58	0	0%	$4,094,358	$0	0%	134	0	0%

Big Water – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	274	0	0%	$12,996,303	$0	0%	417	0	0%
Commercial	33	0	0%	$6,418,007	$0	0%	N/A	N/A	N/A
Total	307	0	0%	$19,414,310	$0	0%	417	0	0%

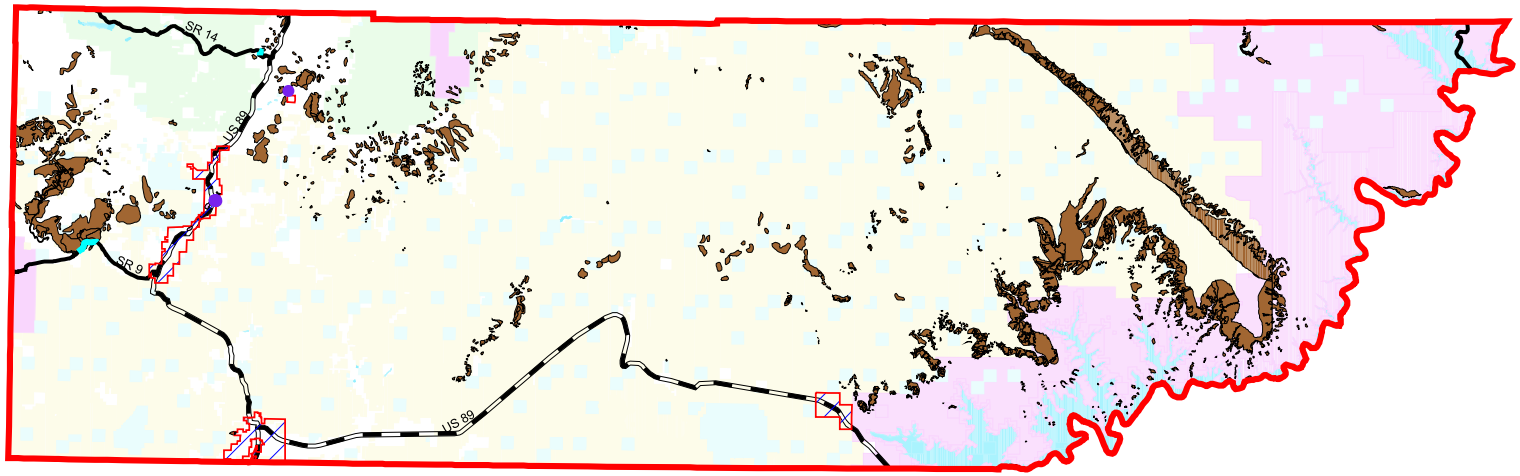
Glendale - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	154	0	0%	$9,979,229	$0	0%	355	0	0%
Commercial	10	0	0%	$705,510	$0	0%	N/A	N/A	N/A
Total	164	0	0%	$10,684,739	$0	0%	355	0	0%

Kanab - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1426	0	0%	$114,383,283	$0	0%	3564	0	0%
Commercial	145	0	0%	$31,714,052	$0	0%	N/A	N/A	N/A
Total	1571	0	0%	$146,097,335	$0	0%	3564	0	0%

Orderville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	248	11	4.43%	$14,940,725	$661,874	4.43%	596	34	5.7%
Commercial	31	0	0%	$5,564,571	$0	0%	N/A	N/A	N/A
Total	279	11	3.94%	$20,505,296	$661,874	3.23%	596	34	5.7%

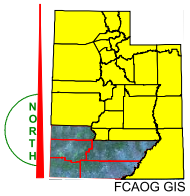
Unincorporated Kane County areas - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2624	1	0.03%	$60,601,537	$23,095	0.03%	980	3	0.30%
Commercial	68	0	0%	$26,671,445	$0	0%	N/A	N/A	N/A
Total	2692	1	0.03%	$87,272,982	$23,095	0.02%	980	3	0.30%

Kane County
Landslide Map



20 0 20 40 Miles

Kane County Boundary
Towns
Landslides
Major Roads
State Route
US Route
* Note: Administrative Ownership is the background layer



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Earthquake

Assessing Vulnerability and Overall Summary of Impacts

HAZUS MH Earthquake Vulnerability Assessment

See Table 51 below for an estimate of earthquake casualties.

Table 51 Earthquake Casualties Risk in Iron County

Casualties	Nighttime –Minor	32
	Nighttime –Major	1
	Nighttime -Fatalities	1
	Daytime –Minor	35
	Daytime –Major	1
	Daytime- Fatalities	2
	Commute –Minor	30
	Commute –Major	1
	Commute-Fatalities	2

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 52 below lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 52 Building Damage from Moderate to Complete by Count

Category	Number of Structures	Total Cost in millions of dollars **
Residential	511	38.28
Commercial	16	9.82
Industrial	0	1.14
Totals	1,266*	50.93**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Table 53 Damage to Critical Facilities from Moderate to Complete

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	0
Schools	7	0	0	0
EOCs	1	0	0	1
Police Stations	3	0	0	0
Fire Stations	1	0	0	1

Debris Removal –Table 54 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty

thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 54 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	40
Loads (25 tons per load)	1,600

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 55 below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

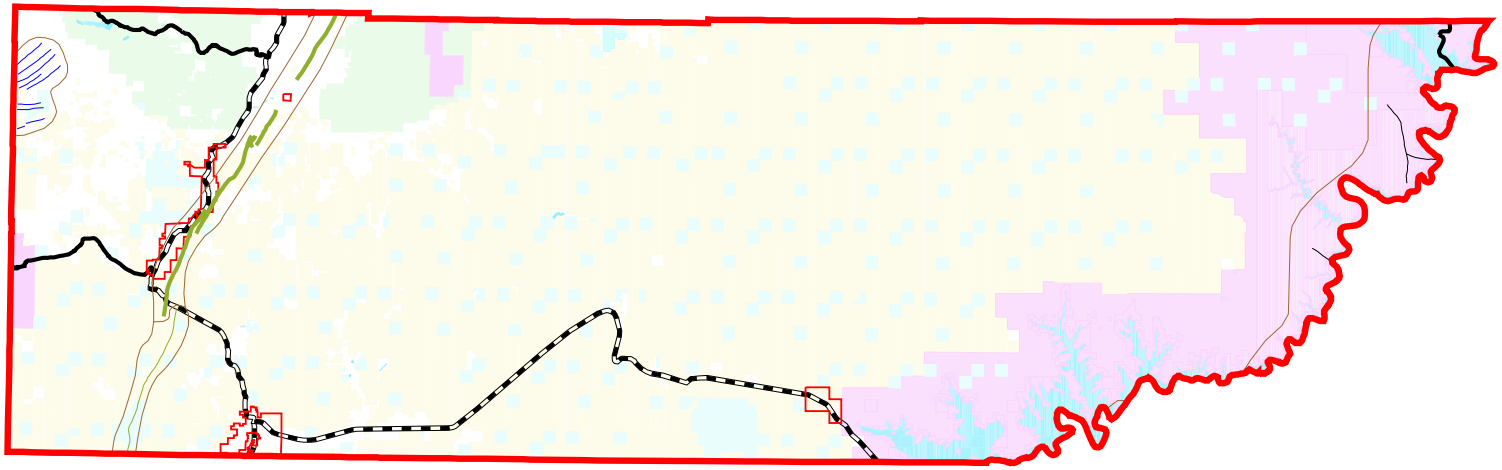
Table 55 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete HAZUS MH run performed by the Utah Division of Emergency Services and Homeland Security is available at the Five County Association of Governments.

Kane County

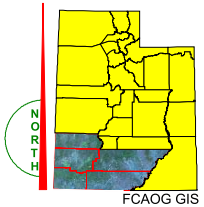
Earthquake Map



8 0 8 16 24 Miles

County Boundaries
Towns
Major Roads
I-15
State Route
US Route
Fault Groups
Folds
Fault Lines
123 = Latest Quaternary (<15,000 years)
124 = Latest Quaternary (<15,000 years)
133 = Late Quaternary (<130,000 years)
134 = Late Quaternary (<130,000 years)
144 = Mid to Late Quaternary (<750,000 years)
154 = Quaternary (<1,600,000 years)

* Note: Administrative Ownership is the background layer



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Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available floodplain data, has identified residential and commercial structures located within the 100-year floodplain (A Zone). See Table 56 below for an analysis of flood risk in Kane County.

Based upon review of available data, in the town of Glendale there are 62 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $4,017,611. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.06 persons per household in Glendale, there are approximately 189 persons at risk from floodplains.

Based upon review of available data, in the town of Orderville there are 108 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $6,506,444. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.07 persons per household in Orderville, there are approximately 331 persons at risk from floodplains.

Based upon review of available data, in Kanab City there are 87 residential structures located in a Floodplain (A Zone). Based upon an average market value of residential structures in the town, the market value of those structures is approximately $6,978,503. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.64 persons per household in Kanab, there are approximately 229 persons at risk from floodplains.

Based upon review of available data, in unincorporated Kane County there are 16 residential structures located in a Floodplain (A Zone). Five of these structures are located in unincorporated area just north of Kanab City. The other eleven structures are located in Johnson Canyon area. Based upon an average market value of residential structures in unincorporated Kane County, the market value of those structures is approximately $369,521. Based an average household size (U.S. Census Bureau, Census 2000) of 2.67 persons per household in Kane County, there are approximately 43 persons at risk from floodplains.

Number of People and Buildings/Structures Impacted by Floodplains

Table 56 Analysis of Flood Risk in Kane County

Alton - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	57	0	0%	$2,957,595	$0	0%	134	0	0%
Commercial	1	0	0%	$1,136,763	$0	0%	N/A	N/A	N/A
Total	58	0	0%	$4,094,358	$0	0%	134	0	0%

Big Water – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	274	0	0%	$12,996,303	$0	0%	417	0	0%
Commercial	33	0	0%	$6,418,007	$0	0%	N/A	N/A	N/A
Total	307	0	0%	$19,414,310	$0	0%	417	0	0%

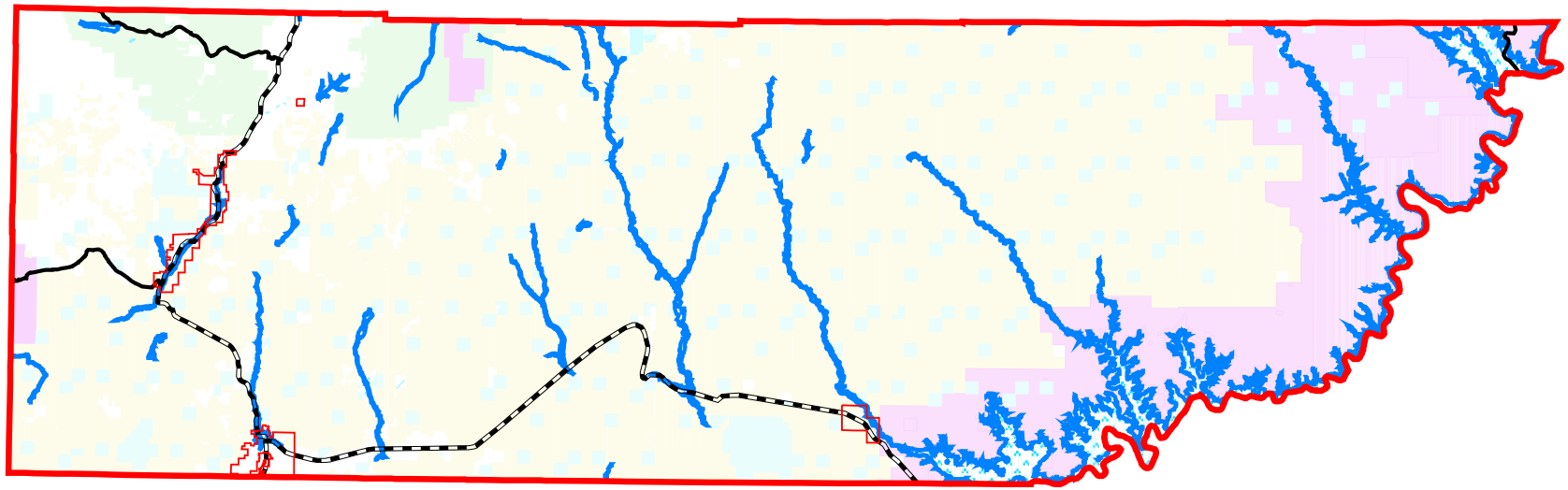
Glendale - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	154	62	40.26%	$9,979,229	$4,017,611	40.26%	355	189	53.24%
Commercial	10	0	0%	$705,510	$0	0%	N/A	N/A	N/A
Total	164	62	37.80%	$10,684,739	$4,017,611	37.60%	355	189	53.24%

Kanab - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1426	87	6.10%	$114,383,283	$6,978,503	6.10%	3564	229	6.42%
Commercial	145	8	5.51%	$31,714,052	$1,749,740	5.51%	N/A	N/A	N/A
Total	1571	95	6.04%	$146,097,335	$8,728,243	5.97%	3564	229	6.42%

Orderville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	248	108	43.54%	$14,940,725	$6,506,444	43.54%	596	331	55.53%
Commercial	31	10	32.25%	$5,564,571	$1,795,022	32.25%	N/A	N/A	N/A
Total	279	118	42.29%	$20,505,296	$8,301,466	40.48%	596	331	55.53%

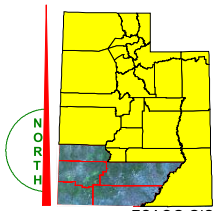
Unincorporated Kane County areas - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2624	16	0.60%	$60,601,537	$369,521	0.60%	980	43	4.38%
Commercial	68	0	0%	$26,671,445	$0	0%	N/A	N/A	N/A
Total	2692	16	0.59%	$87,272,982	$369,521	0.42%	980	43	4.38%

Kane County
Floodzone Map



20 0 20 40 Miles

County Boundary
Towns
Floodzone A (Digitized from FEMA Floodzone Maps)
Major Roads
County Road
Interstate
State Route
* Note: Administrative Ownership is the background layer



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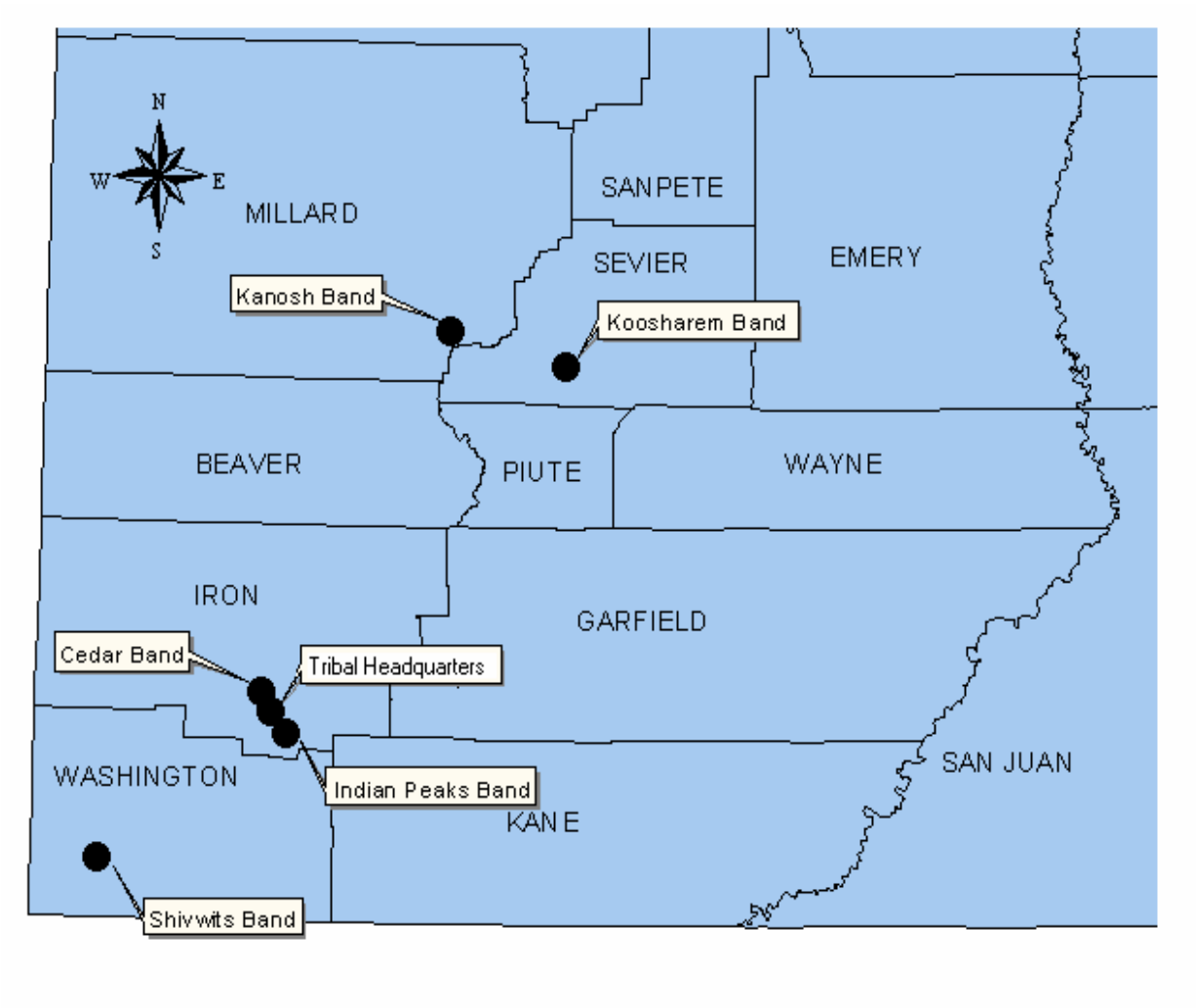
Paiute Indian Tribe Of Utah

Introduction

Location - The Tribal headquarters of the PITU is located in Southeastern Iron County approximately 280 miles South of Salt Lake City on Interstate Highway 15, and adjacent to Cedar City. The geographic location of Tribal Headquarters in relation to the five bands are approximately 84 miles from Shivwits, 5 miles from Indian Peaks and Cedar Band, 115 miles from Koosharem, and 105 miles from Kanosh. All are paved roads with good access. Figure 8, below, PITU Tribal Lands, shows the location of tribal lands in relation to Southern and Central Utah.

Figure 8: **PITU Tribal Lands**



Land Use - Reservation lands of the PITU encompass a total of 32,480 acres. Other than 35 acres of land housing the tribal headquarters and controlled by the Tribal Council, the other 32,445 acres are maintained and controlled by the five tribal bands (see PITU Reservation Lands Comparison). Results of a recent economic development survey revealed that tribal members feel their culture and land are their two greatest strengths ix B).

The majority of survey respondents felt that preservation of reservation lands was most important with planned industrial and community development. Each band's CEDS outlines their respective designation of land use (see Appendices C,D,E,F and G). The graph in

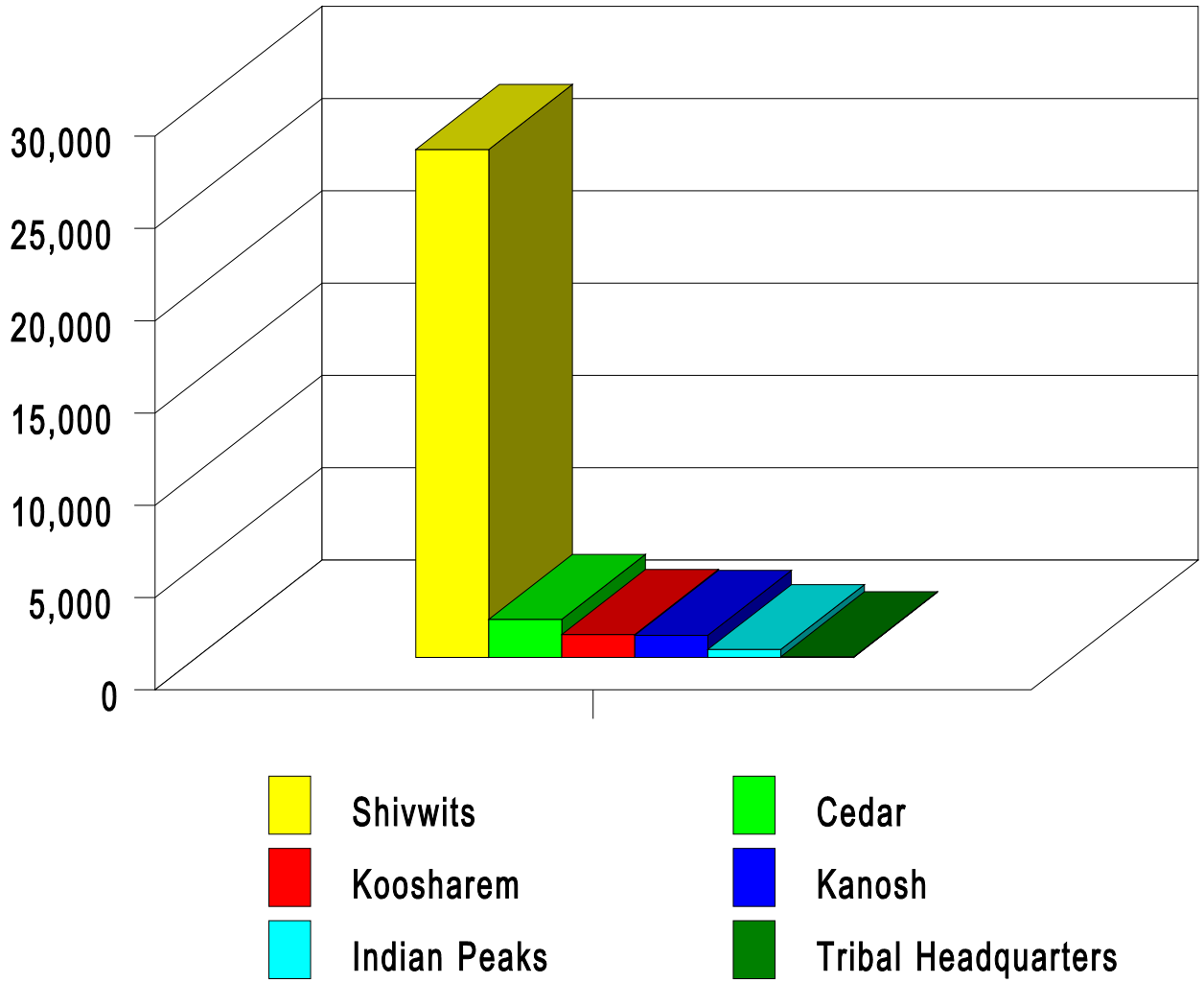


Figure 9, PITU Reservation Lands, compares the land holdings of each band which makes up the PITU reservation.

Figure 9: **PITU Reservation Lands**

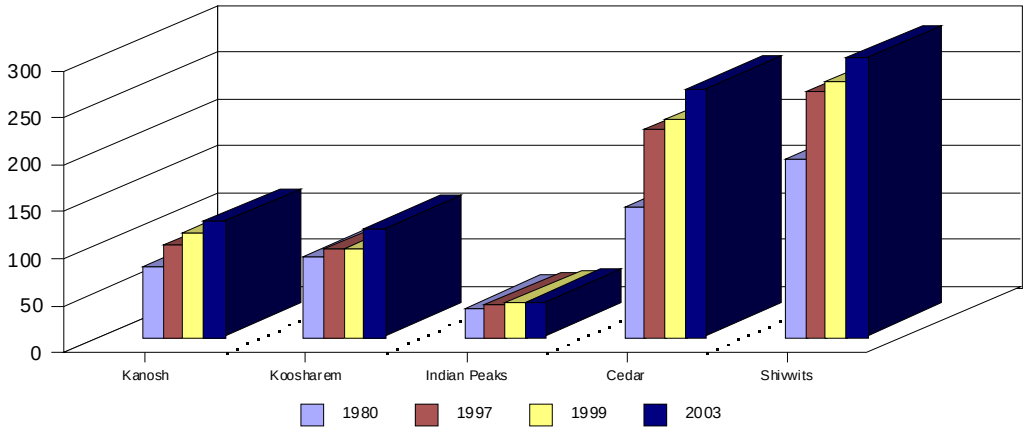
Table 57, PITU Reservation Land Comparison, identifies the actual land acreage of the PITU reservation. This chart compares land acreage of the five bands of the PITU along with the total acreage of State of Utah. Each band has completed a land use plan and is responsible for their respective land use development. Copies of these plans are available for review at the Tribal offices or through individual band councils.

Table 57 - PITU Reservation Land Comparison

Place	Acres
Shivwits Reservation	27,525
Cedar Reservation	2,060
Koosharem Reservation	1,240
Kanosh Reservation	1,195
Indian Peaks Reservation	425
Tribal Headquarters	35
Total Land Holdings of the PITU	**32,480**
State of Utah	54,021,252

Band Membership - According to the July 1999 PITU Tribal enrollment there are 741 members. This compares to 516 in 1980. The graph in Figure 10, below, PITU Population, shows the population trend since 1980.

Figure 10 - PITU Population



Source: 1980"Proposed PITU Reservation Plan," by US. Dept. Of the Interior, Bureau of Indian Affairs; data was compiled by Geneal Anderson and Gerald Kanosh, July 1999; 2003 estimates compiled by Six County Planning Staff.

Table 58, PITU Membership, shows the tribal enrollment according to age and gender. Fifty-seven percent (57%) or 421 members are included in the workforce which is sufficient to support a sizable business owned and employed by Tribal members. Table 59, PITU Membership Trends, evaluates membership trends of each band in the PITU.

Table 58 - PITU Membership

Age	Females	Males
1-5	39	37
6-10	49	44
11-15	44	62
16-20	42	47
21-25	38	39
26-30	44	27
31-40	65	44
41-50	67	52
51-60	31	27
Over 60	15	20
Totals	**434**	**399**

Source: PITU Health Department records, 1999; Six County Planning Estimates for 2003; Totals may not add due to rounding.

Table 59 PITU Membership Trends

Band	1980	1997	1999	2003
Kanosh	74	97	110	122
Koosharem	85	92	94	115
Indian Peaks	30	33	35	36
Cedar	138	220	231	264
Shivwits	189	260	271	296
PITU Total	**516**	**702**	**741**	**833**

Source: PITU Health Department records, 1999; and Six County Planning Estimates for 2003.

Currently 17% of Tribal members are living outside of the counties encompassing reservation lands. The PITU Habitat Chart, Figure 11, graphically displays the current membership who live within and outside of the area. Tribal leadership would like to see improved conditions through economic and community development that would allow members to reside on the reservation.

Figure 11 PITU Habitat Chart

Source: PITU Health Department records, 1999

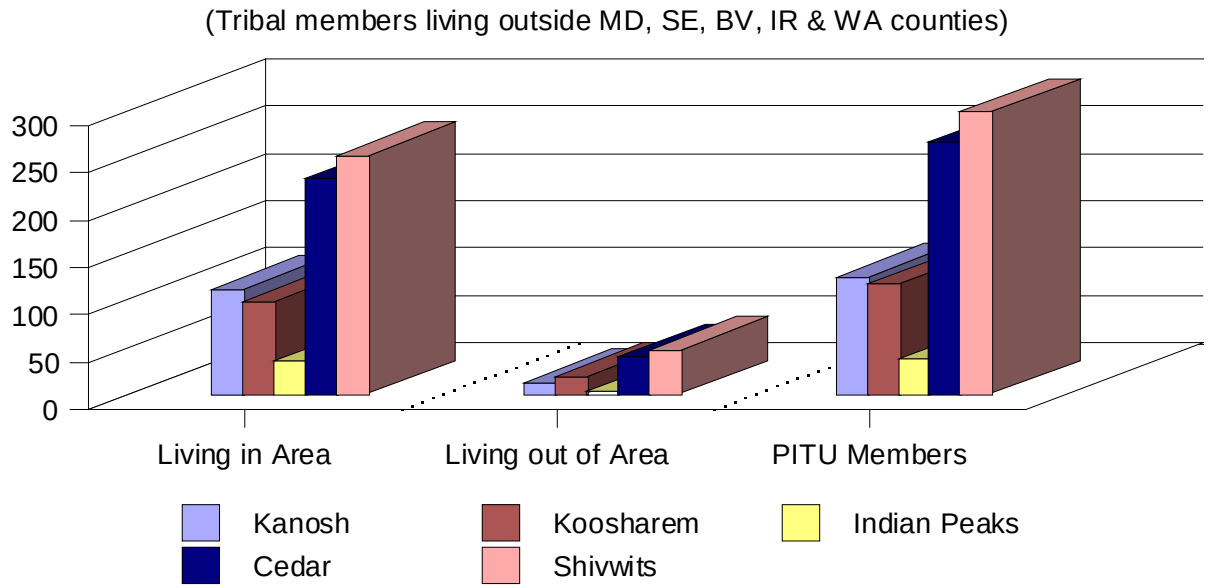


Table 60 below PITU Habitat Chart, provides a comparison of membership of Tribal members living out of the area. Lack of affordable housing and employment seem to be the major reasons for those leaving and living away from the reservation. Another major concern of Tribal leadership is the loss of heritage and cultural values that are disappearing as a result of members living and working outside of the area.

Table 60 - PITU Habitat Chart

Band	In Area	Out of Area	Total Members
Kanosh	110	12	122
Koosharem	97	18	115
Indian Peaks	34	2	36
Cedar	226	38	264
Shivwits	250	46	296
PITU Totals	**717**	**116**	**833**

Land Utilization

The tribal government of PITU does not control reservation lands. Each of the five constituent bands are responsible for their respective land preservation or development. Needed infrastructure to support community and economic development are the responsibility of each band and supported by Tribal Council of the PITU. Concerns among tribal members include affordable housing, water development, industrial zoning, natural resource use and preservation. A general land use plan for the PITU has been developed.

This document should be reviewed to understand current infrastructure and land utilization. Copies of the plan may be reviewed at the Tribal or band headquarters.

Political Environment

Tribal council members are elected to four year terms and meet on a monthly basis. Presently, the Council directs the economic development efforts through the Paiute Economic Development Committee (PEDCO) and are pro-active in achieving and attaining planned growth. They are interested in the development of industry that utilizes their natural resources and heritage, and that will enhance their standard of living through the creation of family sustaining employment. Through a collaborative effort with other local, state, and federal governments the Council is striving to overcome major stumbling blocks including lack of education, underemployment, social ills, lack of business skills, and strained relationships with neighboring cities, counties, and tribe.

Conclusion

The PITU has a rich heritage disrupted by the cultural changes brought by modern society. Nearly wiped out as a people – historically – due to poor economic and living conditions, the PITU has adopted a pro-active position in economic and community development. The development of this CEDS is the first step in achieving their goals toward enhancing their quality of life through the development of family sustaining employment for their members. The implementation of the goals, objectives, and strategies set forth by this document will perpetuate the planning process for the PITU as they strive to meet their economic development endeavors.

(Information regarding the Paiute Tribe of Utah was compiled by the Six County Association of Governments)

Analysis of Infrastructure of Paiute Nation

PITU Lands	**X**	**PITU Land Total**	**X**	**Flood Zone Total**	**Flood Zone Costs in Millions $**	**Land Slide Total**	**Land slide Costs in Millions $**	**Problem Soil Total**	**Problem Soil Costs in Millions $**	**Volcanic Flow Total**	**Volcanic Flow Costs in Millions $**	**Wildfire total**	**Wildfire Costs in Millions $**	**Total Hazard Costs in Millions**
# of Dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	0	.08	0											
Land Slides (sq miles)	0	0	0											
Problem Soils (sq miles)	0	0	0											
Volcanic Flows (sq miles)	0	0	0											
Wildfires (sq miles)	0	0	0											

Name of Band **INDIAN PEAKS**	**X**	**Indian Peaks Band Total**	**X**	**Flood Zone Total**	**Flood Zone Costs in Millions $**	**Land Slide Total**	**Land Slide Costs in Millions $**	**Problem Soil Total**	**Problem Soil Costs in Millions $**	**Volcanic Flow Total**	**Volcanic Flow Costs in Millions $**	**Wildfire Total**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	0	0	0											
Land Slides (sq miles)	0	0	0											
Problem Soils (sq miles)	0	0	0											
Volcanic Flows (sq miles)	0	0	0											
Wildfires (sq miles)	0	.67	0											

Name of Band **CEDAR**	**X**	**Cedar Band Total**	**X**	**Flood Zone Total**	**Flood Zone Costs in Millions $**	**Land Slide Total**	**Land Slide Costs in Millions $**	**Problem Soil Total**	**Problem Soil Costs in Millions $**	**Volcanic Flow total**	**Volcanic Flow Costs in Millions $**	**Wildfire Total**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	0	0	0	0	0	0	0	0	0	0	0	2	0	0
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	0	1.16	0	0	0	.28	1	0	0	0	0	1.16	0	1
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	0	.38	0	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	0	0	0											
Land Slides (sq miles)	0	.14	0											
Problem Soils (sq miles)	0	0	0											
Volcanic Flows (sq miles)	0	0	0											
Wildfires (sq miles)	0	2.92	0											

Name of Band **SHIVWITS**	X	Shivwits Band Total	X	Flood Zone Total	Flood Zone Costs in Millions $	Land Slide Total	Land Slide Costs in Millions $	Problem Soil Total	Problem Soil Costs in Millions $	Volcanic Flow Total	Volcanic Flow Costs in Millions $	Wildfire Total	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards
# of Dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	0	2	0	2	10	0	0	0	0	0	0	1	0	10
# of Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	0	8.82	0	.74	3	0	0	3.53	14	0	0	8.82	0	17
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	0	1.3	0											
Land Slides (sq miles)	0	1.22	0											
Problem Soils (sq miles)	0	21.37	0											
Volcanic Flows (sq miles)	0	0	0											
Wildfires (sq miles)	0	39.92	0											

Wildfire

FEMA Hazard Profile
Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to moderate to structures on Paiute Indian Tribe of Utah land. Moderate to high on land nearby.
Duration: Containment time varies for each fire.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and

suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire.

Within Shivwits Band lands of the Paiute Indian Tribe of Utah there are 24 residential structures at moderate risk from wildfire. According to information provided by the Paiute Indian Tribe of Utah, the value of these structures is estimated at $2,400,000.00. Approximately 96 persons are at moderate risk from wildfire.

Paiute Indian Tribe of Utah, Cedar Band – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	38	0	0%	$0	$0	0%	152	0	0%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	38	0	0%	$0	$0	0%	152	0	0%

Paiute Indian Tribe of Utah, Indian Peaks Band – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	6	0	0%	$600,000	$0	0%	24	0	0%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	6	0	0%	$600,000	$0	0%	24	0	0%

Paiute Indian Tribe of Utah, Shivwits Band – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	24	24	100%	$2,400,000	$2,400,000	100%	96	96	100%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	24	24	100%	$2,400,000	$2,400,000	100%	96	96	100%

Landslide

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to any structures on Paiute Indian Tribe of Utah land.
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified areas at risk from landslide residential and commercial structures at risk from landslide.

The population and value estimates were provided by the Paiute Indian Tribe of Utah. According to the available data, there are no residential structures at risk from landslide in any of the Paiute Indian Tribe of Utah lands. The same data also indicates that there are no commercial structures at risk from landslide on the tribal lands.

Number of People and Buildings/Structures Impacted by Landslide

Paiute Indian Tribe of Utah, Cedar Band – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	38	0	0%	$3,800,000	$0	0%	152	0	0%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	38	0	0%	$3,800,000	$0	0%	152	0	0%

Paiute Indian Tribe of Utah, Indian Peaks Band – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	6	0	0%	$600,000	$0	0%	24	0	0%
Commercial	0	0	0%	$600,000	$0	0%	N/A	N/A	N/A
Total	6	0	0%	$600,000	$0	0%	24	0	0%

Paiute Indian Tribe of Utah, Shivwits Band – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	24	0	0%	$2,400,000	$0	0%	96	0	0%
Commercial	0	0	0%	$2,400,000	$0	0%	N/A	N/A	N/A
Total	24	0	0%	$2,400,000	$0	0%	96	0	0%

Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location. Cedar Band is especially vulnerable.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Assessing Vulnerability: Identifying Assets and Estimating Losses

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified areas at risk from flooding of residential and commercial structures .

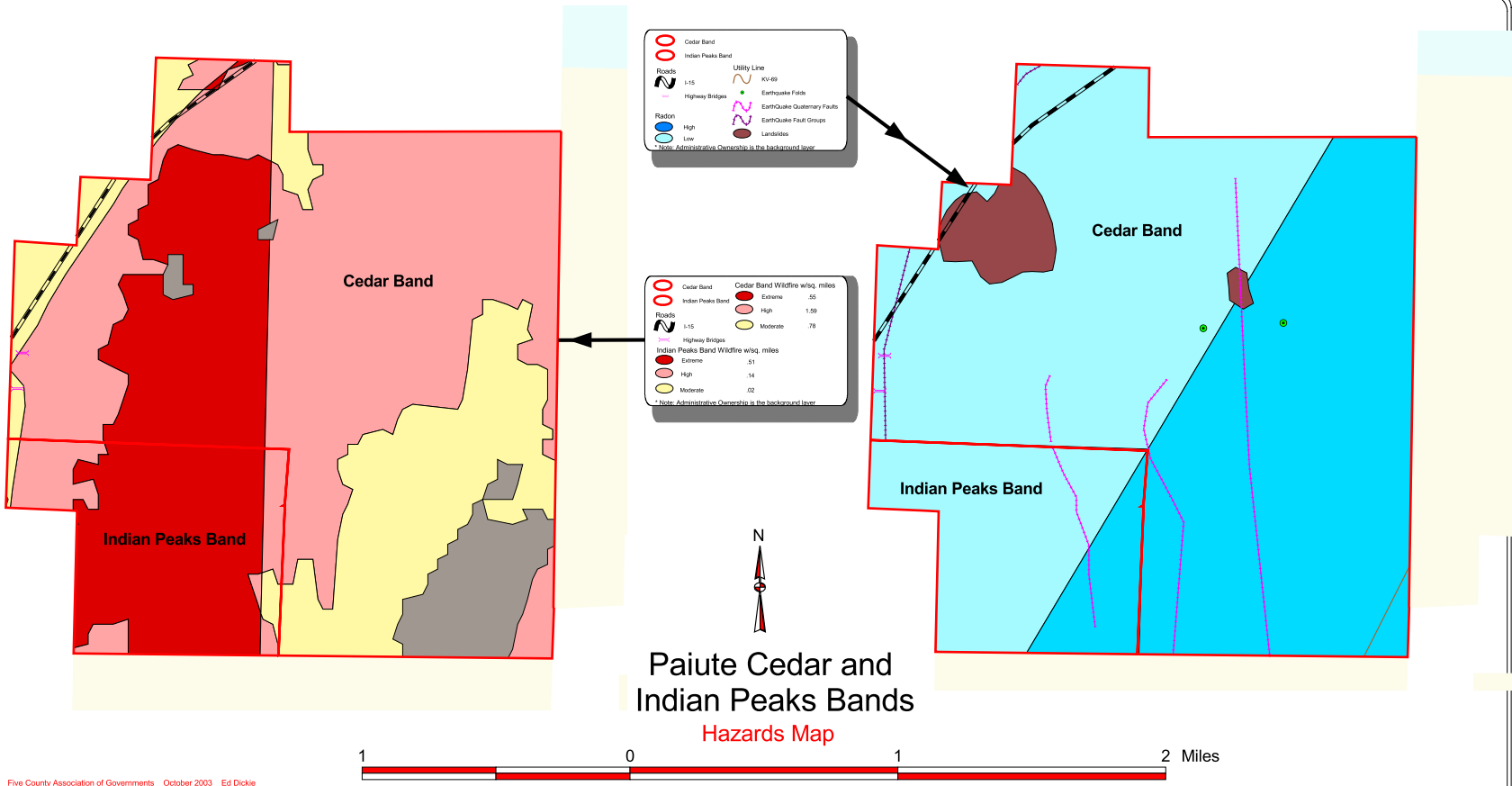
The population and value estimates were provided by the Paiute Indian Tribe of Utah. According to the available data, there are 36 residential structures at risk from landslide on Paiute Indian Tribe of Utah lands. The estimated value of those structures is $3,600,000.

Number of People and Buildings/Structures Impacted by Floodplains

Paiute Indian Tribe of Utah, Cedar Band – Floodplain									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	38	36	94.73%	$3,800,000	$3,600,000	94.73%	152	144	94.73%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	38	36	94.73%	$3,800,000	$3,800,000	94.73%	152	144	94.73%

Paiute Indian Tribe of Utah, Indian Peaks Band – Floodplain									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	6	0	0%	$600,000	$0	0%	24	0	0%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	6	0	0%	$600,000	$0	0%	24	0	0%

Paiute Indian Tribe of Utah, Shivwits Band – Floodplain									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	24	0	0%	$2,400,000	$0	0%	96	0	0%
Commercial	0	0	0%	$0	$0	0%	N/A	N/A	N/A
Total	24	0	0%	$2,400,000	$0	0%	96	0	0%



Paiute Cedar and Indian Peaks Bands

Hazards Map

Five County Association of Governments October 2003 Ed Dickie

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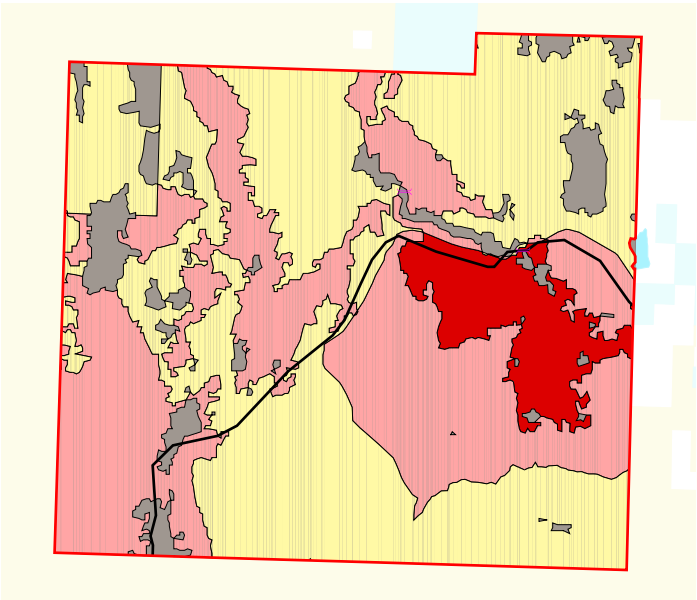
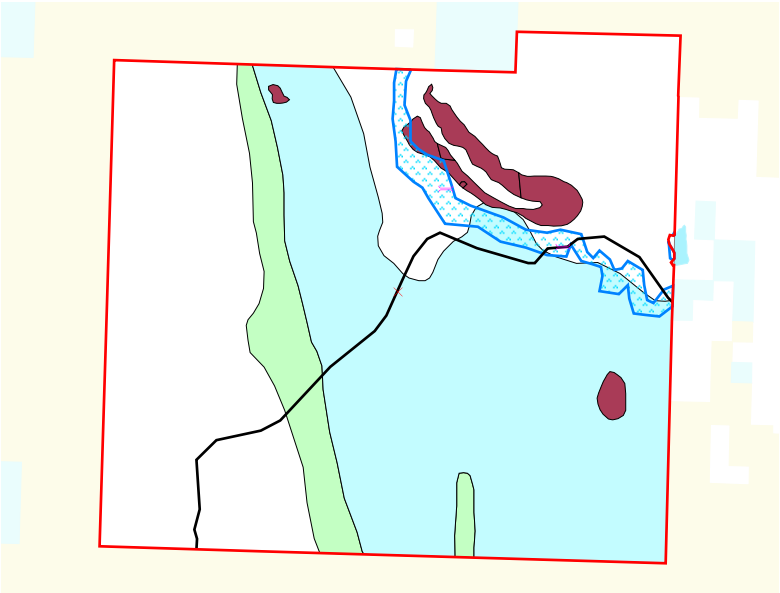
435-673-3548 email edickie@fcaog.state.ut.us

Note: South Central Drought encompass the whole subject area of the Cedar and Indian Peaks Band's





Shivwits Band
Highway Bridge
Shivwits Major Road

Wildfire	sq. mile
Extreme	3
High	15.86
Moderate	21.06

* Note: Administrative Ownership is the background layer

N

Paiute Shivwits Band

Hazards Map

Shivwits Band
Shivwits USDA Insect Points
Shivwits Highway Bridges
Shivwits Major Roads
State Route
Shivwits Flood
Shivwits Landslides
Shivwits Problem Soils
No Data
Expansive Soils
Limestone/Karst

* Note: Administrative Ownership is the background layer

2 0 2 4 Miles

Note: Both Moderate Radon and the Dixie Drought Regions encompass the whole subject area of the Shivwits Band

Five County Association of Governments October 2003 Ed Dickie

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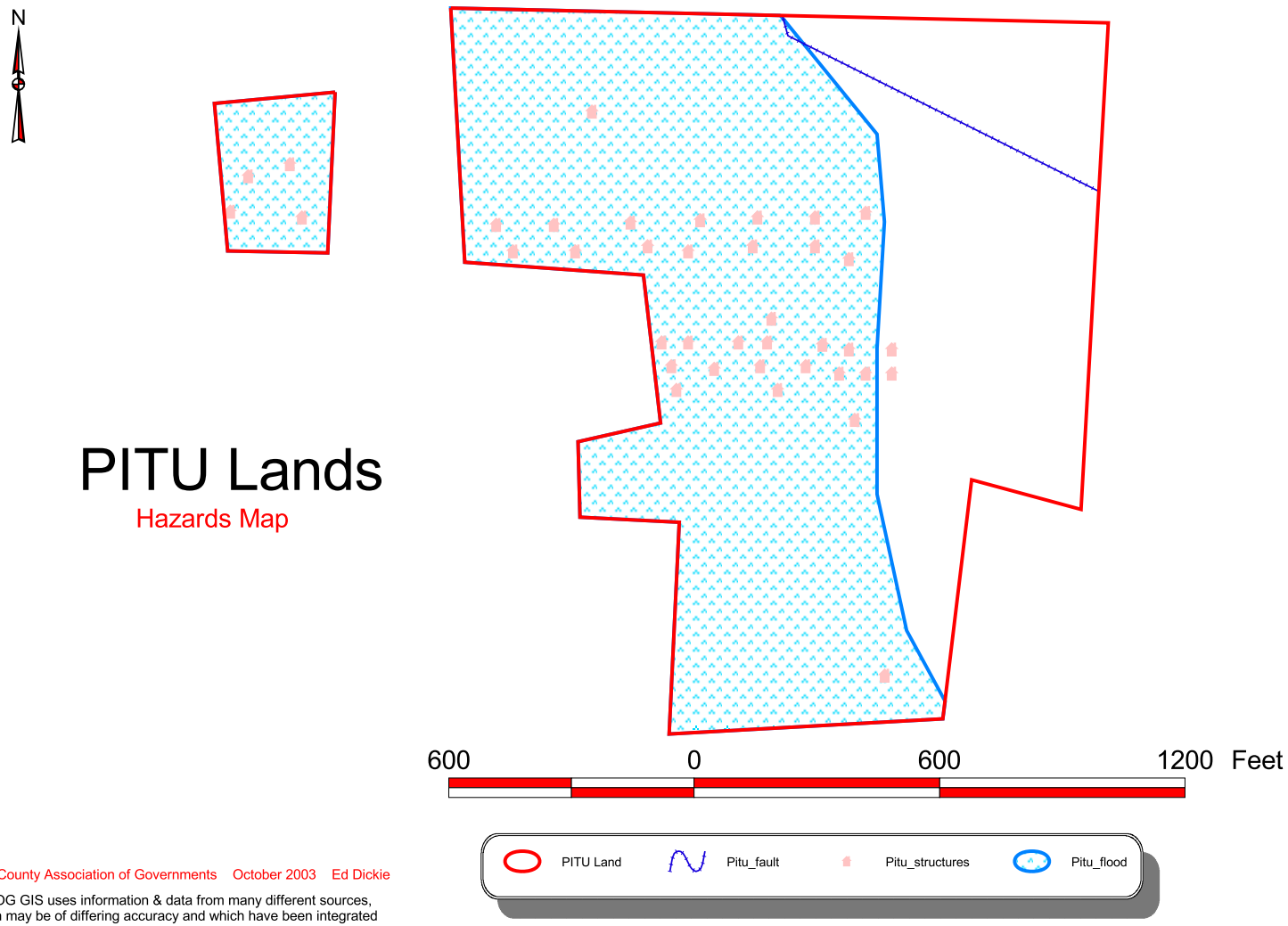

PITU Lands

Hazards Map

Five County Association of Governments October 2003 Ed Dickie

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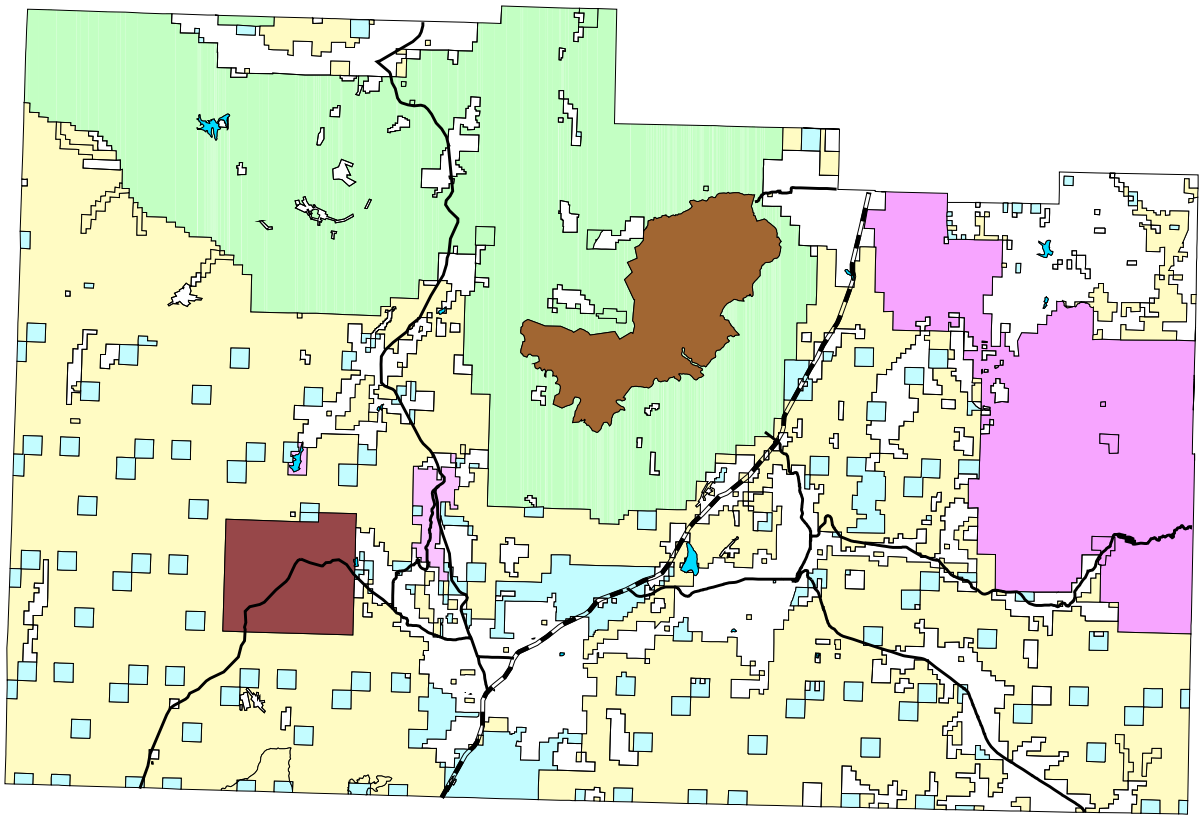
Note: Both Moderate Radon and South Central Drought encompass the whole subject area of the Pitu Band

Washington County



History

In 1847 members of The Church of Jesus Christ of Latter-day Saints settled in the Salt Lake Valley. Church leader, Brigham Young, sent settlers out from the Salt Lake Valley to settle other areas of the new territory. St. George was one such settlement.

In 1854 Brigham Young assigned Jacob Hamblin to be a missionary to the Indians in the southern parts of the territory. He was considered a great friend by the Indians and was heavily involved in keeping the peace between settlers and Native Americans. In 1861, Brigham Young sent 300 families to the St. George area to grow cotton and other products conducive to the climate. Many of these early settlers were from America's southern states and the area soon became know as "Dixie" because of its settlers, location, climate and agricultural products. Cotton, silk, dried fruit, molasses, and pecans were just some of the many products produced in the area.

The Utah territory was officially declared a state of the United States in 1896 and the St. George area is still widely known as "Utah's Dixie". It is here that Dixie State College was established. St. George was likely named after George A. Smith who was heavily involved in the selection of the families who settled the area in 1861 and was recognized as a great leader in the region.

Life in this arid climate was very difficult for the early pioneers. With intense summer heat and just a few inches of annual rainfall, farming was a difficult. Unusually heavy rains or flash floods often destroyed crops and buildings, but the settlers persevered and began to build a city. The climate of the region probably hasn't changed much, but the ability to cope with it in air conditioned comfort as well as its mild winter weather makes Utah's Dixie one of the most pleasant growing population centers in Utah.

Projections for the 1990s are that this growth rate will continue. The county is host to several outstanding events each year, including conferences and conventions, art festivals and art shows, golf tournaments, the Dixie Rotary Bowl Football Game, the St. George Marathon, and the World Senior Games.

The dominant industries of Washington County are tourism, retirement living, and golf.

St. George, the Washington County seat, is the southernmost city in Utah along the I-15 Corridor. St. George proximity to other Utah cities is below

Moab - 341 miles
Provo - 258 miles
Salt Lake City - 303 miles

The average temperature in January is 40º F, and the average July Temperature is 86º F. Annual Average Precipitation is 8".

Development Trends

Population

Population expansion is a major impetus behind the county’s economic growth. As the population continues to expand, the “big box” retailers have found Washington County more

and more attractive. And, other businesses have found customers for their services. Just how fast has the population growth been? Recently released estimates from the U.S. Census Bureau tell us that almost 100,000 individuals lived in Washington County during 2002. That represents a 5-percent increase in population from 2001. Historically, Washington County's population has increased between 85 and 95 percent per decade for the last three decades. The only county in Utah with faster population growth in the 1990s was Summit County. While Ivins experienced the most rapid population boom between 1990 and 2000, St. George continued to attract the most new residents. Rockville and Enterprise were the slowest growing communities in the county. Yet, they still managed to increase their population bases by more than one-third. Population estimates for 2000 to 2002 also show Ivins with the most rapid population growth—22 percent in just two years.

One of the most startling changes the Census revealed was an increase in Washington County's Hispanic population. In 1990, less than 2 percent of the county's population was Hispanic. By 2000, that share had increased to more than 5 percent. Still, Washington County has not become a hotbed of diversity. Only 9 percent of the county's population is nonwhite or Hispanic compared to 31 percent nationally. Despite great in-migration of working-age individuals, Washington County saw its retirement-age population increase slightly during the 90s. Census data shows that 17 percent of the county's population is over the age of 65—compared to only 9 percent in Utah. In addition, Washington County's population is heavy on the young side. Roughly 31 percent of the population is 18 years old or younger, compared to 26 percent nationally. This age distribution means Washington County has a smaller-than-average working-age population to support its non-workers. Washington County's household size has decreased slightly over the 90s. However, Washington County families are more likely than Utah or U.S. families to be headed by a married couple. Moreover, only 7 percent of the county's families are headed by women with children compared to 8 percent in Utah and 11 percent nationally.

Educational status also improved during the last decade. In 2000, 88 percent of Washington County residents over the age of 25 had a high school diploma. But, while the share of the population with a college education increased to 21 percent in 2000, it still lags behind the state and national averages (26 and 24 percent respectively).

Labor Market Indicators

While both the nation and Utah showed a net employment loss during 2002, Washington County managed moderate job growth (4.5 percent). As in 2001, Washington County was the fourth-fastest growing county in the state in terms of job growth. And, just as in 2001, the lead counties were much smaller than Washington County. All in all, county employers added more than 1,600 net new jobs to their payrolls during 2002. During this time, the national industrial structure used to classify industries changed. The newly created industry of private education/health/social services added the most new Washington County jobs. These new positions were largely concentrated in health services and residential care (which includes teen help programs). However, transportation/trade/utilities ran a close "second" in the job-creation race. In fact, the only industry to lose employment was manufacturing, which suffered a small 20-job loss. That's not a bad record during a national recession.

Although the county created jobs at a healthy rate, unemployment did creep up during 2002. In 2001, the jobless rate measured 3.8 percent. The 2002 figure registered 4.6 percent.

However, please note that even with that increase, the jobless rate in Washington County remained more than a full percentage point below the state and national averages.

Recently released data from the 2000 Census shows that while labor force participation remains relatively low in Washington County (it's all those nonworking seniors), it did increase in the 1990s. In particular, women moved into the workforce in greater numbers. Not surprisingly, the census data also shows that more children under six have both parents in the workforce - almost half.

The economy staved off recessionary ills during 2002. Between 2001 and 2002, Washington County's average monthly nonfarm wage increased about 2 percent to measure $1,898. That is just ahead of inflation. In other words, the buying power of county workers improved slightly during 2002. However, the county maintained its status when compared to state wages. Washington County's average wage measured 76 percent of the state average—no different than in 2001. Lower wages are partially due to the county's heavy dependence on retail and tourism. Often, jobs created to fill these needs are typically lowpay and part-time. An abundant young workforce attending Dixie College also plays a part. And, even the expanding economy works to keep wages low. When new firms enter the area or expand, they often hire at the bottom of their payscales. Typically, the less urban the area, the lower the wages are.

With the new industrial coding structure, financial activities show the highest average monthly wages in the county—$2,305. However, information services, private education/health/social services, manufacturing, and government all showed average monthly wages above the $2,000 mark. Where's the lowest pay? The leisure/hospitality industry, which includes the tourism-related industries of recreation, lodging, and restaurants.

Measures of income (which includes interest income, rental income, business income, And government payments such as Social Security and welfare, as well as wages) also show Washington County with lower-than-average per capita and family income indicators. Interestingly, Washington County is unusual in that a high percentage of personal income comes from sources other than wages. Washington County estimates of poverty for individuals (11 percent) falls between the national rate (12 percent) and the state rate (9 percent). Poverty showed a noticeable decline in the 1990s.

Construction Permits

Construction bolstered the case for a strong Washington County economy in 2002. The value of both residential and nonresidential approved building permits reached all-time highs during 2002. While the number of homes permitted didn't touch 1994 levels, their number measured the highest since 1995. The St. George continued as the area of strongest residential expansion with Washington City running a distant second.

Taxable Sales

Taxable sales also contributed to a strong economy in Washington County in 2002. Sales continued to be robust during 2002 by showing a 9-percent increase over 2001. Business investment was particularly strong during 2002. While not totally unphased by the national recessionary ills, Washington County's economy remained healthy during 2002 with strong expansion in jobs, construction, and sales. As the nation begins its economic recovery, Washington County should continue to experience robust expansion in the years ahead.

Land Use Development
Residential development in Washington County is ongoing, primarily within incorporated communities. A majority of the industrial and commercial activities in the county are taking place in St. George, the county seat. The neighboring communities are seeing some of this development, especially Washington City and Hurricane City.

The following major development projects are planned or are under way in Washington County:

New Regional Airport
This replacement airport will provide safer, more convenient, air travel and will allow for economic growth and prosperity. Its estimated completion is 2010. Jerry Atkin, Chairman and CEO of SkyWest Airlines which has its headquarters in St. George, says that "A jet capable airport allows us to serve destinations further away than we are capable of today." This new airport which will accommodate larger planes will bring a general upgrading to the community and to the types of jobs that are available. "A new airport is absolutely a key ingredient in being able to advance the area's economy in a positive manner," states Scott Hirschi, Director of the Washington County Council.

Dixie Regional Medical Center
Construction of the new Dixie Regional Medical Center (DRMC) has been completed on a 65 acres campus located at the northeast intersection of 700 South and River Road. Construction began in 2001 and was completed in late in 2003. Intermountain Health Care (IHC/DRMC) is the largest private employer in Washington County with more than 1,100 employees. The new facility expects an estimated 350 additional jobs will be created. When employment multipliers are factored in (these include the other jobs in the community that the two hospitals help sustain) the current hospital, being renovated for other hospital services, and the new facility, will be responsible for approximately 2,000 jobs and $101 million in household earnings in Washington County. The average wage paid to employees when the new campus is fully operational is estimated to be $41,262 or about 58% higher than the average wage in Washington County of $23,973.

Sunset Corner Lifestyle Center
Sunset Corner is located at the intersection of Sunset Blvd and Bluff Street, one of the busiest corners in St George. Fully developed the center will offer 320,000 sq feet of upscale retail space. It is now the home of the Stadium 8 Theaters, Village Bank, Panda Express, Peaks Wireless and several soon-to-be announced restaurants. Special features of this center will include generous landscaping, attractive and innovated water features, ample outside seating with shaded rest areas, a large electronic message center and an overall ambiance that does not currently exist in St George.

The Tonaquint Center
The Tonaquint Center on Dixie Drive aims to provide a blend of high-tech development and technology-based companies as well as upscale office space for financial, medical, legal and real estate professions. All buildings will have fiber internet access with speeds of up to 45 Mbps, making Tonaquint Center the premier high tech location in Southern Utah. The site is located close the Santa Clara River which gives it access to existing walkways for biking, jogging, and walking and the new Tonaquint Park's tennis courts. Southgate and Sunbrook Golf Courses are located within one-quarter mile of the Center. Currently the Five County Association of Governments and Steton Technolgies occupy facilities in the development.

New Main Street Plaza
The Jennings Building or Main Street Plaza will be the “place to be” for businesses interested in having the best location for their high technology business. This four story building will offer tenants up to 80,000 sq ft of new high quality “Class A” office space. It is located on the corner of Main & Tabernacle and is scheduled to be completed in early spring of 2004. There are already commitments for over 60% of the available space.
The building is attracting high profile tenants in the professional, financial and service categories. Because of its unique position to the central hub for Qwest communications, this building is slated to be a leader in the “Smart Building” category with the latest in broadband technology. Adjacent to this building will be a four story parking garage that will service the needs of the office tenants and also provide a substantial amount of free public parking for visitors to other downtown building and attractions. It is designed to be the stimulus to rebuild the center core and “heart” of St. George.

Washington County Industrial Parks

Fort Pierce Industrial Park
This is St George City’s newest industrial park and home to Wells Dairy, manufacturer of Blue Bunny Ice Cream. In addition to being the newest, Fort Pierce has also had the most activity in relation to expansion of existing local businesses and is the best positioned industrial park in southern Utah to attract out of the area businesses. Key attractions are: close proximity to the new airport, the most favorable electrical power rates in the region and the willingness of the developing partners to accommodate the needs of prospective clients. Two more quality out-of-state companies are purchasing sizable parcels of land in Fort Pierce Industrial Park and are constructing new facilities scheduled to be operational by 2003. This business center has become the place for new industry and job creation in the manufacturing sector.

Gateway Business Park
Gateway Business Park is located near the intersection of I-15 and SR-9 in Hurricane City and is home to the 1.2 million SF WalMart Distribution Center. Nearly 200 acres are available which can be divided into building sites ranging in size from two acres to 50 acres. Some of the present tenants include: Crocker Enterprises, DATS Trucking, Pace American Trailer, Winkle Distributing, UP&L, and Mikohn (Gaming Worldwide). The Gateway is fully developed with all utilities in place. The pre-planning and zoning allows for speedy building permits.

Planned Communities

Outlaw Ridge Resort & Golf Community
This community’s master-plan envisions a destination resort at its core, complete with a first-class hotel which will feature a spa, tennis, two new Johnny Miller golf courses, the Johnny Miller Golf Academy and all other amenities associated with a destination resort. Miller will make Outlaw Ridge his “home course.” At this largest master-planned community in Southern Utah, over 4,000 housing units are planned with a complete range of choices. The Outlaw Ridge project will be unique, in that its proximity to the 1,350 acre Sand Hollow Reservoir and the surrounding 16,000 acre Sand Hollow State Park, will give both residents and resort patrons alike the opportunity to swim, boat, water-ski, fish, sail, ride horses and hike, all within minutes of their home or hotel.

Other large existing and expanding planned communities include:

Entrada (around the Johnny Miller, Entrada Golf Course and Snow Canyon Parkway),

Coral Canyon (Coral Canyon Golf Course and close to I-15 and the Hurricane City exit),

Sun River (an over 55 adult community built around the Sun River Golf Course south of Bloomington)

Sunbrook Communities (many separate communities built around the City of St George's Sunbrook Golf Course).

Development Activities

The following development activities have occurred in Washington County during the past year. While this is not an all-inclusive listing, it is indicative of the development trends occurring in Washington County.

Bucking turbulent conditions industry-wide, St. George-based SkyWest Airlines continues to fly high, reporting net income of nearly $15 million, or 26 cents a share, for the quarter ended June 30. That compares with income of $22 million, or 38 cents, for the same quarter a year ago. SkyWest said those results reflect previously announced adjustments to revenue and expenses related to the company's maintenance policy. The company's second-quarter revenue increased 12 percent to $212.7 million. Salt Lake Tribune, 7/31/03

The redesigned Interstate 15 interchange at Washington, (Exit 10), which has been under construction since April 2002, is now open. The design of the $9.8 million project will handle the flow of traffic more efficiently. Surface streets also have been widened and improved. Salt Lake Tribune, 7/29/03

The Washington City Council is wagering about $17,000 on the future of fiber optics, hoping the small investment will yield lucrative returns. The Council voted to enter into a change order agreement with the Washington Water Conservancy District and St. George, who are already in the process of constructing a fiber optic conduit line through the trenches of the water pipeline from Ivins to Quail Lake. Washington City will pay about 7 percent of the more than $200,000 needed for the conduit, entitling the city to a portion of any returns. There is no way of foretelling the future of fiber optics in the telecommunications industry in general, or the county specifically -- whether the conduit will facilitate business, or vice versa. But if demand is high, the fiber optic conduit could prove a profitable venture. The Spectrum, 7/24/03

SkyWest Airlines Inc., flexing its increasing strength in the regional commuter airline market, reported Tuesday that its passenger traffic for June was up more than a third from the same time a year ago. The St. George-based carrier registered a 39.3 percent increase last month in revenue passenger miles, a measure of available plane seats actually sold. Available seat miles -- a formula determining an airline's seating capacity -- increased 35.1 percent compared to June 2002. Salt Lake Tribune, 7/9/03

The federal government has designated the entire state of Utah a natural disaster area as a result of prolonged drought conditions, insect infestations and high winds. The designation makes farmers in all 29 counties eligible to be considered for low-interest emergency loans

from the Farm Service Agency. Utah is in its fifth year of drought, and the USDA's Palmer drought index ranked the state the nation's driest. What's being offered is low-interest loans and possible future assistance when it is made available by federal and state agencies. Deseret News, 7/2/03

Five Utah parks have received $874,000 in matching grants from the National Park Service to build new picnic areas, playing fields, trails and other improvements. St. George's Slick Rock Park was awarded $90,000 under the program. Salt Lake Tribune, 6/28/03

The vacancy rate at St. George hotels/motels reached 60 percent in May according to the Rocky Mountain Lodging Report. Salt Lake Tribune 6/24/03

Coral Canyon Golf Course in Washington City earned a rating above 20 from the Zagat survey, qualifying it as one of the publication's top golf courses in 2003. In addition, Golf for Women magazine included Coral Canyon on its "50 Best Courses for Women in the U.S." list, and Golf Digest named it the fourth best golf course in Utah. Coral Canyon is owned and managed by SunCor Golf of Tempe, Ariz. Salt Lake Tribune, 6/24/03

A legislative mistake is holding up $500,000 in matching federal funds that would preserve a trove of fossils and petrified dinosaur tracks. U.S. Rep. Jim Matheson, D-Utah, said he plans to introduce a technical correction to a bill that instructs the Interior Department to buy land on the farm of Sheldon Johnson and deed it over to St. George. That $500,000 for the land is secure, but the Interior Department says a problem in the Virgin River Dinosaur Footprint Preserve Act signed by President Bush last December prevents the department from releasing another $500,000 to help preserve the fossilized findings. The Utah Legislature budgeted $400,000 to help build a museum. St. George Mayor Dan McArthur said the city will add $150,000. The city is reviewing building designs for a $700,000 museum that could open within a year, McArthur said. Salt Lake Tribune, 6/15/03

Local communities will soon benefit from a grant distributed by the Utah Department of Public Safety, Division of Emergency Services and Homeland Security. Region IV, which includes Beaver, Garfield, Iron, Kane and Washington counties, received $375,005 from the state homeland security grant, part of nearly $3.9 million awarded across the state. The 2003 grant came from the U.S. Department of Homeland Security, Office of Domestic Preparedness, according to a news release from the Department of Public Safety, Division of Emergency Services and Homeland Security. Region IV decided to use the money awarded to them to improve communications devices and purchase communication devices to allow cities to speak with other cities -- like St. George to Beaver. The Spectrum, 6/13/03

Washington County Board of Education members approved next year's $145 million budget. The district is projecting 3-percent growth in enrollment—about 600 students, or the equivalent of a new school. The district plans to sell around $25 million in bonds this year to fund several projects, including a new elementary school in the Washington Fields area to the east of St. George. Money to repay any bonds sold by the district will come from the county's projected growth in assessed valuation of property, which also is expected to rise next year by 2.3 percent. Any increase in revenue is welcome, especially since the school board earlier voted to increase student fees, raise the student to teacher ratio and cut two paid days from district employee contracts to balance the 2002-2003 budget. Deseret News, 6/12/03

SkyWest Inc. signed a deal with United Airlines that could more than double the size of its commuter fleet and boost its nationwide work force by 50 percent. The 11-year pact with the nation's second-largest commercial air carrier would increase the St. George-based airline's fleet from the current 110 planes -- including 55 turboprops and a like number of 50-seat regional jets -- to 227 total aircraft. While the exact deadline for completion of the SkyWest expansion is not known, United has committed to providing the commuter airline with 30 new 70-seat jets by mid-2005, said Brad Rich, SkyWest's chief financial officer. Salt Lake Tribune, 6/11/03

The Washington County School Board awarded the bid to a Salt Lake City-based company for construction of the Washington Fields Elementary School, which is scheduled to open for the 2004-05 school year. Bud Mahas Construction bid $4,935,000 for the building contract, said Phil Williams, capital facilities director for the Washington County School District. The opening of Washington Fields Elementary is expected to alleviate growth pressure in the Washington Fields area, where student enrollment has grown at 9.5 percent annually in recent years. The Spectrum, 6/11/03

The "Affordable Housing in Utah Cities" study from the University of Utah's Bureau of Economic and Business Research ranks 52 cities based on the percentage of affordable units built between 1997 and 2002. The report defines an affordable dwelling as one with a monthly rental or mortgage payment that a family earning 80 percent or less of their county's median income would be able to afford without spending more than one-third of their pay on housing. Ivins was listed as one of the most unaffordable communities in Utah. Salt Lake Tribune, 6/7/03

The Spectrum has purchased a production facility in the Fort Pierce Industrial Park. The 28,800-square-foot facility will house an 11-unit Goss Urbanite Press with twice the speed, capacity and color capability of the current printing press, said Scott Porter, the newspaper's production director. Operations are to begin in November. Since 1985, the newspaper has been produced on a more than 40-year-old Goss Community Press located in the St. George Boulevard office. The Spectrum contracted other publications the press could not accommodate to printing facilities in Salt Lake City and Las Vegas. Salt Lake Tribune, 6/7/03

Seven years of planning and coordination has finally paid off with the construction process now begun on the new bridge across the Santa Clara River next to Southgate Golf Course. At this time, the foundation of the bridge has been completed and the bridge deck girders will be placed in June. The contractor on the project is Interstate Rock Products from Hurricane, headed up by Don Stratton. Construction began in January and is on schedule to be completed at the end of the summer. What this $3.5 million project will do is connect Hilton Drive where it intersects Indian Hills Drive and tie Hilton into Dixie Drive near the Tonaquint Park entrance as one main 40 mph roadway. The Spectrum, 5/24/03

The Utah Department of Transportation, in conjunction with St. George City, has studied the intersection of Bluff Street and St. George Boulevard to provide a more efficient way to move traffic through the congested junction. There were three primary alternatives being considered. The first would include a moderate widening of Bluff Street to provide two southbound lanes turning left onto the Boulevard and two southbound lanes moving through the intersection. The second would include restriping the existing pavement to accommodate two southbound left turns onto the Boulevard, with one of those lanes sharing with vehicles going straight through the intersection, along with one exclusive through lane.

The third alternative would include widening Bluff Street substantially that would allow two southbound left turn lanes, two southbound through lanes, a southbound right turn lane, and 3 northbound through lanes. The Spectrum, 5/24/03

In cooperation with UDOT, the Exit 10 reconstruction project in Washington is scheduled to be completed in October. The contractor anticipates completion prior to this date. In cooperation with UDOT, there are two new signals -- one of which is being constructed at the intersection of 700 West and Telegraph streets and the other being constructed at the intersection of SR-9 and Telegraph street. The Spectrum, 5/24/03

Public works projects in Virgin include a new two-lane concrete bridge connecting Highway 9 to Highway 59. The bridge replaces an old, two-lane steel one. Mesa Road has recently been covered in 2,000 feet of new black top surface. Safety concrete barriers were purchased recently and approximately half have been placed on the most dangerous turns. The Spectrum, 5/22/04

The bridge spanning the Virgin River between Hurricane and LaVerkin is a major project at this time. The historic arch bridge was becoming inadequate for vehicular traffic and was dangerous for pedestrians and bicyclists. The Utah Department of Transportation and Hurricane and LaVerkin have been planning for many years to help solve these problems. The project is now well under way. The new bridge will be 50-feet 3-inches wide with two travel lanes, two shoulders and a pedestrian lane. Construction costs on the new bridge and the refurbishing of the existing bridge will be $11.2 million with an original completion date of December 2004. The project is expected to be done before its completion date—possibly by six to nine months. The Spectrum, 5/22/03

April's highest Utah hotel occupancy rates were recorded in the St. George area (74 percent), according to Rocky Mountain Lodging Report figures. Statewide occupancy rates measured 58 percent. Salt Lake Tribune, 5/22/03

Despite continuing uncertainty in the air industry, SkyWest Airlines strengthened its position as a regional airline Monday, announcing it will partner with Continental Air- lines. SkyWest 30-passenger Brasilia turbo-prop aircraft will fly as the Continental Connection out of Continental's Houston hub, Sky West chief operating officer Ron Reber said. Continental Connection will link Houston to Killeen, Texas, beginning July 1 and to Waco on Aug. 1, Continental announced. Additional routes with the nation's seventh-largest airline will be announced later. Salt Lake Tribune, 5/20/03

According to the University of Utah's Bureau of Economic and Business Research, during the first three months of 2003, St. George led Utah cities in approving new dwelling permits with 247 permits issued. Deseret News, 5/10/03

SkyWest Airlines Inc. of St. George reported a 33.1 percent increase in revenue passenger miles (RPMs) for April, while available seat miles increased 30.7 percent compared with the same period last year. The airline generated 299.9 million RPMs for the month, while ASMs increased to 445.7 million. Load factor increased 1.3 points to 67.3 percent, compared to 66.0 percent for the same period last year. Passenger boardings for April totaled 775,130 an 18.0 percent increase over April 2002. Salt Lake Tribune, 5/13/03

A computer lab at Tuacahn High School has been designated as a “smart site” for its updated technology and community accessibility. The smart site will be open to Washington

County residents for self-guided training in such areas as computer basics, data management and desktop publishing. LearnKey, a St. George-based e-learning technology company, will conduct some training at the site. The company is donating its time, software and other materials as a service to the community and a selling point to its clients. The Spectrum, 5/8/03

A proposal has be made to build a new highway called the Southern Corridor which would connect St. George to Hurricane via a multi-lane, divided highway on the eastern side of the county. Deseret News, 5/5/03

Dixie College has announced that the college has allocated enough funding to hire new nursing faculty and establish a bachelor's degree in nursing. The program, which will be the fourth four-year program at Dixie State, will be funded by $75,000 from the state, $100,000 donated by Dixie Regional Medical Center and $40,000 from community donations, plus money saved from recent programs that the college has eliminated. The college will also spend $150,000 to hire nursing faculty. The Spectrum, 5/3/03

A private company has indicated it intends to bring fiber-optic redundancy to the St. George area. The city approved a memorandum of understanding with a company called Interlinx which plans to build a fully redundant fiber-optic network in St. George and surrounding areas. The company plans a center office and data center, which will essentially become the hub for St. George. This proposal would be a major advance in telecommunications capacity for the county. The Spectrum, 5/2/03

The U.S. Census reported that Washington County population grew 5.1 percent from July 2001 to July 2002 making it the fasted growing county in Utah. The Spectrum, 4/24/03

The Village Bank broke ground at 1224 S. River Road on March 28 for what will become its third office location serving eastern Washington County residents. The 4,000-square-foot building was designed by Dennis Patten Architects and will be constructed by Pride Construction Company. Construction should be complete by August. The Village Bank on River Road will include four wide drive-through tellers, an ATM and a full-service financial office with on-site loan officers. It will also be equipped to handle all types of personal and commercial accounts. The Spectrum, 4/22/03

Washington County is among the 100 fastest-growing counties in the nation and was the fastest growing in the state between July 1, 2001, and July 1, 2002, according to U.S. Census Bureau estimates. Washington County ranked 26th among the 100 fastest-growing counties (with 10,000 or more residents) between April 1, 2000, when the decennial census was taken, and July 1, 2002. Washington County's population, which nearly doubled during the 1990s, grew by 5.1 percent in 2001-02. Deseret News, 4/17/03

The Sand Hollow Reservoir has been formally dedicated. The reservoir serves several purposes. It will help regenerate the Navajo sandstone on which the reservoir is built and provide a water storage area with a 20,000-acre-foot drought reserve pool. But it also will be a recreation area. Part of the state parks system, Sand Hollow State Park will be constructed in three phases. The first phase will include an entrance station, pavement, boat ramp, marina area and off-highway vehicle staging area, as well as temporary day-use and camping facilities. Phase two includes development of two campgrounds and four day-use facilities. The main campground will offer 50 full utility campsites with shelters, picnic tables, fire rings and restrooms with showers. Another campground will be located on the south

shore. Phase three will offer a group-use acre and an equestrian area that will offer trail access and camping. Phase three also includes development of a concession area. The Spectrum, 4/15/03

The Southwest Center, a five-county government agency that provides services ranging from substance abuse counseling to marriage counseling has officially opened its new building. The $3.5 million, 36,000 square-foot-building combines the functions of five offices that used to be scattered around St. George. The Spectrum, 4/11/03

The LaVerkin City Council has approved a conditional use permit for a new LDS chapel. Construction of the chapel will begin later this year and construction is expected to be completed by July or August of next year. The Spectrum, 4/3/03

The Zion Canyon Transportation System's free shuttle has resumed with its fourth season of operation. Salt Lake Tribune, 3/30/03

The Leeds Planning Commission has recommended approval of a 10-lot subdivision with the condition that the developer get a variance for a cul-de-sac. Salt Lake Tribune, 3/21/03

St. George average price for regular, unleaded gasoline increased 17 cents to $1.76 per gallon during the 30-day period of February 9 to March 11—the largest spike of any place in the state. During the same period, Utah's overall gas price rose 13 cents to $1.69, a 56-cent increase from last year according to AAA's monthly Fuel Gauge Report. The Spectrum, 3/17/03

The Division of Youth Corrections has broken ground for a new juvenile detention center. The new center will solve the over capacity problem of the Washington County Youth Crisis Center. The new center will be constructed adjacent to the existing Purgatory Correctional Facility and will contain 64 beds—with plans to expand to 90 beds. The Spectrum, 3/6/03

Coral Desert Rehabilitation has broken ground on a new $5 million rehabilitation facility to be built south of the new Dixie Regional Center on River Road. The facility is scheduled to open in December and will treat patients of all ages for ailments from car accident injuries to athletic injuries to senior rehabilitation patients. It will include cardiac and neurological rehabilitation, as well as physical therapy, speech therapy and occupational therapy. The Spectrum, 3/4/03

The Legislature's $7.3 billion budget includes $400,000 to preserve more than 400 fossilized dinosaur tracks near the Virgin River in St. George. Officials said the money would help fund a museum to protect the fragile sandstone footprints. The Spectrum, 3/4/03

The Leeds Special Service District recently received a U.S. Department of Agriculture Rural Development Community Facilities loan for $100,000 and a grant for $50,000 for a new fire truck and related equipment. The Spectrum, 2/27/03

According to the Rocky Mountain Lodging Report, St. George was one of only two cities in Utah reporting a hotel/motel occupancy rate of greater than 50 percent (53.2 percent) in January. The Salt Lake Tribune, 2/25/03

Green Design Build, LLC, a residential and commercial design and build firm, has opened an office in St. George. The Spectrum, 2/23/03

Ground has been broken for the Sunset shopping center on Sunset Boulevard. Major tenants will include Alberstons, Hollywood Video, Great Clips, Subway and Baskin Robbins. The shopping mall will also include a pizza parlor and Chinese restaurant. The Spectrum, 2/18/03

In a recently passed bill, Congress approved $250,000 for water system improvements in St. George. Deseret News, 2/14/03

Dixie Regional Medical Center has added a new cancer treatment facility. Formerly, most St. George patients went to Salt Lake City for this type of treatment. The Salt Lake Tribune, 2/14/03

The 13th St. George Area Parade of Homes brought many out-of-town visitors to the St. George area in February. The economic impact of the Parade to the community is estimated at $32 million. The Spectrum, 2/14/03

Ivins will begin advertising for bid on a $50,000 project to repair the rough road along 400 East. The Spectrum, 2/7/03

Sunbrook Communities, a master-planned community in St. George hosted a public grand-opening at its Discovery Center. The Salt Lake Tribune, 2/6/03

Dixie State College has registered record growth in spring enrollment. The number of full-time equivalent students registered for spring semester is up 10 percent from a year ago. The Spectrum, 1/27/03

The Paradise Bowl drew many outsiders to the St. George Area. Promoters estimate that 3,000 out of the 4,500 fans came from outside the area. The Spectrum, 1/26/03

The Washington County School Board has approved a construction timeline for the Washington Fields Elementary School. The $4.9 million project is scheduled to be open for bid in April and be completed in the 2004-2005 school year. The Spectrum, 1/15/03

The Utah State Parks and Recreation Board has approved the first phase of a recreational development at Sand Hollow Reservoir (which is currently filling), northeast of St. George. Initial development will include a park entrance, boat ramp and campground. Salt Lake Tribune, 1/15/03

Zion National Park saw an increase in visitors every month in 2002 with the exception of January and August. The number of tourists climbed to roughly 2,614,700—the highest levels in 10 years.

The St. George City Council has approved a taxing structure that it hopes will aid in energizing the downtown. The developers of the Mainstreet Plaza will not pay property taxes for the first three years of the life of the building and its accompanying parking structure. The council also approved spending $1.2 million for the city's portion of the Mainstreet Plaza parking structure. The Spectrum, 1/10/03

Several companies announced expansion at the Washington County Economic Summit. Deseret Laboratories is projecting an 18 percent increase in sales for fiscal 2003 and plans

to create approximately 20 new Washington County jobs. Pace American also announce plans to add another 20 to 30 employees this year. The Spectrum, 1/9/03

Ground has been broken at the new Tonaquint industrial park for the future headquarters of Steton Technologies Group. The company expects to employ more than 30 workers once the facility is completed in May. Salt Lake Tribune, 01/09/03

The WalMart portion of the Red Cliffs Mall has been purchased by the owner of the mall General Growth Properties. The company is considering several retail opportunities for the space. The Spectrum, 01/04/03

The Hurricane City Council has voted to raise water rates and impact fees. It also voted to start assessing impact fees for new hangers at the Hurricane airport. The Washington County Water Conservancy District has put in an order for $5.4 million worth of pipe and fittings to provide customers with drinking water from the Quail Point Water Treatment Plant. Salt Lake Tribune, 12/24/02

Hurricane is moving forward on a fire station for the city's growing west side. Architectural proposals have been received for a 4,500 to 5,200 square-foot building at 450 N 3400 W. Cost is estimated at $430,000, a portion of which will be paid by a Community Development Block Grant. Salt Lake Tribune, 12/19/02

Developers will begin work on the Main Street Plaza in St. George in January. The 90,000-square-foot complex will have about 70,000 square feet of space available for lease. A Blue Bunny Ice Cream parlor and several other companies have already signed leases. The Spectrum 12/19/02

Hurricane is planning to build a new fire station that will include apparatus bays, office areas, a bunk area and a kitchen/dining area. The station is expected to cost $430,000. The Spectrum, 12/10/02

St. George-based SkyWest expects to escape most of the turbulence of United Airlines' bankruptcy filing. SkyWest receives a fixed fee for every United Express flight regardless of how many passengers it carries. Salt Lake Tribune, 12/10/02

Dixie College has broken ground for its new $19-million fine arts building. The 70,000 square-foot building will be the largest on campus. Completion of construction is expected for January 2004. Deseret News, 12/01/02

The OMG Apex chemical plant will close January 6, 2003 leaving 63 employees jobless. The company is shutting down the cobalt and tungsten production lines to cut corporate costs. Salt Lake Tribune, 11/30/02

Entrada at Snow Canyon was listed among Zagat Survey/ESPN list of best golf courses in the six-state Rocky Mountain region (Utah, Colorado, Montana, Idaho, Nevada, Wyoming), and cited for its scenic qualities and being "Junior Friendly." Coral Canyon made the "Women Friendly" list. Deseret News, 11/29/02

St. George hotels and motels had a 74.8 percent occupancy rate during October 2002 according to the Rocky Mountain Lodging Report. State occupancy rates measured only 58.7 percent. Salt Lake Tribune, 11/26/02

The federal government soon will release $500,000 to St. George so the city can preserve an extraordinary source of dinosaur tracks. The Spectrum, 11/21/02

Majestic View Lodge was approved by the Springdale Town Council to build three buildings with 20 rooms in each. The council also gave approval for the company to put in a building with 13 hotels rooms across the street at the former Eagles Nest. Zion Canyon Campground was approved to build three units of 18 rooms each. Only two will be constructed this year, with the third building to built in another year. The Spectrum, 11/18/02
Dixie State College announced the general contractor for the $18 million Eccles/Graff Fine and Performing Arts Center which has recently received $14.5 million from the Legislature. Layton Construction is expected to finish the 78,000 square-foot center by January 2004. The Spectrum, 11/07/02

St. George may soon be home to a campus of the University of Phoenix—a private, for-profit higher education institution that provides Bachelor's and Master's degrees to working adult students. The Spectrum, 11/05/02

A 100,000-square-foot plastic injection facility will be the next addition to the Fort Pierce Industrial Park in St. George. Bomatic Inc., plans on beginning construction of the plant in December or January. The new facility could create about 100 new jobs. The Spectrum, 10/31/02

The Washington County School Board has leased the Phelps Elementary School in Hildale to a group of investors who plan to open a private school on the site. The school was closed when members of the Fundamentalist Church of Jesus Christ pulled their children out of the school. Salt Lake Tribune, 10/27/02

The National Park Service has approved a project for PacifiCorp to upgrade power lines in and around Zion National Park. The lines have been a source on controversy since new poles will be 20 feet higher than the old ones. Salt Lake Tribune, 10/27/02

The Washington County Commission voted Tuesday to approve a zone change that will allow for the creation of the Copper Rock Golf Course and Development in the Hurricane area. It will be a 1,600-unit development on 900 acres of ground located adjacent to the existing Grassy Meadows Sky Ranch Subdivision in Hurricane. The Spectrum, 10/16/02

Rural Utah counties preparing budgets for next year may face cutbacks in federal PILT funds. Since 1977, the federal government has provided "payment in lieu of taxes" funds to counties with large tracts of nontaxable federal land. The federal budget for 2003 has yet to be approved, and President Bush wants to cut PILT money by 23.5 percent. Utah is fifth in the nation in PILT funding, behind California. In 2002, Utah received more than $16 million. Last year Washington Count received $1.3 million. Deseret News, 10/15/02

After a two-day evaluation, Dixie State College is one step closer to gaining accreditation at the baccalaureate level. A team representing the Northwest Association of Schools and Colleges conducted an intensive review of the college. The complete report and a recommendation on accreditation will be turned over to the college and Commission on Colleges and Universities for review in December. In early January 2003, the college will be notified of the commission's action. Deseret News, 10/12/02

The number on single-family housing units sold in Washington County during third quarter 2002 was up more than 200 percent over the same figure a year ago. The average home price rose from $143,091 in third quarter 2001 to $145,668 in third quarter 2002. Deseret News, 10/11/02

The St. George City Council has decided to participate in a massive power project that involves communities in Utah and Arizona. The plant will be built in Payson. St. George will contribute $10 million to the project over the next 20 years. The cost of power to come from the future plant is estimated to be $5 per megawatt hour. The average price of power to the city of St. George in midsummer 2001 was more than $37 per megawatt hour. The Spectrum, 9/27/02

The Virgin Town Council gave approval to Liahona Academy, residential youth facility to build a home in the town that will house up to 48 boys. The Spectrum, 9/20/02

Utah ranchers, hit hard by drought, will soon receive millions of dollars in immediate federal aid. The U.S. Department of Agriculture announced it would release $752 million in cash to relieve drought-stricken livestock in 37 states. Utah is one of seven states that has declared a statewide drought disaster, and therefore, will qualify for a large share of the money. Salt Lake Tribune, 09/20/02

In response to a recent court ruling, the Federal Aviation Administration issued an order that St. George must conduct a comprehensive environmental study concerning the new airport's possible effect on the natural quiet of Zion National Park. The project, originally scheduled for completion in 2008, will probably be delayed one to two years. Salt Lake Tribune, 9/11/02

The St. George City Council decided to match $130,000 in federal funds to keep Dixie Area Rapid Transit System (DARTS) service running. However, starting in January, the city will cut back service. Deseret News, 9/08/02

St. George-based SkyWest Airlines in one of only a few air carriers to generate a steady profit since terrorists crashed jetliners into the World Trade Center and the Pentagon on September 11, 2001. Over the past 12 months, the airline has increased its fleet by 31 planes, expanded its route system to 10 additional cities and hired more than 700 new employees. Salt Lake Tribune, 9/08/02

A $500,000 dental clinic will soon begin serving Dixie State College's dental hygiene program and offer the community checkup and cleaning for minimal fees. Salt Lake Tribune, 8/24/02

Privately held Deseret Laboratories International and California-based AutoImmune Inc., have formed Colloral LLC, a joint venture that will manufacture, market and sell Colloral, a product for nutritional support of patients with rheumatoid arthritis. Deseret News, 8/20/02

The Learning Center for Families has received a $515,835 grant from the Administration for Children and Families to provide Early Head Start services to low income pregnant women and families of children birth to three.

Work has been completed on the new $3.1 million, 33,800-square-foot Washington County School District headquarters in St. George. The Spectrum, 8/14/02

Las Vegas-based slot machine manufacturer, Mikohn Gaming Corp plans to layoff about 100 employees across the country and move its remaining Las Vegas manufacturing operations to Hurricane. The Spectrum, 8/9/02

Workers are installing the second roundabout intersection in St. George, this one at Tabernacle and Main. At $230,000 the roundabout will cost tree times that of a traffic light installation. Salt Lake Tribune, 8/5/02
Work has begun on a new bridge which will span the 400-foot-wide Virgin River gorge 10 miles southwest of Zion National Park on State Route 9. The old bridge will be retrofitted and widened when the new bridge is completed. In 2004, the upgraded bridge will handle southbound traffic while the new one will take northbound vehicles. Together, the dual bridge project will cost $11.2 million. Salt Lake Tribune, 8/4/02

Critical Facilities of Washington County

A listing of the Critical Facilities of Washington County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 62 below:

Table 62 Critical Facilities of Washington County

Name or Description of Asset Enterprise City	Sources Of Information	Critical Facility	Vulnerable Populations	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value (Estimated)	Located in Hazard Area
Enterprise Clinic	Enterprise City	X					5,300 sq. ft.	$350,000	
Enterprise High School	Enterprise City	X					97,700 sq. ft.	$9,066,560	
Enterprise Elementary School	Enterprise City	X	X				47,250 sq. ft.	$4,262,895	
Enterprise Fire Station	Enterprise City	X					4,000 sq. ft.	$220,000	
Enterprise City Office/Town Hall	Enterprise City	X					4,000 sq. ft.	$220,000	
Enterprise 4 Water Tanks	Enterprise City	X					1.4MG	$970,000	
Enterprise Sewer Lagoons	Enterprise City	X			X		2 lagoons 124 acre ft.	$750,000	

Name or Description of Asset **Hildale Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Hildale Clinic		X					not avail.	$unknown	
Hildale Fire Station		X					not avail.	$unknown	
Hildale Police Station		X					not avail.	$unknown	
Elementary School		X	X				not avail.	$unknown	
Hildale Town Hall		X					not avail.	$unknown	
Hildale Community Center		X					not avail.	$unknown	
Water Tank		X					not avail.	$ unknown	
Water Tank		X					not avail.	$ unknown	
Water Tank		X					not avail.	$ unknown	
Water Tank		X					not avail.	$ unknown	
Sewer Lagoon		X			X		not avail.	$ unknown	

Name or Description of Asset **Hurricane City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Hurricane Fire Station #1	Hurricane City	X					7,500 sq. ft.	$650,000	Earthquake Fault
Hurricane Police Station	Hurricane City	X					3,500 sq. ft.	$240,780	Earthquake Fault
Hurricane Medical Clinic	Hurricane City	X					6,500 sq. ft.	$750,000	
Hurricane Middle School	Washington County School District	X					100,109 sq. ft.	$9,531,377	
Hurricane High School	Washington County School District	X					161,409 sq. ft.	$14,978,755	
Hurricane City Offices	Hurricane City	X					9,750 sq. ft.	$850,000	
Hurricane Airport	Hurricane City	X		X				$1,500,000	Earthquake Fault
Water Tank	Hurricane City	X					2MG	$750,000	Earthquake Fault
Water Tank	Hurricane City	X					1MG	$350,000	Earthquake Fault
Water Tank	Hurricane City	X					1MG	$350,000	
Ash Creek SSD Sewer Lagoons	Ash Creek SSD	X			X		1MG treated daily	$5,000,000	

Name or Description of Asset **Ivins City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Ivins City Office Building	Ivins City	X					7,000 sq. ft.	$591,500	
Ivins City Fire Station	Ivins City	X					9,900 sq. ft.	$548,000	Flood
Water Tank	Ivins City	X					2.0MG	$347,000	Flood
Water Tank	Ivins City	X					1.0MG	$247,000	unknown
Water Tank	Ivins City	X					0.4MG	$200,000	unknown
Water Tank	Ivins City	X					0.5MG	$268,000	unknown
City Yard Building/ Animal Control	Ivins City	X					1,716 sq. ft.	$188,200	
Red Mountain Elementary School	Washington County School District	X	X				49,470 sq. ft.	$4,463,183	

Name or Description of Asset **LaVerkin City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
La Verkin Town Hall	LaVerkin City	X				X	13,367 sq. ft.	$1,327,000	Earthquake Fault
La Verkin Fire Station	LaVerkin City	X					3,200 sq. ft.	$281,500	Earthquake Fault
Water Tank	LaVerkin City	X					1.5MG	$387,000	Earthquake Fault
Water Tank	LaVerkin City	X					1.0MG	$600,000	Earthquake Fault
La Verkin Community Center	LaVerkin City	X					1,800 sq. ft.	$119,900	Earthquake Fault
La Verkin Elementary	Washington County School District	X					45,724 sq. ft.	$4,125,219	Earthquake Fault

Name or Description of Asset **Leeds Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Leeds Area SSD Fire/Rescue Station	Leeds Town	X					not avail.	$unknown	Wildfire
Water Tank	Leeds Town	X					not avail.	$unknown	Wildfire
Water Tank	Leeds Town	X					not avail.	$unknown	
Water Tank	Leeds Town	X					not avail.	$unknown	
Water Tank	Leeds Town	X					not avail.	$unknown	
Cellular Tower	Privately Owned	X					not avail.	$unknown	Wildfire

Name or Description of Asset **New Harmony Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
New Harmony Fire Station	New Harmony	X					not avail.	$unknown	
New Harmony Town Hall/Community Center	New Harmony	X					not avail.	$unknown	
Water Tank	New Harmony	X					not avail.	$unknown	

Name or Description of Asset **Rockville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Rockville Community Center	Rockville Town	X				X	7,659 sq. ft.	$550,800	
Iron Bridge across Virgin River	Rockville Town	X				X	not avail.	$unknown	Floodplain
Water Tank	Private Stockholder Company	X					0.4MG	$800,000	

Name or Description of Asset **Santa Clara City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Santa Clara Fire Station	Santa Clara City	X					2,123 sq. ft.	$362,890	
Santa Clara Heights Area Fire Station	Santa Clara City	X					6,148 sq. ft.	$410,730	Floodplain
Santa Clara Elementary School	Washington County School District	X	X				45,065 sq. ft.	$4,065,764	
Lava Ridge Intermediate School	Washington County School District	X					126,615 sq. ft.	$12,055,014	Floodplain
Santa Clara Public Works Facility	Santa Clara City	X					3,800 sq. ft.	$179,100	
Water Tank #1	Santa Clara City	X					0.4MG	$329,990	
Water Tank #2	Santa Clara City	X					2MG	$748,320	
Santa Clara City Office	Santa Clara City	X					2,881 sq. ft.	$223,820	

Name or Description of Asset **St. George City**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
St. George City Office Building	St. George City	X					33,096 sq. ft.	$3,650,560	
St. George Police Station	St. George City	X					18,900 sq. ft.	$2,500,000	
St. George Fire Station #1	St. George City	X					4,000 sq. ft.	$393,750	
St. George Fire Station #2	St. George City	X					6,500 sq. ft.	$164,850	
St. George Fire Station #3	St. George City	X					2,435 sq. ft.	$168,000	
St. George Fire Station #4	St. George City	X					2,700 sq. ft.	$183,750	
St. George Fire Station #5	St. George City	X					2,435 sq. ft.	$168,000	
St. George Fire Station #6	St. George City	X					5,000 sq. ft.	$400,000	
St. George Fire Station #7	St. George City	X					10,000 sq. ft.	$1,000,000	
Quail Lake Water Treatment Facility	St. George City	X					Complete Facility	$30,000,000	
Wastewater Treatment Plant	St. George City	X			X		Complete Facility	$16,800,000	
Bloomington Hills Area Water Tank	St. George City	X					5MG	$800,000	
T-Bone Water Tank	St. George City	X					3MG	$690,000	
Gunlock Water Tank	St. George City	X					3MG	$690,000	
Concrete Water Tank	St. George City	X					1MG	$350,000	
Stone Cliff Water Tank	St. George City	X					0.3MG	$90,000	

Bloomington Hills So. Water Tank	St. George City	X					2.25MG	$585,000	
Green Water Tank	St. George City	X					1.7MG	$442,000	
Main Street Water Tank	St. George City	X					2MG	$520,000	
Industrial Water Tank	St. George City	X					2MG	$520,000	
Snow Canyon So. Water Tank	St. George City	X					3MG	$2,100,000	
Snow Canyon No. Water Tank	St. George City	X					3MG	$2,100,000	
St. George Municipal Airport	St. George City	X		X			Terminal only	$1,050,500	
Dixie Regional Medical Center	IHC Hospitals	X					400,000 sq. ft.	$100,000,000	
Dixie High School	Washington County School District	X					173,688 sq. ft.	$16,118,246	
Dixie Middle School	Washington County School District	X					116,387 sq. ft.	$11,081,206	
Pine View High School	Washington County School District	X					190,166 sq. ft.	$17,647,404	
Pine View Middle School	Washington County School District	X					120,000 sq. ft.	$11,425,200	
Snow Canyon High School	Washington County School District	X					242,105 sq. ft.	$22,467,344	
Snow Canyon Middle School	Washington County School District	X					134,109 sq. ft.	$12,768,517	

Name or Description of Asset **Virgin Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Springdale City Office		X					unknown	$unknown	
Springdale Elementary School	Washington County School District	X	X				6,566 sq. ft.	$592,384	
Springdale Fire Station		X					unknown	$unknown	

Name or Description of Asset **Toquerville Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Toquerville Town Hall	Toquerville City	X				X	4,000 sq. ft.	$100,000	Landslide, Earthquake Fault
Concrete Water Tank	Toquerville City	X					0.25MG	$375,000	Landslide, Earthquake Fault
Steel Water Tank	Toquerville City	X					0.475MG	$400,000	
Steel Water Tank	Toquerville City	X					0.1MG	$100,000	

Name or Description of Asset **Virgin Town**	**Sources Of Information**	**Critical Facility**	**Vulnerable Populations**	**Economic Assets**	**Special Considerations**	**Historic/Other Considerations**	**Size of Building (sq. ft.)**	**Replacement Value (Estimated)**	**Located in Hazard Area**
Virgin Town Hall	Virgin Town	X				X	3,000 sq. ft.	$unknown	
Concrete Water Tank	Virgin Town	X					0.2MG	$unknown	
Steel Water Tank	Virgin Town	X					0.5MG	$unknown	

Name or Description of Asset Washington City	Sources Of Information	Critical Facility	Vulnerable Populations	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.)	Replacement Value (Estimated)	Located in Hazard Area
Washington City Office Building	Washington City	X					18,947 sq. ft.	$2,012,100	
Washington City Fire Station #61	Washington City	X					6,800 sq. ft.	$800,000	
Washington City Fire Station #62	Washington City	X					4,870 sq. ft.	$650,000	
Water Treatment Plant (SR9 & Telegraph Street)	Washington City	X					7,200 sq. ft. (bldg.)	$3,000,000	
Warner Valley Water Tank	Washington City	X					1MG	$600,000	
Grape Vine Pass Water Tank	Washington City	X					1MG	$600,000	
Red Cliffs Water Tank#1	Washington City	X					1MG	$600,000	
Red Cliffs Water Tank #2	Washington City	X					2.3MG	$750,000	
Sewer Lift Station at Grapevine Wash & Telegraph Street)	Washington City	X			X		300 sq. ft.	$80,000	

Analysis of Infrastructure of Washington County

A listing of the Infrastructure of Washington County, and whether or not they are located within a Hazard area, along with an estimated cost for replacement of those facilities is shown in Table 63

Table 63 Critical Infrastructure of Washington County

Name of Town **St George**	**County Total**	**Town Total**	**Unincorporated Total**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	3	10	0	0	0	0	1	0	1	0	1	0	0
# of Highway Bridges	109	37	31	18	140	0	0	4	60	0	0	13	0	200
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	23.37	117.08	3.95	15.8	0	0	4.69	19	3.91	16	5.59	0	50.8
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	2.51	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	5.95	139.54	.19	.010	.10	.005	0	0	.79	.040	2.33	.117	.172
HAZARDS														
Flood Zones (sq miles)	40.47	9.72	15.26											
Land Slides (sq miles)	132.68	.69	126.82											
Problem Soils (sq miles)	361.33	23.60	302.21											
Volcanic Flows (sq miles)	224.20	2.38	196.74											
Wildfires (sq miles)	1274.35	33.10	1161.7											

Name of Town Enterprise	County Total	Town	Unincorporated	Flood Zone Town	Flood Zone Costs in Millions $	Land Slide Town	Land Slide Costs in Millions $	Problem Soil Town	Problem Soil Costs in Millions $	Volcanic Flow Town	Volcanic Flow Costs in Millions $	Wildfire Town	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	0	31	0	0	0	0	0	0	1	5	0	0	5
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	1.73	117.08	0	0	0	0	0	0	0	0	.27	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	0	15.26											
Land Slides (sq miles)	132.68	0	126.82											
Problem Soils (sq miles)	361.33	0	302.21											
Volcanic Flows (sq miles)	224.20	.14	196.74											
Wildfires (sq miles)	1274.35	.76	1161.7											

Name of Town **Hilldale**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	0	31	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	1.25	117.08	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	1.56	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	.02	15.26											
Land Slides (sq miles)	132.68	.06	126.82											
Problem Soils (sq miles)	361.33	0	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	.24	1161.7											

Name of Town **Hurricane**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	2	10	0	0	0	0	1	0	0	0	1	0	0
# of Highway Bridges	109	7	31	1	5	0	0	1	5	0	0	2	0	10
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	15.07	117.08	.90	3.6	0	0	1.72	7	4.54	18	10	0	28.6
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	7.09	99.55	.26	.013	0	0	1.86	.093	6.63	.332	6.91	.346	.784
Other Utility Lines (miles)	169.86	10.25	139.54	.68	.034	.04	.002	2.48	.12	5.83	.29	7.68	.384	.830
HAZARDS														
Flood Zones (sq miles)	40.47	1.34	15.26											
Land Slides (sq miles)	132.68	.14	126.82											
Problem Soils (sq miles)	361.33	4.43	302.21											
Volcanic Flows (sq miles)	224.20	.96	196.74											
Wildfires (sq miles)	1274.35	24.02	1161.7											

Name of Town **Ivins**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	1	10	1	0	0	0	0	0	0	0	1	0	0
# of Highway Bridges	109	0	31	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	4.86	117.08	1.61	6.44	0	0	0	0	0	0	1.59	0	6.44
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	4.30	15.26											
Land Slides (sq miles)	132.68	.01	126.82											
Problem Soils (sq miles)	361.33	.88	302.21											
Volcanic Flows (sq miles)	224.20	1.0	196.74											
Wildfires (sq miles)	1274.35	5.61	1161.7											

Name of Town **LaVerkin**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	3	31	1	5	0	0	0	0	0	0	2	0	5
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	6.24	117.08	.21	.84	0	0	0	0	0	0	2.36	0	.84
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	4.89	99.55	2.15	.125	0	0	0	0	0	0	.99	.050	.175
Other Utility Lines (miles)	169.86	1.29	139.54	0	0	0	0	.12	.006	0	0	.07	.0004	.0064
HAZARDS														
Flood Zones (sq miles)	40.47	.90	15.26											
Land Slides (sq miles)	132.68	.86	126.82											
Problem Soils (sq miles)	361.33	2.19	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	2.33	1161.7											

Name of Town **Leeds**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	6	31	0	0	0	0	0	0	0	0	4	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	2.32	117.08	.68	2.72	0	0	0	0	0	0	1.20	0	2.72
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	.23	15.26											
Land Slides (sq miles)	132.68	0	126.82											
Problem Soils (sq miles)	361.33	.31	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	2.01	1161.7											

Name of Town **New Harmony**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	1	31	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	.82	117.08	0	0	0	0	0	0	0	0	0	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	.01	15.26											
Land Slides (sq miles)	132.68	0	126.82											
Problem Soils (sq miles)	361.33	0	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	.04	1161.7											

Name of Town **Rockville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	2	31	1	0	0	0	0	0	0	0	0	0	5
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	3.63	117.08	1.04	4.16	0	0	0	0	0	0	0	0	4.16
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	3.58	139.54	1.26	63k	0	0	1.44	72k	0	0	0	0	.135
HAZARDS														
Flood Zones (sq miles)	40.47	2	15.26											
Land Slides (sq miles)	132.68	1.37	126.82											
Problem Soils (sq miles)	361.33	5.39	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	1.32	1161.7											

Name of Town **Santa Clara**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	0	31	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	2.44	117.08	.25	1	0	0	0	0	0	0	.27	0	1.04
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	1.01	15.26											
Land Slides (sq miles)	132.68	.01	126.82											
Problem Soils (sq miles)	361.33	3.14	302.21											
Volcanic Flows (sq miles)	224.20	.14	196.74											
Wildfires (sq miles)	1274.35	3.37	1161.7											

Name of Town **Springdale**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	1	31	0	0	0	0	0	0	0	0	0	0	0
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	3.72	117.08	1.28	5.12	0	0	1.90	8	0	0	0	0	13.12
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	.63	139.54	0	0	0	0	.63	32k	0	0	0	0	32k
HAZARDS														
Flood Zones (sq miles)	40.47	1.10	15.26											
Land Slides (sq miles)	132.68	1.80	126.82											
Problem Soils (sq miles)	361.33	2.41	302.21											
Volcanic Flows (sq miles)	224.20	00	196.74											
Wildfires (sq miles)	1274.35	.96	1161.7											

Name of Town **Toquerville**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	0	0	0
# of Highway Bridges	109	6	31	1	5	0	0	0	0	2	20	4	0	25
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	7.71	117.08	.20	.80	0	0	0	0	3.77	15	4.86	0	15.84
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	0	99.55	0	0	0	0	0	0	0	0	0	0	0
Other Utility Lines (miles)	169.86	0	139.54	0	0	0	0	0	0	0	0	0	0	0
HAZARDS														
Flood Zones (sq miles)	40.47	.94	15.26											
Land Slides (sq miles)	132.68	0	126.82											
Problem Soils (sq miles)	361.33	0	302.21											
Volcanic Flows (sq miles)	224.20	.07	196.74											
Wildfires (sq miles)	1274.35	11.90	1161.7											

Name of Town **Virgin**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	1	0	0	0	0	0	0
# of Highway Bridges	109	2	31	2	10	0	0	2	10	0	0	0	0	20
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	5.07	117.08	.75	3	0	0	3.58	14	0	0	0	0	17
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	7.07	99.55	0	0	0	0	10.9	.55	0	0	1.5	.075	.625
Other Utility Lines (miles)	169.86	4.31	139.54	.39	20k	0	0	3.81	.19	0	0	.53	.027	.237
HAZARDS														
Flood Zones (sq miles)	40.47	.88	15.26											
Land Slides (sq miles)	132.68	.29	126.82											
Problem Soils (sq miles)	361.33	14.04	302.21											
Volcanic Flows (sq miles)	224.20	.40	196.74											
Wildfires (sq miles)	1274.35	5.48	1161.7											

Name of Town **Washington**	**County Total**	**Town**	**Unincorporated**	**Flood Zone Town**	**Flood Zone Costs in Millions $**	**Land Slide Town**	**Land Slide Costs in Millions $**	**Problem Soil Town**	**Problem Soil Costs in Millions $**	**Volcanic Flow Town**	**Volcanic Flow Costs in Millions $**	**Wildfire Town**	**Wildfire Costs in Millions $**	**Total Cost in millions $ for all Hazards**
# of Dams (High Hazard)	16	0	10	0	0	0	0	0	0	0	0	2	0	0
# of Highway Bridges	109	13	31	1	5	0	0	0	0	0	0	6	0	5
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	5.15	117.08	0	0	0	0	0	0	0	0	.19	0	0
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	8.72	99.55	0	0	.40	.020	0	0	1.28	.064	3.86	.193	.277
Other Utility Lines (miles)	169.86	2.74	139.54	0	0	0	0	0	0	.45	.023	2.46	.123	.146
HAZARDS														
Flood Zones (sq miles)	40.47	3.86	15.26											
Land Slides (sq miles)	132.68	.64	126.82											
Problem Soils (sq miles)	361.33	2.61	302.21											
Volcanic Flows (sq miles)	224.20	.02	196.74											
Wildfires (sq miles)	1274.35	21.40	1161.7											

Unincorporated Area of County	County Total	Towns Total	Unincorporated Total	Flood Zone Unincorporated	Flood Zone Costs in Millions $	Land Slide Unincorporated	Land Slide Costs in Millions $	Problem Soil Unincorporated	Problem Soil Costs in Millions $	Volcanic Flow Unincorporated	Volcanic Flow Costs in Millions of $	Wildfire Unincorporated	Wildfire Costs in Millions $	Total Cost in millions $ for all Hazards in Unincorporated
# of Dams (High Hazard)	16	6	10	0	0	1	0	1	0	2	0	7	0	0
# of Highway Bridges	109	78	31	4	40	4	60	4	50	7	65	22	0	215
# Tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Major Roads (miles)	200.46	83.38	117.08	8.78	35.1	6.84	27	16.1	64	16.2	65	53.3	0	191.4
Railways (miles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utility Lines (miles)	127.32	27.77	99.55	1.14	.056	8.33	.42	10.1	.51	18.9	.95	71.5	.286	2.222
Other Utility Lines (miles)	169.86	30.32	139.54	2.77	.139	.61	.031	19.9	1	19.2	.96	57.6	2.88	5.010
HAZARDS														
Flood Zones (sq miles)	40.47	25.21	15.26											
Land Slides (sq miles)	132.68	5.86	126.82											
Problem Soils (sq miles)	361.33	59.12	302.21											
Volcanic Flows (sq miles)	224.20	27.46	196.74											
Wildfires (sq miles)	1274.35	112.63	1161.7											

Wildfire

FEMA Hazard Profile
Frequency: Likely (drought patterns are cyclical)
Severity: Negligible to structures in most incorporated communities with the exception of structures in the town of Leeds and in unincorporated Washington County located in a Moderate to High wildfire risk area.
Duration: Containment time varies for each fire.

Assessing Vulnerability

Overall Summary of Impacts

Wildfires occur every year in the United States. Factors that influence the potential for wildfires include: type, amounts and conditions of fuel supply (vegetation); temperatures; wind conditions; precipitation patterns; humidity levels; topography and the levels of human activity on the land. Fires in areas of heavy vegetation, if not quickly detected and suppressed can quickly flare out of control and cause major damage to habitat, crops, livestock, wildlife, people, and structural property.

Most rural wildfires result from thunderstorm activity. In addition, other wildfires are started by acts of human carelessness during activities such as controlled burns of forest areas; burning of ditch banks and fields by landowners; recreational activity such as camping, hunting, and other off-road vehicle travel; and use of both legal and illegal fireworks.

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at moderate or high risk from wildfire. See Table 64 below for an analysis of wildfire risk in Washington County.

In unincorporated Washington County there are 233 residential structures at moderate risk from wildfire. This is 7.70% of the homes in unincorporated Washington County. Based upon figures provided by the Washington County Assessors Office, the market value of those structures is estimated to be $24,892,388. Based upon the average household size of 2.97 persons, in Washington County, from the 2000 U.S. Census, there are approximately 692 persons residing full or part time in a residential structure at moderate risk from wildfire. This is 22.89% of the 3,023 population of unincorporated Washington County. There are also 64 residential structures at high risk from wildfire. Based upon figures provided by the Washington County Assessors Office, the market value of those structures is estimated to be $6,822,287. Based upon the average household size of 2.97 persons, in Washington County, from the 2000 U.S. Census, there are approximately 190 persons residing full or part time in a residential structure at high risk from wildfire. This is 6.28% of the 3,023 population of unincorporated Washington County. There are no commercial structures in unincorporated Washington County identified to be in a moderate, high or extreme wildfire risk area.

In Enterprise City there are approximately 8 homes at moderate risk from wildfire. These account for 1.84% of the 434 residential structures in Enterprise City. The value of the structures at risk is estimated to be $615,717. Based upon the average household size in Enterprise City of 3.40 persons, there are approximately 27 persons at moderate risk from wildfire. This is 2.10% of the 1,285 population of Enterprise City. There are 2 homes at high risk from wildfire. These account for 0.46% of the 434 residential structures in Enterprise City. The value of the structures at risk is estimated to be $153,930. Based upon the average household size in Enterprise City of 3.40 persons, there are approximately 7 persons at high risk from wildfire. This is 0.54% of the 1,285 population of Enterprise City.

In Hurricane City there are approximately 176 homes at moderate risk from wildfire. These account for 5.88% of the 2,991 residential structures in Hurricane City. The value of the structures at risk is estimated to be $16,663,587. Based upon the average household size in Hurricane City of 2.97 persons, there are approximately 523 persons at moderate risk from wildfire. This is 6.33% of the 8,250 population of Hurricane City. There are approximately 74 homes at high risk from wildfire. These account for 2.47% of the 2,991 residential structures in Hurricane City. The value of the structures at risk is estimated to be $6,982,470. Based upon the average household size in Hurricane City of 2.97 persons, there are approximately 219 persons at high risk from wildfire. This is 2.65% % of the 8,250 population of Hurricane City. There are 58 businesses at moderate risk from wildfire in Hurricane City. This is 26.24% of the commercial structures in Hurricane City. The value of those structures is estimated at $18,789,255. There are 86 businesses at high risk from wildfire in Hurricane City. This is 38.91% of the commercial structures in Hurricane City. The value of those structures is estimated at $27,853,937.

In Ivins City there are approximately 34 homes at moderate risk from wildfire. These account for 1.61% of the 2,103 residential structures in Ivins City. The value of the structures at risk is estimated to be $4,045,841. Based upon the average household size in Ivins City of 3.10 persons, there are approximately 105 persons at moderate risk from wildfire. This is 2.35% of the 4,450 population of Ivins City. There are approximately 141 homes at high risk from wildfire. These account for 6.70% of the 2,103 residential structures in Ivins City. The value of the structures at risk is estimated to be $16,774,724. Based upon the average household size in Ivins City of 3.10 persons, there are approximately 437 persons at high risk from wildfire. This is 9.82% % of the 4,450 population of Ivins City. There are 7 businesses at moderate risk from wildfire in Ivins City. This is 33.33% of the commercial structures in Ivins City. The value of those structures is estimated at $3,441,284. There are 8 businesses at high risk from wildfire in Ivins City. This is 38.09% of the commercial structures in Ivins City. The value of those structures is estimated at $3,932,011.

In LaVerkin City there are approximately 204 homes at high risk from wildfire. These account for 20.05% of the 1,017 residential structures in LaVerkin City. The value of the structures at risk is estimated to be $16,041,141. Based upon the average household size in LaVerkin City of 3.20 persons, there are approximately 653 persons at high risk from wildfire. This is 19.25% of the 3,392 population of LaVerkin City. There are 26 businesses at moderate risk from wildfire in LaVerkin City. This is 52.00% of the commercial structures in LaVerkin City. The value of those structures is estimated at $6,573,897. There are 13 businesses at high risk from wildfire in LaVerkin City. This is 26.00% of the commercial structures in LaVerkin City. The value of those structures is estimated at $3,286,949.

In the town of Leeds there are approximately 36 homes at moderate risk from wildfire. These account for 16.51% of the 218 residential structures in the town of Leeds. The value of the structures at risk is estimated to be $5,067,790. Based upon the average household size in the town of Leeds of 2.64 persons, there are approximately 95 persons at moderate risk from wildfire. This is 17.36% of the 547 population of the town. There are approximately 2 homes at high risk from wildfire. These account for 0.91% of the 218 residential structures in the town of Leeds. The value of the structures at risk is estimated to be $281,178. Based upon the average household size in Leeds of 2.64 persons, there are approximately 5 persons at high risk from wildfire. This is 0.91% of the 547 population of Leeds. There are 2 businesses at moderate risk from wildfire in the town of Leeds. This is 22.22% of the commercial structures in the town. The value of those structures is estimated at $184,362.

In the town of New Harmony there are approximately 3 homes at moderate risk from wildfire. These account for 3.26% of the 92 residential structures in the town. The value of the structures at risk is estimated to be $221,660. Based upon the average household size in the town of New Harmony of 2.75 persons, there are approximately 8 persons at moderate risk from wildfire. This is 4.21% of the 190 population of the town.

In St. George City there are approximately 230 homes at moderate risk from wildfire. These account for 1.15% of the 19,851 residential structures in St. George City. The value of the structures at risk is estimated to be $26,399,953. Based upon the average household size in St. George City of 2.81 persons, there are approximately 646 persons at moderate risk from wildfire. This is 1.30% of the 49,663 population of the City. There are approximately 3,010 homes at high risk from wildfire. These account for 15.16% of the 19,851 residential structures in the City. The value of the structures at risk is estimated to be $345,458,680. Based upon the average household size in St. George City of 2.81 persons, there are approximately 8,458 persons at high risk from wildfire. This is 17.03% of the 49,663

population of St. George City. There are approximately 33 business structures at moderate risk from wildfire in St. George City. This is approximately 2.36% of the commercial structures in the City. The value of those structures is estimated at $11,408,360. There are approximately 365 businesses at high risk from wildfire in St. George City. This is 26.18% of the commercial structures in St. George City. The value of those structures is estimated at $126,516,229.

In Santa Clara City there are approximately 117 homes at high risk from wildfire. These account for 8.00% of the 1,461 residential structures in Santa Clara City. The value of the structures at risk is estimated to be $15,465,139. Based upon the average household size in Santa Clara City of 3.78 persons, there are approximately 442 persons at high risk from wildfire. This is 9.54% % of the 4,630 population of Santa Clara City. There are 7 businesses at high risk from wildfire in Santa Clara City. This is 58.33% of the commercial structures in the City. The value of those structures is estimated at $2,281,976.

In the town of Springdale there are approximately 4 homes at moderate risk from wildfire. These account for 1.76% of the 226 residential structures in the town of Springdale. The value of the structures at risk is estimated to be $417,831. Based upon the average household size in the town of Springdale of 2.38 persons, there are approximately 10 persons at moderate risk from wildfire. This is 2.18% of the 457 population of the town. There is one business at moderate risk from wildfire in the town of Springdale. This is 1.78% of the commercial structures in the town. The value of that structure is estimated at $400,516.

In Toquerville City there are approximately 66 homes at moderate risk from wildfire. These account for 19.29% of the 342 residential structures in Toquerville City. The value of the structures at risk is estimated to be $6,557,010. Based upon the average household size in Toquerville City of 3.23 persons, there are approximately 213 persons at moderate risk from wildfire. This is 23.40% of the 910 population of Toquerville City. There are approximately 18 homes at high risk from wildfire. These account for 5.26% of the 342 residential structures in Toquerville City. The value of the structures at risk is estimated to be $1,787,799. Based upon the average household size in Toquerville City of 3.23 persons, there are approximately 58 persons at high risk from wildfire. This is 6.37% of the 910 population of Toquerville City. There is one business at moderate risk from wildfire in Toquerville City. This is 33.33% of the commercial structures in Toquerville City. The value of that structure is estimated at $86,487. There are 2 businesses at high risk from wildfire in Toquerville City. This is 66.66% of the commercial structures in Toquerville City. The value of those structures is estimated at $172,974.

In Washington City there are approximately 106 homes at moderate risk from wildfire. These account for 2.92% of the 3,626 residential structures in Washington City. The value of the structures at risk is estimated to be $10,252,929. Based upon the average household size in Washington City of 3.00 persons, there are approximately 318 persons at moderate risk from wildfire. This is 3.88% of the 8,186 population of Washington City. There are approximately 86 businesses at moderate risk from wildfire in Washington City. This is approximately 49.71% of the commercial structures in Washington City. The value of those structures is estimated at $23,827,877. There are approximately 17 businesses at high risk from wildfire in Washington City. This is approximately 9.82% of the commercial structures in Washington City. The value of those structures is estimated at $4,707,096.

Number of People/Buildings Impacted by Wildfire

Table 64 Analysis of Wildfire Risk in Washington County

Enterprise - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	434	10	2.30%	$33,402,680	$769,647	2.30%	1,285	34	2.64%
Commercial	23	0	0%	$2,210,150	$0	0%	N/A	N/A	N/A
Total	457	10	2.18%	$35,612,830	$769,647	2.16%	1,285	34	2.64%

Hildale – Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	243*	0	0%	$25,505,620	$0	0%	1,895	0	0%
Commercial	32	0	0%	$6,527,949	$0	0%	N/A	N/A	N/A
Total	275	0	0%	$ 32,033,569	$0	0%	1,895	0	0%

*source: U.S. Census Bureau, Census 2000

Hurricane - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,991	250	8.35%	$283,186,314	$23,646,057	8.35%	8,250	742	8.99%
Commercial	221	144	65.15%	$71,593,541	$46,643,192	65.15%	N/A	N/A	N/A
Total	3,212	394	12.26%	$354,779,855	$70,289,249	19.81%	8,250	742	8.99%

Ivins - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,103	175	8.32%	$250,247,181	$20,820,565	8.32%	4,450	542	12.17%
Commercial	21	15	71.42%	$10,323,853	$7,373,295	71.42%	N/A	N/A	N/A
Total	2,124	190	8.94%	$260,571,034	$28,193,860	10.82%	4,450	542	12.17%

La Verkin - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,017	204	20.05%	$80,005,690	$16,041,141	20.05%	3,392	653	19.25%
Commercial	50	39	78.00%	$12,642,111	$9,860,846	78.00%	N/A	N/A	N/A
Total	1,067	243	22.77%	$92,647,801	$25,901,987	27.95%	3,392	653	19.25%

Leeds - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	218	38	17.43%	$30,688,289	$5,348,968	17.43%	547	100	18.28%
Commercial	9	2	22.22%	$829,715	$184,362	22.22%	N/A	N/A	N/A
Total	227	40	17.62%	$31,518,004	$5,533,330	17.55%	547	100	18.28%

New Harmony - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	92	3	3.26%	$6,799,397	$221,660	3.26%	190	8	4.21%
Commercial	1	0	0%	$6,302	$0	0%	N/A	N/A	N/A
Total	93	3	3.22%	$6,805,699	$221,660	3.25%	190	8	4.21%

Rockville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	137	0	0%	$11,655,825	$0	0%	247	0	0%
Commercial	2	0	0%	$1,053,524	$0	0%	N/A	N/A	N/A
Total	139	0	0%	$12,709,349	$0	0%	247	0	0%

St. George - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	19,851	3,240	16.32%	$2,278,545,551	$371,858,633	16.32%	49,663	9,104	18.33%
Commercial	1,394	399	28.62%	$481,916,804	$137,924,589	28.62%	N/A	N/A	N/A
Total	21,245	3,639	17.12%	$2,760,462,355	$509,783,222	18.46%	49,663	9,104	18.33%

Santa Clara - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,461	117	8.00%	$193,314,237	$15,465,139	8.00%	4,630	442	9.54%
Commercial	12	7	58.33%	$3,911,959	$2,281,976	58.33%	N/A	N/A	N/A
Total	1,473	124	8.41%	$197,226,196	$17,747,115	8.99%	4,630	442	9.54%

Springdale - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	226	4	1.76%	$23,740,428	$417,831	1.76%	457	10	2.18%
Commercial	56	1	1.78%	$22,500,887	$400,516	1.78%	N/A	N/A	N/A
Total	282	5	1.77%	$46,241,315	$818,347	1.76%	457	10	2.18%

Toquerville - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	342	84	24.56%	$33,977,235	$8,344,809	24.56%	910	271	29.78%
Commercial	3	3	100%	$259,461	$259,461	100%	N/A	N/A	N/A
Total	345	87	25.21%	$34,236,696	$8,604,270	25.13%	910	271	29.78%

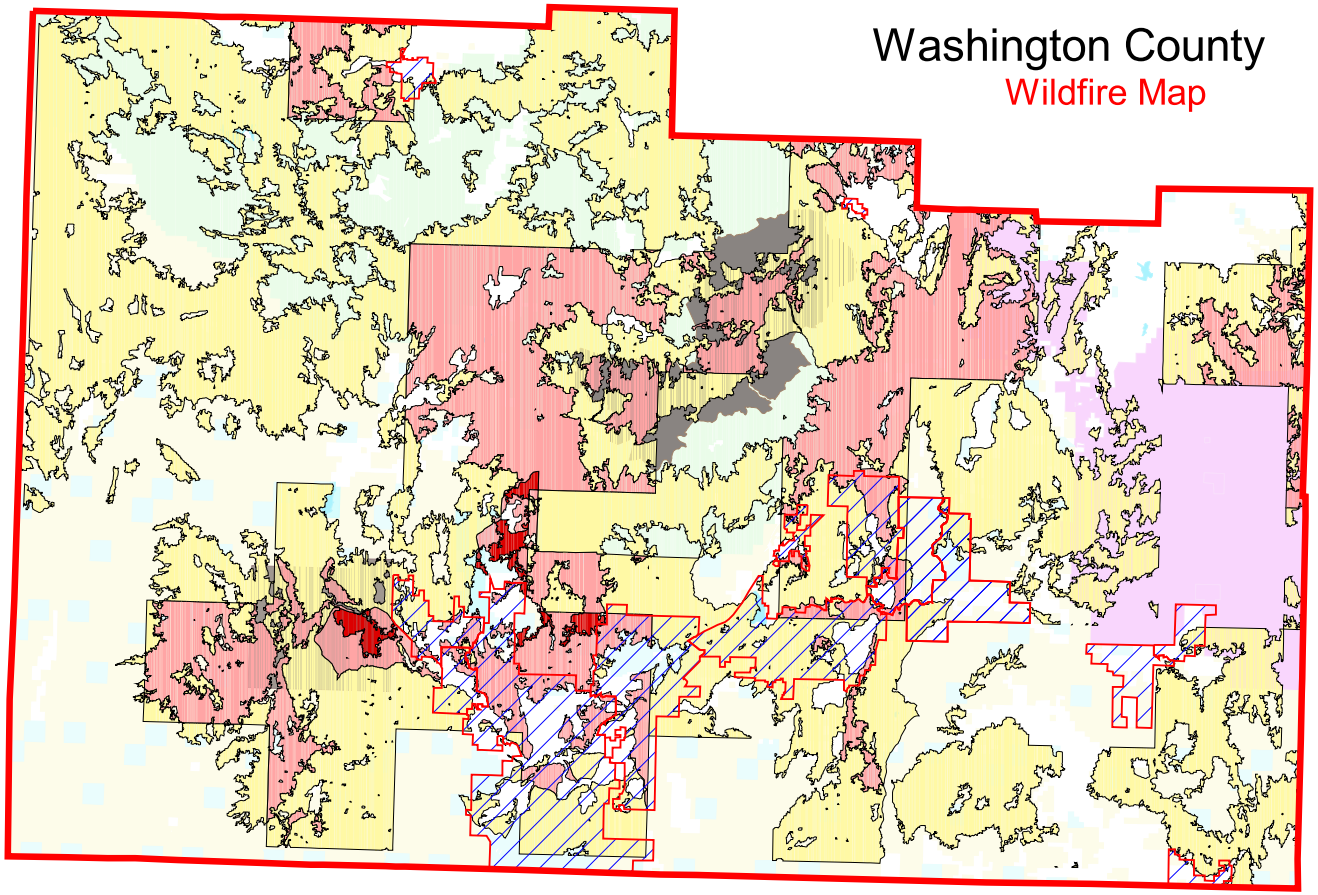
Virgin - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	164	0	0%	$12,125,010	$0	0%	394	0	0%
Commercial	7	0	0%	$1,633,519	$0	0%	N/A	N/A	N/A
Total	171	0	0%	$13,758,529	$0	0%	394	0	0%

Washington - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,626	106	2.92%	$351,127,720	$10,252,929	2.92%	8,186	318	3.88%
Commercial	173	103	59.53%	$47,933,770	$28,534,973	59.53%	N/A	N/A	N/A
Total	3,799	209	5.50%	$399,061,490	$38,787,902	9.71%	8,186	318	3.88%

Unincorporated Washington County areas - Wildfire									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,023	297	9.82%	$322,960,038	$31,714,675	9.82%	5,858	882	15.05%
Commercial	33	0	0%	$6,460,642	$0	0%	N/A	N/A	N/A
Total	3,056	297	9.71%	$329,420,680	$31,714,675	9.62%	5,858	882	15.05%

Washington County

Wildfire Map



10 0 10 20 Miles

Five County Association of Governments July 2003 Ed Dickie

FCAOG GIS uses information & data from many different sources, which may be of differing accuracy and which have been integrated to provide a planning context. These products should be used only for the purpose they were intended. For specific data source information, please contact FCAOG GIS.

435-673-3548 email edickie@fcaog.state.ut.us

County Boundary

Town Boundary

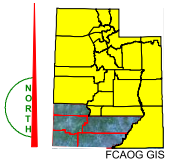
Fire Danger Categories W/ sq. miles

Extreme	9.55
High	332.62
Moderate	932.18

Major Roads

I-15 State Route US Route

* Note: Administrative Ownership is the background layer



Landslides

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe. The location of potential slope failures and landslides is spread throughout the county. Table 65 assesses the risk to structures in incorporated and unincorporated potions of Washington County.
Duration: range from very short duration slope failures to long-term ground movement. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available data, has identified residential and commercial structures at risk from landslide. See Table 65 for an analysis of landslide risk in Washington County.

According to available data, there are 87 residential structures at risk from landslide in unincorporated Washington County. This is 2.87% of the residential units in unincorporated Washington County. The market value of those structures is estimated to be $9,294,582. Based upon an estimated 1.93 persons per household, there are 168 persons at risk from landslide in unincorporated Washington County.

According to available data, there are 79 residential structures at risk from landslide in Washington City. This is 2.18% of the residential units in Washington City. The market value of those structures is estimated to be $7,650,052. Based upon an estimated 3.00 persons per household, there are 237 persons at risk from landslide in Washington City.

According to available data, there are 63 residential structures at risk from landslide in Springdale. This is 27.87% of the residential units in Springdale. The market value of those structures is estimated to be $6,616,457. Based upon an estimated 2.38 persons per household, there are 150 persons at risk from landslide in Springdale.

According to available data, there are 36 residential structures at risk from landslide in St. George. This is 0.18% of the residential units in St. George. The market value of those structures is estimated to be $4,132,166. Based upon an estimated 2.81 persons per household, there are 101 persons at risk from landslide in St. George.

According to available data, there are 4 residential structures at risk from landslide in Santa Clara City. This is 0.27% of the residential units in Santa Clara. The market value of those structures is estimated to be $529,265. Based upon an estimated 3.78 persons per household, there are 15 persons at risk from landslide in Santa Clara.

According to available data, there are 4 residential structures at risk from landslide in Toquerville City. This is 1.17% of the residential units in Toquerville. The market value of those structures is estimated to be $397,394. Based upon an estimated 3.23 persons per household, there are 13 persons at risk from landslide in Toquerville.

According to available data, there are 4 residential structures at risk from landslide in Hurricane City. This is 0.06% of the residential units in Hurricane. The market value of those structures is estimated to be $189,359. Based upon an estimated 2.97 persons per household, there are 6 persons at risk from landslide in Hurricane.

Available data also indicates that there appears to be no commercial structures at risk from landslide in Washington County.

Number of People/Buildings Impacted by Landslides

Table 65 Analysis of Landslide Risk in Washington County

Enterprise - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	434	0	0%	$33,402,680	$0	0%	1,285	0	0%
Commercial	23	0	0%	$2,210,150	$0	0%	N/A	N/A	N/A
Total	457	0	0%	$35,612,830	$0	0%	1,285	0	0%

Hildale – Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	243*	0	0%	$25,505,620	$0	0%	1,895	0	0%
Commercial	32	0	0%	$6,527,949	$0	0%	N/A	N/A	N/A
Total	275	0	0%	$ 32,033,569	$0	0%	1,895	0	0%

*source: U.S. Census Bureau, Census 2000

Hurricane - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,991	2	0.06%	$283,186,314	$189,359	0.06%	8,250	6	0.07%
Commercial	221	0	0%	$71,593,541	$0	0%	N/A	N/A	N/A
Total	3,212	2	0.06%	$354,779,855	$189,359	0.05%	8,250	6	0.07%

Ivins - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,103	0	0%	$250,247,181	$0	0%	4,450	0	0%
Commercial	21	0	0%	$10,323,853	$0	0%	N/A	N/A	N/A
Total	2,124	0	0%	$260,571,034	$0	0%	4,450	0	0%

La Verkin - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,017	0	0%	$80,005,690	$0	0%	3,392	0	0%
Commercial	50	0	0%	$12,642,111	$0	0%	N/A	N/A	N/A
Total	1,067	0	0%	$92,647,801	$0	0%	3,392	0	0%

Leeds - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	218	0	0%	$30,688,289	$0	%	547	0	0%
Commercial	9	0	0%	$829,715	$0	0%	N/A	N/A	N/A
Total	227	0	0%	$31,518,004	$0	0%	547	0	0%

New Harmony - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	92	0	0%	$6,799,397	$0	0%	190	0	0%
Commercial	1	0	0%	$6,302	$0	0%	N/A	N/A	N/A
Total	93	0	0%	$6,805,699	$0	0%	190	0	0%

Rockville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	137	0	0%	$11,655,825	$0	0%	247	0	0%
Commercial	2	0	0%	$1,053,524	$0	0%	N/A	N/A	N/A
Total	139	0	0%	$12,709,349	$0	0%	247	0	%

St. George - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	19,851	36	0.18%	$2,278,545,551	$4,132,166	0.18%	49,663	101	0.20%
Commercial	1,394	0	0%	$481,916,804	$0	0%	N/A	N/A	N/A
Total	21,245	36	0.17%	$2,760,462,355	$4,132,166	0.17%	49,663	101	0.20%

Santa Clara - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,461	4	0.27%	$193,314,237	$529,265	0.27%	4,630	15	0.32%
Commercial	12	0	0%	$3,911,959	$0	0%	N/A	N/A	N/A
Total	1,473	4	0.27%	$197,226,196	$529,265	0.27%	4,630	15	0.32%

Springdale - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	226	63	27.87%	$23,740,428	$6,616,457	27.87%	457	150	32.82%
Commercial	56	0	0%	$22,500,887	$0	0%	N/A	N/A	N/A
Total	282	63	22.34%	$46,241,315	$6,616,457	0%	457	150	32.82%

Toquerville - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	342	4	1.17%	$33,977,235	$397,394	1.17%	910	13	1.43%
Commercial	3	0	0%	$259,461	$0	0%	N/A	N/A	N/A
Total	345	0	0%	$34,236,696	$397,394	1.16%	910	13	1.43%

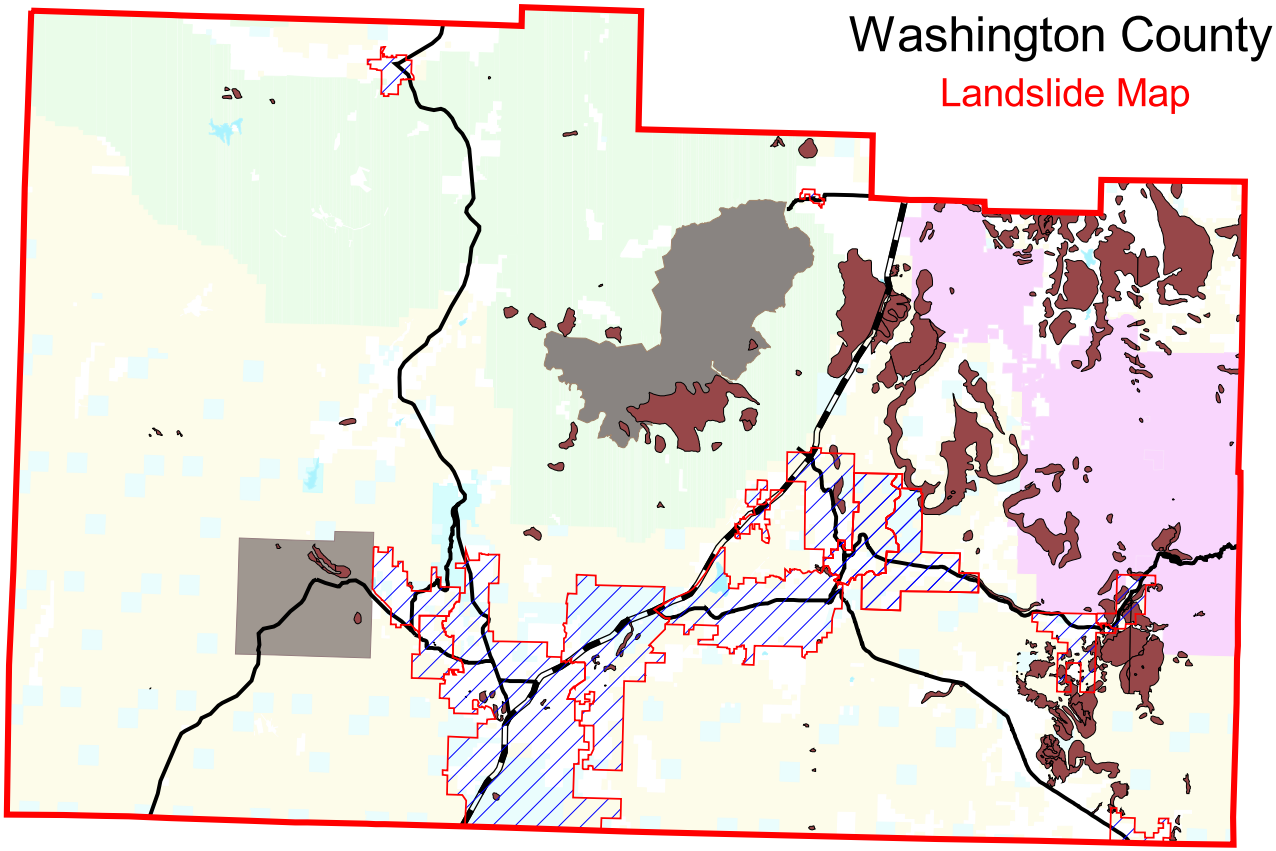
Virgin - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	164	0	0%	$12,125,010	$0	0%	394	0	0%
Commercial	7	0	0%	$1,633,519	$0	0%	N/A	N/A	N/A
Total	171	0	0%	$13,758,529	$0	0%	394	0	0%

Washington - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,626	79	2.18%	$351,127,720	$7,650,052	2.18%	8,186	237	2.89%
Commercial	173	0	0%	$47,933,770	$0	0%	N/A	N/A	N/A
Total	3,799	79	2.08%	$399,061,490	$7,650,052	1.92%	8,186	237	2.89%

Unincorporated Washington County areas - Landslide									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,023	87	2.87%	$322,960,038	$9,294,582	2.87%	5,858	168	2.87%
Commercial	33	0	0%	$6,460,642	$0	0%	N/A	N/A	N/A
Total	3,056	87	2.84%	$329,420,680	$9,294,582	2.82%	5,858	168	2.87%

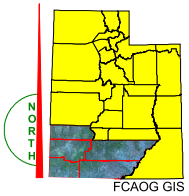
Washington County

Landslide Map



10 0 10 20 Miles

Kane County Boundary
Towns
Landslides
Major Roads
State Route
US Route
* Note: Administrative Ownership is the background layer



Five County Association of Governments August 2003 Ed Dickie

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Earthquake

Assessing Vulnerability and Overall Summary of Impacts

HAZUS MH Earthquake Vulnerability Assessment

See Table 66 below for an estimate of earthquake casualties.

Table 66 Earthquake Casualties Risk in Washington County

Casualties	Nighttime –Minor	583
	Nighttime –Major	13
	Nighttime -Fatalities	25
	Daytime –Minor	707
	Daytime –Major	23
	Daytime- Fatalities	45
	Commute –Minor	582
	Commute –Major	18
	Commute-Fatalities	34

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 67 below lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 67 Building Damage from Moderate to Complete by Count

Category	Number of Structures	Total Cost in millions of dollars **
Residential	3,338	575.45
Commercial	215	160.95
Industrial	24	34.17
Totals	14,114*	789.62**

*****Includes all building categories with moderate to complete damage
** Structural, non-structural, content, inventory

Table 68 Damage to Critical Facilities from Moderate to Complete

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	2	0	0	0
Schools	33	0	0	0
EOCs	1	0	0	1
Police Stations	3	0	0	0
Fire Stations	6	0	0	0

Debris Removal –Table 69 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty

thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 69 –Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	567
Loads (25 tons per load)	22,680

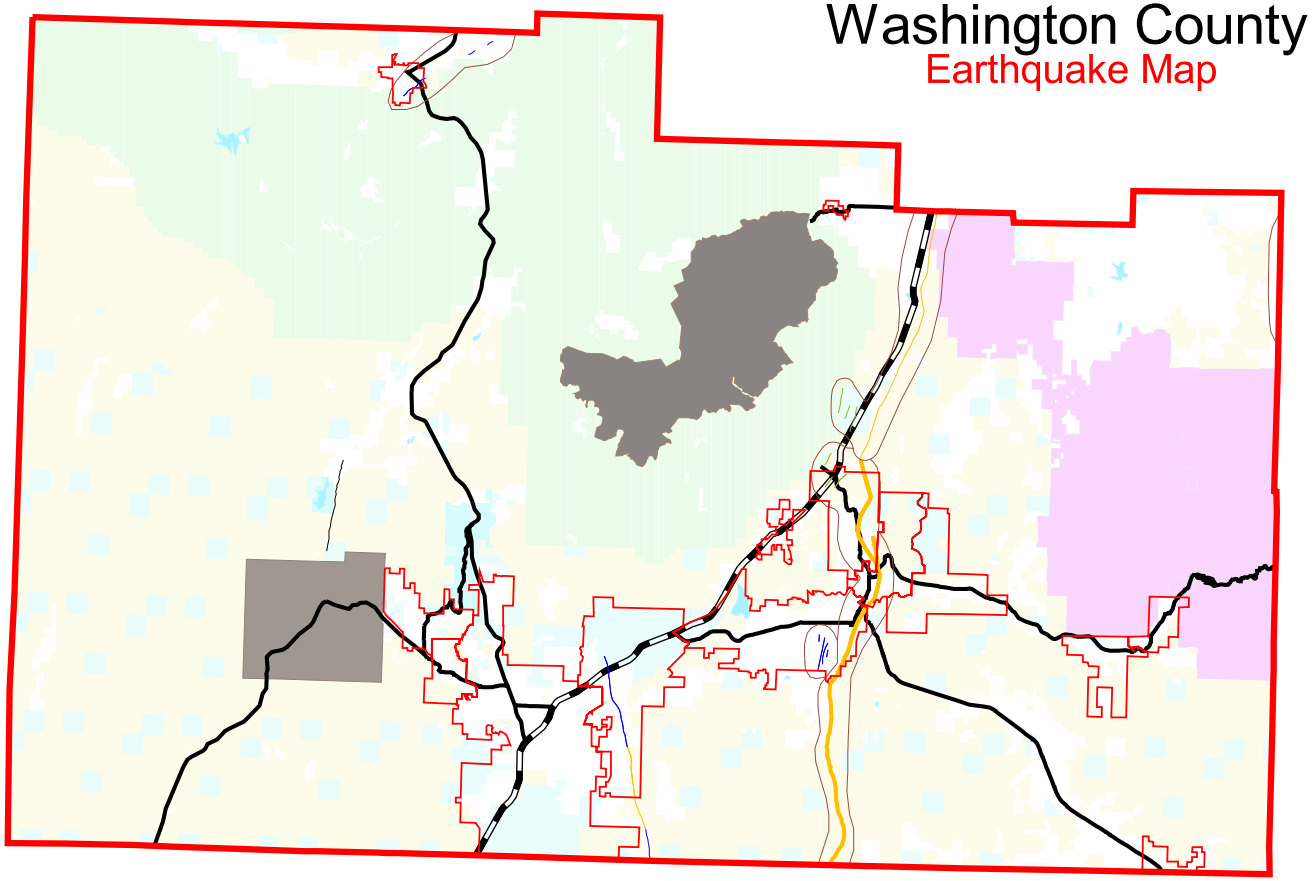
Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 70 below provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 70 –Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	3
People Displaced	29
Value Exposed (mill. $)	2

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. The complete HAZUS MH run performed by the Utah Division of Emergency Services and Homeland Security is available at the Five County Association of Governments.

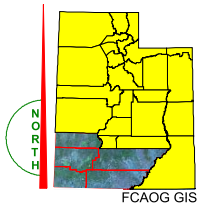
Washington County
Earthquake Map



5 0 5 10 15 Miles

County Boundaries
Towns
Major Roads
I-15
State Route
US Route
Fault Groups
Folds
Fault Lines
123 = Latest Quaternary (<15,000 years)
124 = Latest Quaternary (<15,000 years)
133 = Late Quaternary (<130,000 years)
134 = Late Quaternary (<130,000 years)
144 = Mid to Late Quaternary (<750,000 years)
154 = Quaternary (<1,600,000 years)

* Note: Administrative Ownership is the background layer



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Flood

FEMA Hazard Profile

Frequency: Likely
Severity: Negligible to severe depending on location.
Duration: range from very short duration flash flooding to longer-term inundation. Duration varies by location.

Assessing Vulnerability

Overall Summary of Impacts

The Five County Association of Governments GIS, utilizing available floodplain data, has identified residential and commercial structures located within the 100-year floodplain (A Zone). See Table 71 for an analysis of flood risk in Washington County.

Based upon review of available data, in the City of Hildale there are 2 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 0.82% of the residential structures in Hildale. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $209,922. Based upon an average household size (U.S. Census Bureau, Census 2000) of 8.17 persons per household in Hildale, there are approximately 16 persons at risk from floodplains.

Based upon review of available data, in the City of Ivins there are 595 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 28.29% of the residential structures in Ivins. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $70,802,222. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.10 persons per household in Ivins, there are approximately 1,844 persons at risk from floodplains. There are approximately 13 businesses in Ivins located in a floodplain. This is 61.90% of the businesses in the city with a market value of approximately $6,390,956.

Based upon review of available data, in the City of LaVerkin there are 11 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 1.08% of the residential structures in LaVerkin. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $865,351. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.20 persons per household in LaVerkin, there are approximately 35 persons at risk from floodplains.

Based upon review of available data, in the town of Leeds there is one residential structure located in a floodplain (A Zone). This home located in floodplains accounts for 0.45% of the residential structures in Leeds. Based upon an estimated average market value of residential structures in the town, the market value of this structure is approximately $140,722. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.64 persons per household in Leeds, there are approximately 3 persons at risk from floodplains.

Based upon review of available data, in the town of Rockville there are 14 residential structures located in a floodplain (A Zone). The homes located in floodplains account for 10.21% of the residential structures in Rockville. Based upon an estimated average market value of residential structures in the town, the market value of these structures is approximately $1,191,106. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.15 persons per household in Rockville, there are approximately 30 persons at risk from floodplains.

Based upon review of available data, in St. George City there are approximately 741 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 3.73% of the residential structures in St. George. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $85,083,763. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.81 persons per household in St. George, there are approximately 2,082 persons at risk from floodplains. There are approximately 82 businesses in St. George located in a floodplain. This is 5.88% of the businesses in the city with a market value of approximately $28,348,047.

Based upon review of available data, in Santa Clara City there are approximately 143 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 9.78% of the residential structures in Santa Clara. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $18,921,243. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.81 persons per household in Santa Clara, there are approximately 540 persons at risk from floodplains.

Based upon review of available data, in the town of Springdale there are approximately 152 residential structures located in a floodplain (A Zone). The homes located in floodplains account for 67.25% of the residential structures in Springdale. Based upon an estimated average market value of residential structures in the town, the market value of these structures is approximately $15,967,013. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.38 persons per household in Springdale, there are approximately 362 persons at risk from floodplains. There are approximately 20 businesses in Springdale located in a floodplain. This is 35.71% of the businesses in the town with a market value of approximately $8,036,031.

Based upon review of available data, in Toquerville City there are approximately 7 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 2.05% of the residential structures in Toquerville. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $695,440. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.23 persons per household in Toquerville, there are approximately 23 persons at risk from floodplains.

Based upon review of available data, in the town of Virgin there are 26 residential structures located in a floodplain (A Zone). The homes located in floodplains account for 15.85% of the residential structures in Virgin. Based upon an estimated average market value of residential structures in the town, the market value of these structures is approximately $1,922,257. Based upon an average household size (U.S. Census Bureau, Census 2000) of 2.70 persons per household in Virgin, there are approximately 70 persons at risk from

floodplains. There is one business in Virgin located in a floodplain. This is 14.28% of the businesses in the town with a market value of approximately $233,359.

Based upon review of available data, in Washington City there are approximately 167 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 4.60% of the residential structures in Washington. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $16,171,629. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.00 persons per household in Washington City, there are approximately 501 persons at risk from floodplains.

Based upon review of available data, in the City of Enterprise there are approximately 29 residential structures located in a floodplain (A Zone). Homes located in floodplains account for 6.68% of the residential structures in Enterprise. Based upon an estimated average market value of residential structures in the city, the market value of those structures is approximately $2,231,976. Based upon an average household size (U.S. Census Bureau, Census 2000) of 3.40 persons per household in the City of Enterprise, there are approximately 99 persons at risk from floodplains.

Based upon review of available data, in unincorporated Washington County there are a total of 46 residential structures located in a Floodplain (A Zone). Twenty-six of these structures are located in Zion National Park and are not private homes. These 46 homes account for 1.52% of the homes in unincorporated Washington County. Eleven homes are located in the Pine Valley area. Seven are located in the New Harmony area. Two homes are located along the road to Kolob Reservoir. Based upon an average market value of residential structures in unincorporated Washington County, the market value of those 46 structures is approximately $4,914,377. Based an average household size (U.S. Census Bureau, Census 2000) of 2.97 persons per household in Washington County, there are approximately 137 persons at risk from floodplains in unincorporated Washington County. There is one business in unincorporated Washington County located in a floodplain. This is 3.03% of the businesses in unincorporated Washington County with a market value of approximately $195,777.

Number of People and Buildings/Structures Impacted by Floodplains

Table 71 Analysis of Flood Risk in Washington County

Enterprise – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	434	29	6.68%	$33,402,680	$2,231,976	6.68%	1,285	99	7.70%
Commercial	23	0	0%	$2,210,150	$0	0%	N/A	N/A	N/A
Total	457	29	6.34%	$35,612,830	$2,231,976	6.26%	1,285	99	7.70%

Hildale – Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	243*	2	0.82%	$25,505,620	$209,922	0.82%	1,895	16	0%
Commercial	32	0	0%	$6,527,949	$0	0%	N/A	N/A	N/A
Total	275	2	0.82%	$ 32,033,569	$209,922	0.65%	1,895	16	0%

Hurricane - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,991	0	0%	$283,186,314	$0	0%	8,250	0	0%
Commercial	221	0	0%	$71,593,541	$0	0%	N/A	N/A	N/A
Total	3,212	0	0%	$354,779,855	$0	0%	8,250	0	%

Ivins - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	2,103	595	28.29%	$250,247,181	$70,802,222	28.29%	4,450	1,844	41.43%
Commercial	21	13	61.90%	$10,323,853	$6,390,956	61.90%	N/A	N/A	N/A
Total	2,124	608	28.62%	$260,571,034	$77,193,178	29.62%	4,450	1,844	41.43%

La Verkin - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,017	11	1.08%	$80,005,690	$865,351	1.08%	3,392	35	1.03%
Commercial	50	0	0%	$12,642,111	$0	0%	N/A	N/A	N/A
Total	1,067	11	1.03%	$92,647,801	$865,351	0.93%	3,392	35	1.03%

Leeds - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	218	1	0.45%	$30,688,289	$140,772	0.45%	547	3	0.54%
Commercial	9	0	0%	$829,715	$0	0%	N/A	N/A	N/A
Total	227	1	0.44%	$31,518,004	$140,722	0.44%	547	3	0.54%

New Harmony - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	92	0	0%	$6,799,397	$0	0%	190	0	0%
Commercial	1	0	0%	$6,302	$0	0%	N/A	N/A	N/A
Total	93	0	0%	$6,805,699	$0	0%	190	0	0%

Rockville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	137	14	10.21%	$11,655,825	$1,191,106	10.21%	247	30	12.14%
Commercial	2	0	0%	$1,053,524	$0	0%	N/A	N/A	N/A
Total	139	14	10.07%	$12,709,349	$1,191,106	9.37%	247	30	12.14%

St. George - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	19,851	741	3.73%	$2,278,545,551	$85,083,763	3.73%	49,663	2,082	4.19%
Commercial	1,394	82	5.88%	$481,916,804	$28,348,047	5.88%	N/A	N/A	N/A
Total	21,245	823	3.87%	$2,760,462,355	$106,936,244	3.87%	49,663	2,082	4.19%

Santa Clara - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	1,461	143	9.78%	$193,314,237	$18,921,243	9.78%	4,630	540	11.66%
Commercial	12	0	0%	$3,911,959	$0	0%	N/A	N/A	N/A
Total	1,473	143	9.71%	$197,226,196	$18,921,243	9.59%	4,630	540	11.66%

Springdale - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	226	152	67.25%	$23,740,428	$15,967,013	67.25%	457	362	79.21%
Commercial	56	20	35.71%	$22,500,887	$8,036,031	35.71%	N/A	N/A	N/A
Total	282	172	60.99%	$46,241,315	$24,003,044	51.91%	457	362	79.21%

Toquerville - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	342	7	2.05%	$33,977,235	$695,440	2.04%	910	23	2.52%
Commercial	3	0	0%	$259,461	$0	0%	N/A	N/A	N/A
Total	345	7	2.02%	$34,236,696	$695,440	2.03%	910	23	2.52%

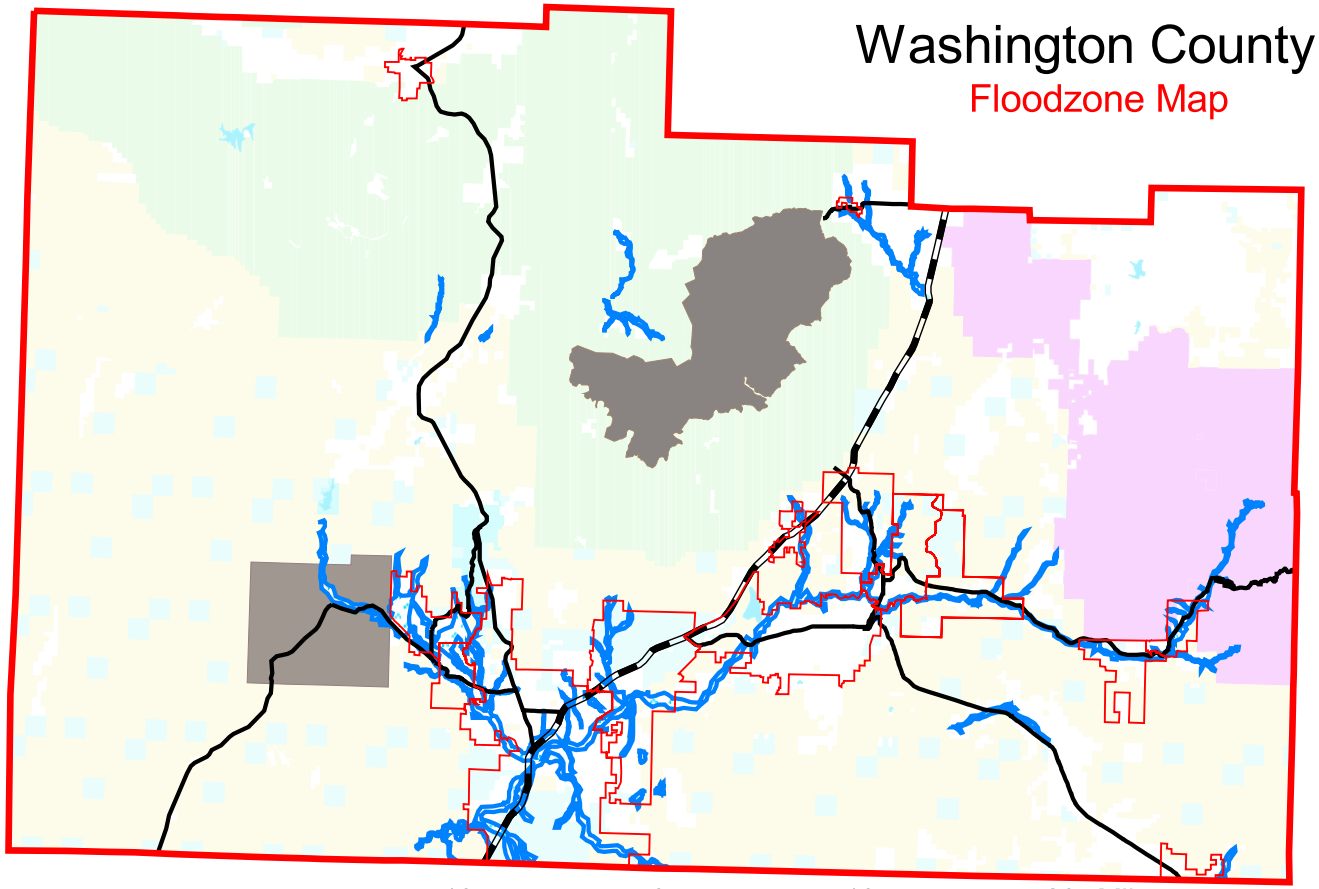
Virgin - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	164	26	15.85%	$12,125,010	$1,922,257	15.85%	394	70	17.76%
Commercial	7	1	14.28%	$1,633,519	$233,359	14.28%	N/A	N/A	N/A
Total	171	27	15.79%	$13,758,529	$2,155,616	15.66%	394	70	17.76%

Washington - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,626	167	4.60%	$351,127,720	$16,171,629	4.60%	8,186	501	6.12%
Commercial	173	0	0%	$47,933,770	$0	0%	N/A	N/A	N/A
Total	3,799	167	4.39%	$399,061,490	$16,171,629	4.05%	8,186	501	6.12%

Unincorporated Washington County areas - Floodplains									
Type of Structure (Occupancy Class)	Number of Structures			Value of Structures			Number of People		
	# in Comm-unity	# in Hazard Area	% in Hazard Area	$ in Comm-unity	$ in Hazard Area	% in Hazard Area	# in Comm-unity	# in Hazard Area	% in Hazard Area
Residential	3,023	46	1.52%	$322,960,038	$4,914,377	1.52%	5,858	137	2.33%
Commercial	33	1	3.03%	$6,460,642	$195,777	3.03%	N/A	N/A	N/A
Total	3,056	47	1.54%	$329,420,680	$5,110,154	1.55%	5,858	137	2.33%

Washington County

Floodzone Map



10 0 10 20 Miles

Major Roads

County Boundary

County Road

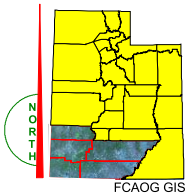
Towns

Interstate

State Route

Floodzone A (Digitized from FEMA Floodzone Maps)

* Note: Administrative Ownership is the background layer



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Mitigation Strategies

A section of the planning process, included in Appendix P details how the mitigation projects were identified and prioritized. The projects in that process were prioritized utilizing the concepts of the STAPLEE explained in FEMA 386-3. Normally used to evaluate alternative mitigation actions for a single identified problem, the STAPLEE process, in this case was used as a rational basis to determine the prioritization of each mitigation project. These projects were submitted by an expanded LEPC in each county for inclusion in the plan. The Planning Team believes that using the STAPLEE provided a reasonable and objective means to determine relative priority of the mitigation actions identified in this plan. The STAPLEE process allows for a review of each project based upon the following considerations:

- **S**ocial- Is the proposed action/project socially acceptable to the community and does it unfairly affect one segment of the community?
- **T**echnical- Is the action/project feasible from a technical standpoint? Can it be accomplished using available engineering practices?
- **A**dministrative- Is there adequate staffing, funding and maintenance available for the proposed mitigation project?
- **P**olitical- Is there political support for the proposed action/project?
- **L**egal- Does the jurisdiction possess the appropriate legal authority to undertake the action/project?
- **E**conomic-Are there sources of funding to accomplish the action/project? What benefits does the action/project provide and are the estimated costs in line with the benefits the action/project would provide?
- **E**nvironmental-Will the proposed action/project have an adverse effect on the environment (land, water, endangered species) and will the action/project comply with applicable environmental laws?

These factors were all considered, by each County LEPC, in determining a final relative score for each action/project listed below:

Drought

Region-wide Mitigation

Problem Identification: Several years of severe drought have affected southwestern Utah in varying degrees.

Goal R1- Priority Medium

Objective R1.1 - Providing drought education to the public
Action: Use several ways in educating the public on efficient water usage.
Time Frame: Ongoing
Funding: State and Federal grants and loans, federal program money, city and county funds, irrigation companies.
Estimated Cost: Unknown
Staff: Natural Resources Conservation Service, Utah Association of Conservation Districts, Utah State University Extension, Municipalities.
Background: Research problem areas. Create programs to make the public aware. Use newsletters and the newspapers. Hold field trips.

County-specific Mitigation

Beaver County

Problem Identification: Inadequate Water Storage in Beaver County

Goal R2- Priority Medium

Objective R2.1 Developing more water storage capacity in several areas in Beaver County.
Action: Conduct feasibility study.
Time Frame: 5 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background: Contact land agencies and irrigation companies to see if studies have been done.

Problem Identification: Outdated irrigation systems throughout Beaver County.

Goal R3- Priority Medium

Objective R3.1 Upgrading irrigation systems.
Action: Put new hardware on the ground to improve efficiency of water.
Time Frame: Ongoing
Funding: State and Federal grants and loans.
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, etc.
Background: This is an ongoing project at this time throughout the county.

Problem Identification: There has not been enforcement of water law.

Goal R4- Priority Low

Objective R4.1 Enforcing water law.
Action: Find out who is responsible to enforce the water law, then enforce it.
Time Frame: 5 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background: May start by litigation.

Problem Identification: Lack of public awareness of efficient water usage.

Goal R5 - Priority High

Objective R5.1 Education
Action: Use several ways in educating the public on efficient water usage.
Time Frame: Ongoing

Funding: State and Federal grants and loans, federal program money, city and county funds, irrigation companies.
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, Municipalities.
Background: Research problem areas. Create programs to make the public aware. Use newsletters and the newspapers. Hold field trips.

Garfield

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal R6 - Priority Medium

Objective R6.1 Conserve culinary water by educating the public
Action: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State grants, County funds
Estimated Cost: Minimal
Staff: Water districts, County, State
Background: Newsletter developed to educate general public on conserving water

Objective R6.2 Conserve culinary water by conservation
Action: Maintain and enforce rate policies that encourage water conservation
Time Frame: Ongoing
Funding: State grants, County funds
Estimated Cost: Minimal
Staff: Water districts, County, State
Background: Evaluate the use of a tiered water rate structure.

Problem Identification: Cyclical periods of drought place a strain on availability of community culinary and irrigation water resources.

Goal R7 - Priority High

Objective R7.1 Meet current and future water needs of the community
Action: Develop additional source and storage as well as implement conservation plans
Time Frame: Ongoing
Funding: State and Fedearl grants/loans, County funds
Estimated Cost: To be determined
Staff: Water districts, County, State, Contractors
Background: Garfield County has experienced several years of drought conditions. To meet the needs of the community's residential and business water users, vigilance is locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.

Objective R7.2 Conserve culinary water by conservation
Action: Maintain and enforce rate policies that encourage water conservation
Time Frame: Ongoing
Funding: State grants, County funds
Estimated Cost: Minimal
Staff: Water districts, County, State

Background: Evaluate the use of a tiered water rate structure.

Iron County

Problem Identification: Assessment of range and pasture conditions in Iron County for the 2002/2003 growing season, simply put they were the worst in recorded history. Data shows that we only received 20-30 percent of our normal precipitation; this is characterized as exceptional drought. Range and pasture have been impacted by lack of precipitation. Growing conditions have been so poor many ranges produced no useable forage. There has been mortality of sagebrush and juniper trees due to the drought with conditions so dry in the spring even the cheatgrass did not grow.

Goal R8 - Priority Medium

Objective R8.1 It will take many years of above average precipitation to make up for the many years of drought we have experienced. Estimates of overall pasture and range conditions is about 60% of normal. Conditions are extremely variable depending on what area of the county you are looking at. Any precipitation received in September 2003 was very random in distribution and did not make much of an impact on the overall drought.
Action: Many studies have been done and we are involved in a drought cycle. We are supposedly in the downhill side of the cycle. Hopefully, things will start to get back to normal and improve the drought situation.

Time Frame: On going
Funding: unknown
Estimated Cost: Could cost farmers/livestock many dollars. Some may even face bankruptcy.
Staff: unknown
Background: Studies done over the generations of time. History records show this to be the worst drought ever seen in Iron County. Need to keep an eye on underground water levels, seeps and springs to see if there will be enough for livestock and agricultural use in the future.

Washington County

Enterprise

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal R9 - Priority High

Objective R9.1 Conserve culinary water
Action: Educate the public on the need to be water wise

Time Frame: Ongoing
Funding: City funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: Use a newsletter to educate the public

Action: Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: The City should continue to maintain and implement a tiered water rate structure.

Hurricane

Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

Goal R10 - Priority High

Objective R10.1 Meet current and future water needs of community
Action: Develop additional source and storage as well as implementing conservation plans
Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Hurricane City Staff, Professional Services, Contractors
Background: Hurricane is in a desert climate and has experienced several years of drought conditions. To meet the needs of the community's residential and business water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.

LaVerkin

Problem Identification: Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources.

Goal R11 - Priority High

Objective R11.1 Meet current and future water needs of community
Action: Develop additional source and storage as well as provide ongoing plans and education.
Time Frame: Ongoing
Funding: City funds and possible grants
Estimated Cost: To be determined
Staff: Water and Public Works Departments
Background: LaVerkin has experienced several years of drought conditions. Source supply and storage need to keep pace with population growth. An education program needs to be implemented to educate water users on methods to conserve available water resources.

Rockville

Problem Identification: Currently the Rockville Ditch and Pipeline Companies provide water to most areas of town. Because of its design, the system is not as efficient as it could be.

Goal R12 – Priority High

Objective R12.1 Conserve irrigation water by improving the area of irrigation water delivery and efficiency.
Action: Determine how the irrigation delivery system could be improved to provide comprehensive service as well as more efficient means of delivery.

Time Frame: Ongoing
Funding: Private irrigation companies
Estimated Cost: To be determined
Staff: Irrigation water purveyor
Background: Rockville has experienced several years of drought conditions. The distribution of irrigation water in Rockville is by a combination or open ditches and non pressurized pipe. Not all properties in town can utilize this. A pressurized system is a consideration, however the cost of such a system may be high.

Problem Identification: Currently the Rockville Ditch and Pipeline Companies provide water to most areas of town. Because of its design, the system is not as efficient as it could be.

Goal R13 – Priority Moderate

Objective R13.1 Conserve culinary water through education and continued water conservation policies.
Action: Continue the practice of providing written educational materials with water bills and educational materials at the post Office/Community Center, etc

Time Frame: Ongoing
Funding: Private irrigation companies
Estimated Cost: To be determined
Staff: Irrigation water purveyor
Background: A continued program of providing education on methods of water conservation will help ensure adequate supply of culinary water.

St. George

Problem Identification: Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources.

Goal R14 - Priority High

Objective R14.1 Excessive water used for landscaping
Action: Develop and enforce policies to limit the amount of area that can be used as water requiring landscape.

Time Frame: Ongoing
Funding: none
Estimated Cost: To be determined
Staff: City Planning Staff
Background: St. George City removed water requiring landscape from around the City office building and replaced it with water conserving desert landscape. This should be encouraged throughout the city where appropriate.

Toquerville

Problem Identification: Limited water supplies during the extended years of drought have placed a strain on availability of community culinary water resources.

Goal R15 – Priority High

Objective R15.1 Reduce use of culinary water
Action: Continue to enforce policies to reduce water usage.
Time Frame: Ongoing
Funding: none
Estimated Cost: none
Staff: City staff
Background: In 2003, Toquerville implemented a mandatory even/odd day watering schedule between June 1st and October 31st .

Washington City

Problem Identification: Community is suffering, as is all of southwestern Utah through and extended, severe drought.

Goal R16 – Priority High

Objective R16.1 Conserve water resources.
Action: Enforce existing City water conservation ordinance.
Time Frame: On-going
Funding: N/A
Estimated Cost: N/A
Staff: Washington City Public Works Department
Background: The City has already adopted a water conservation ordinance.

Action: Adopt a time-of-day outdoor watering ordinance.
Time Frame: Spring 2004
Funding: N/A
Estimated Cost: N/A
Staff: Washington City Public Works Department
Background: The existing water conservation ordinance does not include provisions for designated times in which outdoor watering should take place.

Action: Create new water sources.
Time Frame: 20 years
Funding: Bonding/City
Estimated Cost: $1,000,000 or more
Staff: Washington City Public Works Department/Consultants
Background: The City needs to identify new water resources for its increasing population and to better plan for future periods of drought. Difficulties may be that some citizens do not approve of the City committing to additional bonding.

Problem Soils

Region-wide Mitigation

Problem Identification: Wind Erosion

Goal R17 - Priority Medium

Objective R17.1 Reduce damage to crops and structures.
Action: Improve conditions to reduce soil erosion.
Time Frame: Ongoing
Funding: U.S. Department of Agriculture government programs.
Estimated Cost: Unknown
Staff: Natural Resources Conservation Service (NRCS), Utah Association of Conservation Districts (UACD)
Background: Encourage people to sign up for help

County-specific Mitigation

Washington County

Hurricane

Problem Identification: South Fields area has collapsible soils.

Goal R18 – Priority High

Objective R18.1 Lessen the risk to buildings from collapsible soils
Action: Require soils testing prior to building and following engineer's requirements
Time Frame: Ongoing
Funding: Local Government and possible grants
Estimated Cost: To be determined
Staff: Building Department, City Engineer, Public Works
Background: The South Fields area of the community is located on a dry lake bed. Sink holes have developed in areas where no testing and mitigation has been completed.

Rockville

Problem Identification: The Rockville Sensitive Lands Overlay Map has identified problem areas such as slopes, flood plains and wetlands.

Goal R19 – Priority High

Objective R19.1 Lessen the risk to buildings from problem soils
Action: Restrict building in areas identified as having problem soils
Time Frame: Ongoing
Funding: Town funds
Estimated Cost: minimal
Staff: Town, Engineering Consultant

Background: The overlay map identifies likely problem areas. Site specific studies would identify risks and issues specific to a given parcel.

Action: Maintain land use code chapters dealing with sensitive lands
Time Frame: Ongoing
Funding: Town funds
Estimated Cost: minimal
Background: The town has codes on the books. These need to be enforced and amended as needed.

Washington City

Problem Identification: Expansive soils are found throughout the City.

Goal R20 – Priority High

Objective R20.1 Reduce potential building foundation settling risks.
Action: Enforce existing City ordinances requiring geotechnical studies and require recommended mitigation measures from studies.
Time Frame: On-going
Funding: Developers
Estimated Cost: case by case
Staff: Developer's consultant's with review by Washington City Public Works and Community Development departments.
Background: All developments require geotechnical studies to ensure stable foundations for buildings. There are many areas of expansive soils throughout the City.

<u>Severe Weather</u>

County-specific Mitigation

Beaver County

County-wide

Problem Identification: Wind damage to property and resulting loss of power to facilities in the Milford and Beaver valleys.

Goal R21- Priority High

Objective R21.1 - Reduce power outages.
Action: Improve infrastructures to minimize power outages.
Time Frame: Ongoing
Funding: Multiple groups.
Estimated Cost: Unknown
Staff: Private people and local utilities.

Background: Contact utilities on current situation. Gather data on power outage, and frequency of outages.

Objective R21.2 - Reduce damage to power lines from trees and limbs that blow down in severe wind storms
Action: Decrease the number of trees which have limbs growing around power lines
Time Frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Local Utilities
Background: Identify trees which pose a problem, remove or trim trees that are a threat to power lines

Milford

Problem Identification: Wind damage to crops and structures in the Milford valley.

Goal R22- Priority

Objective R22.1 - Reduce damage to crops and structures.
Action: Improve conditions to reduce soil erosion.
Time Frame: Ongoing
Funding: USDA government programs.
Estimated Cost: Unknown
Staff: NRCS, UACD
Background: Encourage people to sign up for help

Garfield County

County-wide

Problem: Snowstorms, summer thunderstorms, flash floods, hail, and high winds over central Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists

Goal R23 – Priority High

Objective R23.1 Protect County from adverse affects of severe weather
Action: County participation in the StormReady program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action: Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Sanpete County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.

Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOCs, Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.

Washington County

Enterprise

Problem Identification: Enterprise experiences occasional, damaging high winds.

Goal R24 – Priority High

Objective R24.1 Reduce damage to structures through strict adherence to building codes
Action: Ensure that 80 MPH wind load requirement is met by builders

Time Frame: Ongoing
Funding: Building permit fees
Estimated Cost: Minimal
Staff: Building Inspector
Background: Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events

Hurricane

Problem Identification: Power lines are at risk from seasonal high winds.

Goal R25 – Priority High

Objective R25.1 Reduce service disruptions and damage to power lines
Action: Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.

Time Frame: Ongoing
Funding: Hurricane City Power, Possible Grants
Estimated Cost: To be determined
Staff: Hurricane City Power, 138 Task Force
Background: Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.

LaVerkin

Problem Identification: Power lines are at risk from seasonal high winds.

Goal R26 – Priority High

Objective R26.1 Provide adequate clearances for power lines
Action: Conduct regular line maintenance.

Time Frame: Ongoing
Funding: Local government and possible grants
Estimated Cost: To be determined
Staff: Water and Public Works Departments
Background: Occasional severe seasonal winds pose risk of damage to power poles and transmission lines by high winds.

New Harmony

Problem Identification: Periodic severe thunderstorms and occasional periods of rain over several days cause flooding. Severe windstorms and occasional hailstorms cause structural damage.

Goal R27 – Priority High

Objective R27.1 Reduce structural damage from windstorms, occasional hailstorms.
Action: Assure adherence to building codes.

Time Frame: Ongoing
Funding: Building Permit Fees
Estimated Cost: Minimal, by builder
Staff: County Building Department
Background: Due to its geographic location the town is subject to occasional severe windstorms and thunderstorm activity with associated hail.

St. George

Problem Identification: Strong winds can cause trees to fall on power lines, causing power outages

Goal R28 – Priority High

Objective R28.1 Improve electrical power system reliability by reducing risk from damage by trees falling in windstorms.
Action: Prune trees back from power lines.

Time Frame: 3 year plan
Funding: City Power Department
Estimated Cost: Not determined, minimal to moderate
Staff: City Power Department
Background: Due to its geographic location the town is subject to occasional severe windstorms and thunderstorm activity with associated hail.

Problem Identification: Occasional heavy rains bring problems with flooding

Goal R29 – Priority Medium

Objective R25.1 Improved public awareness about flood hazards in the community.
Action: Prepare educational materials and presentations about "100 year flood events" that occur in the area. Distribute this information and/or conduct educational programs for the public.

Time Frame: 2 years
Funding: City/FEMA/Army Corps of Engineers
Estimated Cost: Minimal
Staff: Can be done through the CERT program
Background: Most people are not aware of what the term "100 year flood event" or building in a100 year flood zone really means.

Virgin

Problem Identification: Power lines are at risk from seasonal high winds.

Goal R30 – Priority High

Objective R30.1 Reduce service disruptions and damage to power lines
Action: Ensure that adequate clearance for power lines is provided and conduct ongoing line maintenance through Utah Power.

Time Frame: Ongoing
Funding: Commercial power provider
Estimated Cost: To be determined
Staff: Utah Power employees
Background: Occasional strong winds have caused utilities disruption due to damage to power poles and transmission lines by high winds.

<u>Insect Infestation</u>

County-specific Mitigation

Beaver County

Problem Identification: Heavy infestations of Mormon crickets and grasshoppers south of Minersville, Bald Ridges, North of Beaver and in the Mineral Ranges.

Goal R31- Priority Medium

Objective R31.1 Have government agencies develop better control methods on federal grounds.
Action: Improve control methods on private and federal grounds.
Time Frame: 5 years
Funding: Federal government.
Estimated Cost: Unknown
Staff: APHIS, BLM and other federal and state agencies.
Background: Educate private and federal landowners on control methods and more into their lifecycles.

Action: Eradicate crickets and grasshoppers.
Time Frame: Ongoing.
Funding: Federal government.
Estimated Cost: Unknown
Staff: APHIS, BLM and other federal and state agencies.

Garfield County

Problem Identification: Western Garfield County is occasionally vulnerable to Mormon Cricket and Cutworm infestations as well as some mosquito problems

Goal R32 – Priority Low

Objective R32.1 Reduce the impact of insects
Action: Spread insect bait and spray for mosquitos
Time Frame: When required
Funding: City and County funds, abatement taxes
Estimated Cost: Approximately $3.00/property owner/month
Staff: County Mosquito Abatement District
Background: Insect infestation impacts agriculture as well as communities

Iron County

Problem Identification: Grasshoppers and Mormon Crickets are present every year in Iron County. Most years grasshoppers are an economic pest in the New Harmony Flats area and on Cedar Mountain. Mormon Crickets have been especially bad in 2003, they were reported in the Urie Creek area of Cedar Mountain. There was also a severe grasshopper infestation. 2002-2003 seems to have been especially bad for grasshoppers with reports of them eating landscaping, vinyl screens on windows and even eating the handle grips of bicycles laid down in the grass.

Goal R33- Priority Medium

Objective R33.1 The best thing would be to totally get rid of the problem. However, that will never happen. Our objective is to learn to control the insects by trying different types of insecticides.
Action: Cut grasses short near homes

Time Frame: Yearly, on going
Funding: U. S. Department of Agriculture, Iron County
Estimated Cost: $5,000.00
Staff: Landowners, farmers, County Agents
Background: Something that has taken place in and around Southwestern Utah for decades. Our pioneer heritage even notes these infestations happening back then. Keeping grasses mowed short near homes would help keep some of the infestation away from subdivisions. Trying to control them has been difficult in the past due to problems with the endangered species act. There has been use of Dimilin in some of the harder hit areas of Iron County and it has proven to reduce the grasshopper populations in the areas that have been treated.

Kane County

Problem Identification: Lack of public knowledge on insect infestation problems.

Goal R34 – Priority Medium

Objective R34.1 To increase the level of awareness for the residents of Kane County.
Action: Conduct a Countywide community awareness campaign
Estimated Cost: $10,000.00
Time Frame: 2 to 5 years
Funding: Public Funds
Staff: Emergency Services Personnel.
Background: The citizens of Kane County need to be made aware of insect infestation issues that may affect their area. Through a public awareness program such as on Africanized bees, general individual preparedness will be improved.

Washington County

Enterprise

Problem Identification: South and west sides of the City are occasionally vulnerable to Mormon Cricket and Cutworm infestations as well as some mosquito problems.

Goal R35 – Priority High

Objective R35.1 Reduce the impact of insects
Action: Spread insect bait and spray for mosquitoes
Time Frame: When required
Funding: City and County funds. Mosquito abatement funds come from property tax.
Estimated Cost: Approximately $3.00 per property owner per month
Staff: County Mosquito Abatement District
Background:

New Harmony

Problem Identification: Periodic Grasshopper infestations more sever on edge of developed town area and in field surrounding town.

Goal R36 – Priority High

Objective R36.1 Reduce the severity of infestations

Action: Conduct aerial spraying to reduce infestations
Time Frame: As infestations occur
Funding: By private individuals in most cases
Estimated Cost: Varies, depending on acreage treated
Staff: Contractor
Background: New Harmony is surrounded by many agricultural fields. These have been subjected to insect infestation especially during the recent years of drought.

Radon Gas

County-specific Mitigation

Iron

Problem Identification: The United States Geological Survey has evaluated the potential for radon gas within the boundaries of Iron County as low, less than 2 pCi/L to moderate, 2 to 4 pCi/L. The EPA recommends that all homes that measure 4 pCi/L and greater be mitigated. Radon Gas is a naturally occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through particles of soil and rock, and can accumulate under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.

Goal R37 – Priority Medium

Objective R37.1 Try to identify the areas that would be most susceptible to this problem and restricting building in these potential problem areas.
Action: Try to identify the areas in the county that would have this problem.
Homes that are already built in problem areas could possibly be fixed so that radon gas is not a problem to the owners.

Time Frame: Best done at time of construction. Possible to retrofit.
Funding: Property owner/homeowners expense
Estimated Cost: $400.00
Staff: County Building Department for advise.
Background: Contact your local building department/contractor

Beaver County

Wildfire

County-wide

Problem Identification: Continuing non-compliance with existing building and fire codes.

Goal B1-Priority High

Objective B1.1 - Increase compliance with existing building and fire codes.
Action: Develop and enforce current local, state and national codes.
Time Frame: Ongoing
Funding: Local state and federal grants
Estimated Cost: Unknown
Staff: Local state and federal agencies
Background: Implement and enforce rules, regulations and codes.

Problem Identification: Specific areas of the county are susceptible to wildland fire danger.

Goal B2- Priority Medium

Objective B2.1 - Reduce the threat of Wildfire in Elk Meadows, Whispering Pines and HiLo subdivision areas.
Action: Complete community fire plans for each of these areas
Time Frame: next fiscal year
Funding: Local
Estimated Cost: Minimal
Staff: Local state and federal agencies
Background: Contact Keith Parke (Five County Fire Planner)

Beaver City

Problem Identification: Specific areas of the Grove in the county/city area are susceptible to wildland fire danger.

Goal B3- Priority Medium

Objective B3.1 - Reduce the threat of Wildfire in The Grove area
Action: Complete community fire plans for the Grove
Time Frame: next fiscal year
Funding: Local
Estimated Cost: Minimal
Staff: Local state and federal agencies
Background: Contact Keith Parke (Five County Fire Planner)

Landslide

County-wide

Problem Identification: Potential landslides around upper elevations mostly by Kents Lake and Elk Meadow. Possibility of east Hwy 153 being washed out, stream damned up, etc.

Goal B4 - Medium

Objective B4.1 - Reduce landslide impact on Hwy 153, east of Beaver.
Action: Determine hazard according to UDOT.
Time Frame: According to UDOT.
Funding: According to UDOT funding.
Estimated Cost: Undetermined
Staff: Undetermined
Background: Hazard will be referred to UDOT.

Problem Identification: Potential risk of structures in mountainous areas to be damaged by landslides.

Goal B5 - Medium

Objective B5.1 - Reduce potential landslide risk on commercial and residential structures on upper elevations.
Action: Assessing possibility of landslides.
Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown
Background: Soil surveys and other engineer surveys.

Flood

County-wide

Problem Identification: There is not enough flood information on flood areas in Beaver County to identify the problem at this time.

Goal B6 – Priority High

Objective B6.1 - Identify flood prone areas in County.
Action: Mapping of potential flood areas.
Time Frame: Unknown
Funding: Undetermined
Estimated Cost: Undetermined
Staff: State and FEMA personnel.
Background: Contact DESHS flood map specialist.

Beaver City

Problem Identification: The Beaver River floods between the Grove area and Highway 160

Goal B7-Priority Medium

Objective B7.1 - Reduce flooding along the Beaver River between the Grove and Highway 160
Action: Alleviate obstructions to Beaver River
Time Frame: 1-2 years
Funding: City
Estimated Cost: $5,000.00
Staff: City
Background: Clean the riverbed of trees and undergrowth

Milford

Problem Identification: The area on the eastern boundary of Milford in the Industrial Park has flooded periodically which can impact some farms, Circle 4 Farms and Basin Perlite

Goal B8-Priority Medium

Objective B8.1 To impound
Action: To impound flood waters if and when it leaves the river prior to reaching Milford to help recharge the
Time Frame: 5 years
Funding: Local
Estimated Cost:
Staff: Local, UACD
Background:

Minersville

Problem Identification: Possible Impact from flooding due to a seismic event that could cause failure of Rocky Ford Irrigation Dam (Minersville Reservoir)-**Multi hazard event**

Goal B9- Priority High

Objective B9.1 - To reduce flooding impact of a Minersville Dam failure due to a seismic event.
Action: .Identify areas of inundation from possible failure of the Rocky Ford Irrigation Dam (Minersville Reservoir)
Time Frame: Next funding year
Funding: FEMA, state and local.
Estimated Cost: Minimal
Staff: AOG/state
Background: Contact state GIS center (AGRC) to request a mapping study with assistance from the Five County Association of Governments

Problem Identification: There has been an ongoing flooding problem along Center Street within town boundaries that threatens 4 homes and 1 business

Goal B10- Priority High

Objective B10.1 - To reduce reoccurring flooding problems along a 2½ block section of Center Street.
Action: Retain flood waters in the street
Time Frame: 1-5 years
Funding: FEMA, state and local.
Estimated Cost: $10,000.00
Staff: Town staff
Background: Install a drainage line along Center Street

Earthquake

County-wide

Problem Identification: Unknown number of seismically unsafe structures around the county.

Goal B11- Priority High

Objective B11.1 - Have a study done to determine seismic resistance of specific structures within the county ie. elementary and high schools, hospitals, public buildings, high traffic areas, etc.
Action: Structural and non-structural earthquake hazard assessment.
Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background: Contact DESHS earthquake program specialist.

Objective B11.2 - Public Awareness
Action: Conduct pubic awareness campaign.
Time Frame: Ongoing
Funding: Federal and state grants, local sources.
Estimated Cost: Unknown
Staff: Agency personnel and volunteers.
Background: Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.

Objective B11.3 - Better community response to emergency situations
Action: Organize Community Emergency Response Teams.
Time Frame: Ongoing
Funding: Federal and State grants.
Estimated Cost: $2000 for course.
Staff: State and local personnel.
Background: Contact the Regional Citizens Corp. Council.

Beaver City

Problem Identification: Cast iron water pipes in 200 North on the West side of town break after a small seismic event.

Goal B12- Priority High

Objective B12.1 - Reduce the likelihood of pipe failure due to small tremors
Action: Upgrade the quality of water pipes in specific areas
Time Frame: 1-5 years
Funding: City
Estimated Cost: $75,000.00
Staff: City
Background: Replace existing cast iron pipes, install new bedding materials, install PVC pipe

Milford

Problem Identification: Old city water lines at 200 West 600 South to 600 North break due to seismic events

Goal B13-Priority High

Objective B13.1 To maintain continuous water service to all areas of Milford
Action: Upgrade water pipes along 200 West
Time Frame: 1-3 years
Funding: CIB or other grants
Estimated Cost: unknown
Staff: City staff
Background: Replace existing cast iron pipes, install new bedding materials, install PVC pipe

Minersville

Problem Identification: During small seismic events caste iron water pipes along 200 west break causing an interruption in service of culinary water to residents

Goal B14-Priority High

Objective B14.1 To maintain continuous water service to all areas of Milford
Action: Upgrade water pipes along 200 West
Time Frame: 1-3 years
Funding: CIB or other grants
Estimated Cost: unknown
Staff: City staff
Background: Replace existing cast iron pipes, install new bedding materials, install PVC pipe

Garfield County

Wildfire

County-wide

Problem Identification: Continuing non-compliance with existing building codes and fire codes.

Goal G1 - Priority High

Objective G1.1 Increase compliance with existing building ad fire codes
Action: Develop and enforce current local, state and national codes
Time Frame: Ongoing
Funding: Local, State and Federal grants
Estimated Cost: Unknown
Staff: Local, State and Federal agencies
Background: Implement and enforce rule, regulations and codes

Panguitch

Problem Identification: Approximately 20 homes are at risk from wildfire

Goal G2 - Priority High

Objective G2.1 Educate homeowners on how to reduce risk of wildfire damage
Action: Conduct an education program on reducing wildfire risks
Time Frame: Ongoing
Funding: City and County
Estimated Cost: Minimal
Staff: Fire Chief and State Fire Warden
Background: Educate homeowners using newsletters and personal contacts of importance of clearing combustibles from perimeters of their homes

Hatch

Problem Identification: Fire is a threat to power facilities and transmission lines

Goal G3 - Priority High

Objective G3.1 Reduce threat of utilities interruption due to wildland fire
Action: Safeguard facilities and poles
Time Frame: Ongoing
Funding: Local
Estimated Cost: Undetermined
Staff: Task Force
Background: Power and telephone transmission lines in Hatch travel via overhead lines through many developed and undeveloped areas. A wildland fire could disrupt

services to customers by igniting poles or arcing. Facilities and transmission lines need to be evaluated and plans implemented to safeguard facilities and poles. Plans must be developed it isolate affected areas and maintain services to customers.

Tropic

Problem Identification: Wildfire is a threat to the west and south side of the City

Goal G4 - Priority High

Objective G4.1 Reduce threat of damage to a wildland fire
Action: Conduct an education program on reducing wildfire risks
Time Frame: Ongoing
Funding: City and County
Estimated Cost: Minimal
Staff: Fire Chief and State Fire Warden
Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes

Cannonville

Problem Identification: Wildire is a threat to the community

Goal G5 - Priority High

Objective G5.1 Reduce threat of damage due to a wildland fire
Action: Educate the residents of the community on how to make their properties fire safe
Time Frame: Periodic
Funding: City and County
Estimated Cost: Minimal to Town
Staff: Town Staff, County Fire
Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes.

Henrieville

Problem Identification: Wildfire is a threat due to grasslands drying out during extending dry periods.

Goal G6 - Priority High

Objective G6.1 Reduce threat of damage due to a wildland fire
Action: Educate residents of the value of maintaining firebreaks around their homes
Time Frame: Periodic
Funding: Local
Estimated Cost: Minimal
Staff: City and County
Background: During extended dry periods the grasslands dry out and represent a potential fire hazard

Escalante

Problem Identification: Wildfire is a threat due to grasslands drying out during extended dry periods.

Goal G7 - Priority High

Objective G7.1 Reduce threat of damage due to a wildland fire
Action: Thin or remove vegetation causing exposure problem
Time Frame: 1 year
Funding: Moderate, no local funds
Estimated Cost: Moderate
Staff: City and County
Background: During extended dry periods the grasslands dry out and represent a potential fire hazard

Boulder/Antimony

Problem Identification: Power facilities and telephone poles are at greatest risk from wildfire.

Goal G8 - Priority High

Objective G8.1 Reduce threat of damage due to a wildland fire
Action: Thin vegetation along river or create a fire break to protect nearby facilities
Time Frame: Ongoing
Funding: Moderate, local funds
Estimated Cost: Moderate
Staff: County and Cities
Background: The dense Boulder Creek bottom cover provides an ideal location for a wildfire. To reduce or eliminate exposure to structures, redundant communications systems should be installed to provide necessary coverage.

Landslide

County-Wide

Problem Identification: There is a potential risk to structures located in areas identified in the FCAOG GIS as landslide risk areas

Goal G9 - Priority Medium

Objective G9.1 Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential
Action: Assess the probability of landslides and identify specific structures at risk
Time Frame: Undetermined
Funding: Property Owner
Estimated Cost: Unknown
Staff: Unknown
Background: Soil surveys and other engineering surveys are needed.

Problem Identification: There is a low risk, but potential for landslide or land movement to impact water supply systems.

Goal G10 - Priority Medium

Objective G10.1 Provide for a second means of supplying culinary water to residents within Cities and Towns of Garfield County
Action: Establish and maintain a means to readily connect the City's and Town;s culinary water users to alternative water sources.

Time Frame: Undetermined
Funding: Local governments and possible grants and loans
Estimated Cost: To be determined
Staff: Panguitch City
Background: In case City/Town's water supply is damaged, the communities would need to connect to emergency means. Use of water would need to be curtailed to essential services only.

Flood

County-Wide

Problem Identification: Control flooding in unincorporated residential areas of Garfield County. Flooding occurs from heavy rains and fast moving thunderstorms.

Goal G11 - Priority High

Objective G11.1 Obtain aerial photography with contours for identified residential areas in Garfield County to assist in flood risk identification.
Action: Set horizontal and vertical survey control and order aerial photography with contours for each identified residential area in the County

Time Frame: 3 months to 2 years, depending on number in areas
Funding: Local, State and Federal grants
Estimated Cost: $700 per residential area, depending on size
Staff: County staff and Contractor
Background: Aerial photography is needed in the development of Master Storm Drainage design.

Objective G11.2 Design Master Storm Drainage Plans for residential areas in the County
Action: Design Master Storm Drainage Plan to handle storm water runoff

Time Frame: 3 months to 2 years, depending on number of areas worked on
Funding: Grants
Estimated Costs: $10,000 per residential area, depending on size
Staff: County Staff and Contractor
Background: Engineers design Master Storm Drainage Plans for residential areas for flooding.

Objective G11.3 Develop a comprehensive storm drainage plan for Garfield County
Action: Implement storm drainage plans throughout the residential areas of Garfield County

Time Frame: 3 years plus, as soon as Plans are completed
Funding: State and Federal grants

Estimated Cost: Unknown, will depend on final plans and requirement of facilities and structures.
Staff: County and Contractor
Background: Construct storm drainage facilities and require all new developments to meet County storm drainage plan(s)

Problem Identification: Control flooding in unincorporated residential areas of Garfield County. Flooding occurs from heavy rains and fast moving thunderstorms.

Goal G12 - Priority Medium

Objective G12.1 Implement storm drainage plans through out residential areas of Garfield County.
Action: Implement storm drainage plans throughout the residential areas of Garfield County
Time Frame: 2 years
Funding: State and Federal grants
Estimated Cost: Unknown, will depend on final plans and what facilities are required
Staff: City and Contractor
Background: Construct storm drainage facilities and require all new developments to meet County storm drainage plan(s).

Problem Identification: Flood insurance is not promoted actively promoted in the County.

Goal G13 - Priority High

Objective G13.1 Encourage 100% participation in the National Flood Insurance Program (NFIP).
Action: Assist Town of Antimony in joining NFIP
Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Floodplain Administrator, State Floodplain Manager
Background: The Town of Antimony has mapped Special Flood Hazard Areas (SFHAs), but does not participate in the NFIP. Flood insurance is not available in the community

Objective G13.2 Promote flood insurance throughout the County
Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Floodplain Administrator, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Earthquake

County-wide

Problem Identification: Transportation and utilities services could be severely impacted by an earthquake affecting emergency response and relief activities

Goal G14 - Priority Medium

Objective G14.1 Provide for emergency response and relief
Action: Identify and maintain critical transportation and utility services
Time Frame: Ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown
Staff: County Public Works, County Emergency Management, UDOT, Utilities
Background: Critical transportation and utility systems need to be maintained

Problem Identification: There is a high probability of rockfall caused by seismic events and possible liquefaction along river systems.

Goal G15 - Priority Medium

Objective G15.1 Raise awareness of problems and risk associated with earthquakes
Action: Maintain adherence to Land Use Codes and restriction to building in identified sensitive areas
Time Frame: Immediate and ongoing
Funding: None
Estimated Cost: None
Staff: County, City and Town Building Officials and staff
Background: Problem associated with falling rocks can be identified in areas along Paria River, Escalante River, Calf Creek, Boulder Creek.

Problem Identification: Damage to residential structures and public facilities is likely during a seismic event

Goal G16 - Priority Medium

Objective G16.1 Reduce threat to public safety during an earthquake
Action: Retrofit inadequate construction
Time Frame: Long term
Funding: Private
Estimated Cost: Expensive
Staff: County, City and Town Building Officials and Engineers, Contractors
Background: Old inadequate construction in buildings, un-reinforced masonry, should be mitigated.

Problem Identification: Lack of public awareness about earthquake damage prevention practices

Goal G17 - Priority Medium

Objective G17.1 Educate community on earthquake damage prevention practices
Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness

Time Frame: 2 year
Funding: Unknown, possible grants
Estimated Cost: Unknown
Staff: County Emergency Management, DES
Background: Having a community educated on earthquake damage prevention practices will ensure greater safety for its residents.

Objective G17.2 Educate community on disaster preparedness and response
Action: Continue to support CERT Programs

Time Frame: 2 year
Funding: State and Federal grants
Estimated Cost: $25,000
Staff: County Emergency Management, DES
Background: CERT is proactive measure to educate public on earthquake hazard and community response to an event.

Iron County

<u>Wildfire</u>

County-wide

Problem Identification: Iron County has a Moderate to Severe wildfire risk throughout the county. Areas of high concern are as follows:

Brian Head
Parowan Front
Iron Town
Comstock/Far West
Cedar Highlands
And other communities identified through hazard analysis

Goal I1 - Priority High

Objective I1.1 -Reduce the risk of Wildland Fire throughout Iron County
Action: Create community fire safe councils and implement the “Community Fire Planning” process.

Time Frame: On going
Funding: Obtain grant monies and alternative sources of funding through various grants and foundation.
Estimated Cost: $5,000.00 per plan
Staff: Unknown
Background: The “Community Fire Planning” process was implemented through the Utah Division of Forestry, Fire, and State Lands in support of on-going efforts under the National Fire Plan to educate and empower landowners to take action to reduce the threat of wildfires within a community.

Action: Implement fuel modification projects

Time Frame: On going
Funding: Grants and private landowners
Estimated Cost: Variable based on acreage and type of materialsbeing removed.
Staff: State, County, Cities, Towns and residents
Background: Through the creation of defensible space in and around communities, the threat of catastrophic wildfires will be greatly reduced.

Action: To educate and inform the community of fire prevention

Time Frame: Immediate and on going
Funding:
Estimated Cost: $5,000.00 per year
Staff: County Planning and Zoning, Building Department, Fire Warden
Background: Education is the key to informing homeowners about the risk of wildfires. Through a comprehensive education, program homeowners can take action independent to protect values at risk, and understand the effects of wildfires.

Brian Head

Problem Identification: Brian Head Town is surrounded by federal and private lands that have suffered a severe beetle infestation. Fuel loading is 20 to 30 tons per acre and needs to be cleaned up to lessen the effects of a wildland fire on this community.

Goal I2 - Priority High

Objective I2.1-Minimize the damage of a wildland fire and provide the appropriate emergency response.
Action: Require all homeowners and businesses to provide a defense able space around there structures as provided in the international fire code.

Time Frame: Continuing action. Twenty year plan
Funding: National Fire Plan and grants
Estimated Cost: $5,000.00
Staff: Brian Head Public Safety
Background: International Fire Code and Fire Wise publications

Action: Provide the necessary emergency services to properly respond to the effects of a wildland fire.

Time Frame: In Place
Funding: Brian Head Town and Iron County
Estimated Cost: $5,000.00
Staff: Brian Head Public Safety(police, fire, EMS) and other emergency services provided in Iron County
Background: We feel that emergency services located in the Iron County region will be adequate to deal with the effects of a wildland fire in Brian Head Town.

Kanarraville

Problem Identification: Kanarraville is surrounded by dry brush and juniper trees that have suffered 5 years of drought. The canyon winds from Kanarra

Canyon increase the fire threat. The town is situated at the mouth of the canyon. The town has more than adequate water storage to fight fires. (350,000 + gal.)

Goal I3 - Priority High

Objective I3.1- To clean brush from under trees and blade a fire zone protection around the town on county property.
Action: Work with landowners to clean a fire protection area around their properties.

Time Frame: 6 months to two years
Funding: From General Fund of the Town of Kanarraville, Inc./local property owners.
Estimated Cost: $3,000.00
Staff: Contracted workers, local landowners, Town maintenance crew.
Background: Landowners are to be contacted and a request made that dry grass be mowed. Out lying landowners will be asked to clear a fire protection zone. All city property will be mowed and underbrush cleaned out. Iron County will be requested to help with clearing the canyon.

Landslide

Cedar City

Problem Identification: In the "Ground Surface Subsidence in Cedar City" report by Bruce N. Kaliser in January 1978 indicates two areas in sections 26, 27, 33, and 34 of Township 36 South, Range 11 West and Sections 19, 20, 29, and 30 of Township 35 South, Range 10 West that were massive landslide deposit areas. The report stated that Developments of this terrain may reinitiate mass movement.

Goal I4 - Priority Medium

Objective I4.1-Minimize the possibility to reinitiate mass movement in the Landslide areas that are shown on the Kaliser, January 1978 Report.
Action: Inform property owners developing in the area of the possibilities for landslides.

Time Frame: As development is proposed
Funding: None
Estimated Cost:
Staff: City Staff and Property Owner
Background: Bruce N. Kaliser, January 1978 Report on Ground Surface subsidence in Cedar City.

Action: Required Geological and Geotechnical reports for any proposed developments in the designated landslide areas with the possibility of independent reviews of the reports.

Time Frame: With development engineering plans for the area
Funding: Developer
Estimated Cost:
Staff: Licensed Geology and Geotechnical Firms
Background: Required by Cedar City Subdivision OrdinanceChapter 32

Action: Require developers to install developments according to recommends for the Geological and Geotechnical reports provided and approved.

Time Frame: As landslide areas develop

Funding: Developer
Estimated Cost:
Staff: Developer and Contractor
Background:

Flood

County-wide

Coal Creek Flooding in Cedar Valley

Problem Identification: Coal Creek at Cedar City is the outlet of a hydrologic basin of approximately 82 square miles. This basin ranges in elevation from 10,000+ to 5,000 ft. in the Cedar Valley. A 100 year storm would produce a flow of 5,000+ cfs through Cedar City and the unincorporated areas of Cedar Valley. The flow is highly variable. This flow is divided at the Woodbury split so about 1/3 goes west and 2/3 goes north.

Goal I5 - Priority High

Objective I5.1-Reduce flood threat through Cedar City and Cedar Valley.
Action: WEST ROUTE:
With the project coming on Airport Road by Cedar City Corporation the small structure will be increased to the appropriate size, adequate to handle approximately 1,500 cfs, so this west route will go to Quichapa.

The new structure on Hwy. 56 at the intersection with Lund Hwy. is being increased to handle approximately 1,500 cfs also.

Iron County must presently realign and construct a new flood channel below this Hwy. 56 structure for approximately 1 mile. From there to Quichapa
the existing channel must be widened in places and always maintained.

Action:NORTH ROUTE:
The north leg of this channel is in relatively good shape as far as structures are concerned until it reaches Midvalley Road. The structure there must be significantly enlarged. The channel on this leg must be improved thru the Flying “L” Ranch Subdivision, it must also be improved from the Brent Hunter Farm all the way past Regional Wastewater Treatment Plant and to Mud Springs.

Time Frame: Within the next 3 years
Funding: County Public Works routine maintenance and Engineer’s budget.
Estimated Cost:
Staff: County Public Works
Background: Flatten side slopes, construct new channel as necessary, clean willows, roses, Russian olive, and cottonwood trees, and debris that impedes flow. Rip rap may be advantageous in certain locations. Some rights-of-way must be obtained.

Fiddlers Canyon Flood Waters

Problem Identification: Floods from Fiddlers Canyon still have some potential of covering Cedar Valley lands.

Goal I6 - Priority High

Objective I6.1-Prevent these waters from doing damage to homes and/or farmlands.
Action: Prevent these waters from doing damage to homes and/or farmlands.

Time Frame: Within the next 3 years
Funding: All possibilities are open
Estimated Cost:
Staff: Public Works personnel
Background: Construct a channel from the west side of the freeway to the north route of the Coal Creek flood channel.

Flooding from Summit Canyon

Problem Identification: Excess spring runoff or thundershower waters from Summit Canyon cause flooding in Summit all too frequently. The main historic and natural flood channel is still discernible upon old aerial photos all the way from the northern town limits to the Little Salt Lake. Over the years the channel has become obstructed and is now functionally obsolete.

Goal I7 - Priority High

Objective I7.1-Keep these waters in the natural and historic flood channel.
Action: Keep these waters in the natural and historic flood channel.

Time Frame: Within the next 10 years.
Funding: County Public Works and Engineer's budget
Estimated Cost:
Staff: County Engineer and Public Works personnel
Background: By survey, mark upon the ground the natural channel. Then construct and/or open it up so when necessary it will convey flood waters thru the town and valley to the Little Salt Lake. Rip rap may be necessary at some locations. Some easements may be necessary to obtain from the landowners.

Flooding in Parowan Valley

Problem Identification: Excess spring runoff or thundershower waters from Parowan Canyon cause flooding in Parowan all too frequently. The main historic an natural flood channel is still discernible upon old aerial photos all the way from the western city limits to the Little Salt Lake. Over the years the channel has become obstructed and is now functionally obsolete.

Goal I8 - Priority High

Objective I8.1-Keep these waters in the natural and historic flood channel.
Action: Keep these waters in the natural and historic flood channel.

Time Frame: Within the next 3 years
Funding: County Public Works and Engineer's budget
Estimated Cost:

Staff: County Engineer and Public Works personnel
Background: By survey, mark upon the ground the natural channel. Then construct and/or open it up so when necessary it will convey flood waters thru the Parowan Valley to the Little Salt Lake. Rip rap may be necessary at some locations. Some easements may be necessary to obtain from the landowners.

Paragonah Town **Flooding from Red Creek in and near Paragonah Town**

Problem Identification: Paragonah town has been flooded by waters from Red Creek much too often. It occurs mostly from July, August, and September thundershowers. Occasionally, excess spring runoff may pose significant threats.

Goal I9 - Priority High

Objective I9.1-Prevent these flood waters from coming through residential areas. Iron County is responsible from the mouth of the canyon to the town boundary and again after it leaves the town boundary to west of I-15. Paragonah is responsible within the town boundary.
Action: Prevent these flood waters from going through residential areas.
Time Frame: Within the next 2 years
Funding: Utah Army National Guard 115th Engineer Battalion, 348 East Main Street, Lehi, Utah 84043, will contribute equipment and personnel, but no cash outlay. Iron County and Paragonah town will purchase what materials are necessary.
Estimated Cost:
Staff: Utah Army National Guard, Iron County, and Paragonah townpersonnel
Background: Construct and/or widen and deepen the existing flood way from the mouth of the canyon to west of I-15. UDOTwill assist with crossing on Old Hwy. 91.

Flood waters from Little Creek Cyn.

Goal I10 - Priority Medium

Problem Identification: Occasionally, there are times when these waters may cover the frontage road on the east side of I-15.

Objective I10.1-Keep the frontage road from being covered by flood waters.
Action: Keep the borrow ditches and culverts on the frontage road clean and functional.
Time Frame: This is a on going maintenance item.
Funding: County Public Works
Estimated Cost:
Staff: County Public Works personnel
Background: Keep the borrow ditches and culverts clean.

Holt Canyon Flood Water in Hwy. 18 Right-of-Way

Problem Identification: When there is above normal winter snowfall, the spring runoff waters from Holt Canyon will make it all the way to Hwy. 18 in the Escalante Valley. These waters within the Hwy. right-of-way present a safety hazard.

Goal I11 - Priority Medium

Objective I11.1-Prevent these waters from getting to the Hwy. 18 right-of-way.

Action: Prevent these waters from getting to the Hwy. 18 right-of-way.

Time Frame: Within the next 3 years
Funding: a) Iron County Public Works b) UDOT c) Natural Resource Conservation Service d) Involved land owners
Estimated Cost:
Staff: Personnel for the above listed entities
Background: Construct a diversion structure in the Holt Canyon drainage to take part of this water east and spread it on various farms and in storage ponds. Construct 5 ponds on the Sherwood Bracken land to retain water so it will percolate into the underground water basin. Construct ditches so if the 5th pond overflows then the water will be spread to various farmlands.

Shoal Creek Flooding in Escalante Valley.

Problem Identification: If there is a heavy snow year and both the upper and lower Enterprise Reservoirs are relatively full, the spring runoff waters may reach almost to Beryl. This does not happen very often, but when it does it can be serious.

Goal I12 - Priority High

Objective I12.1: To prevent these waters from reaching Beryl and causing problems.
Action:

Time Frame: This is an ever and on going issue.
Funding: Maintenance dollars and efforts.
Estimated Cost:
Staff: County Engineer and Public Works personnel
Background: Prevent land use activities and growth from obstructing the natural drainage ways.

Cedar City

Problem Identification: Coal Creek is the main drainage through Cedar City from Cedar Mountain. Flooding through the City along Coal Creek would damage homes, businesses and the City's infrastructure if the projected flows of 6,600 CFS were realized.

Goal I13 - Priority High

Objective I13.1-Install flood control improvements along Coal Creek that would contain the design flood and protect the adjacent homes, businesses and City infrastructure.
Action: Relocate the irrigation structure in Coal Creek that is currently located west of the SR-130 bridge structure.

Time Frame: 2004-2005
Funding: City and Federal Natural Resources Conservation Svc.
Estimated Cost:
Staff: City Engineering Staff/NRCS Staff and Contractor
Background: A Grant from the NRCS has been secured for thisproject.

Action: Construct berms, levees, and other channel improvements that will contain the 100-year flood within the channel.

Time Frame: 2005-2006
Funding: City and Federal Natural Resources Conservation Svc.
Estimated Cost:

Staff: City Engineering Staff/NRCS Staff and Contractor
Background: A Grant from the NRCS has been secured for this project.

Action: Obtain a Letter of Map revision from FEMA that will remove the flood zone designation from the property adjacent to Coal Creek.
Time Frame: 2006
Funding: City and Federal Natural Resources Conservation Svc.
Estimated Cost:
Staff: City Engineering and Consultant
Background: A Conditional Letter of map revision has been obtained from FEMA for the project. When the project is completed, the actual Letter of Map Revision can be obtained.

Cedar City

Problem Identification: In 1962 Cedar City and the Soil Conservation Service constructed flood control facilities in the mouth of the Greens Lake drainage to protect the developments downstream from flooding from drainage above.

Goal I14 - Priority High

Objective I14.1-Maintain the effectiveness of the flood control improvements in the Greens Lake Drainage to protect the affected development within the center of Cedar City.
Action: Annually perform inspections of the Greens Lake flood control improvements to identify maintenance action items.
Time Frame: February of Each Year
Funding: None
Estimated Cost:
Staff: City Engineering Staff
Background: Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.

Action: Annually perform the maintenance identified from the inspection on the Greens Lake Flood Control Improvements.
Time Frame: March thru April of each year
Funding: City Drainage Maintenance Budget
Estimated Cost:
Staff: City Drainage Maintenance Crews
Background: Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.

Action: Clean grates on the Greens Lake Flood Control Improvements to ensure unobstructed flow.
Time Frame: Monthly during the months of April through October and during all storms.
Funding: City Drainage Maintenance Budget
Estimated Cost:
Staff: City Drainage Maintenance Crews
Background:

Cedar City

Problem Identification: In 2001 Cedar City constructed flood control facilities in the mouth of the Dry Canyon drainage to eliminate the FEMA flood zones and protect the developments in the area from 100 year flooding from drainage above.

Goal I15 - Priority High

Objective I15.1 - Maintain the effectiveness of the flood control improvements in the Dry Canyon Drainage to protect the affected developments.
Action: Annually perform inspections of the Dry Canyon flood control improvements to identify maintenance action items.

Time Frame: February of each year
Funding: None
Estimated Cost:
Staff: City Engineering Staff
Background: Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.

Action: Annually perform the maintenance identified from the inspection on the Dry Canyon Flood Control Improvements.

Time Frame: March thru April of each year
Funding: City Drainage Maintenance Budget
Estimated Cost:
Staff: City Drainage Maintenance Crews
Background: Inspection and maintenance to be performed according to recommendations of the facility SOP and EAP.

Action: Clean Grates on the Dry Canyon Flood Control Improvements to ensure unobstructed flow.

Time Frame: Monthly during the months of April through October and during all storms.
Funding: City Drainage Maintenance Budget
Estimated Cost:
Staff: City Drainage Maintenance Crews
Background:

Kanarraville

Problem Identification: Kanarraville Town is in the foothills of Kanarra Mountain and at the mouth of the Kanarra Canyon and main drainage from the mountain. The slope of the terrain to the east of Kanarraville increases the probability of flooding.

Goal I16 - Priority High

Objective I16.1-To clean and refurbish existing dikes to the north and south and one dike in the central area of town.
Action: To maintain the existing dikes so they operate at peak performance.

Time Frame: 6 months to 1 year
Funding: Town resources and general maintenance expenses
Estimated Cost: $1,000 - $2,000

Staff: Contracted equipment operators, citizens, town maintenance
Background: Rebuild central dam that was destroyed with the new water tank. Clean out brush from the north dam. Rebuild the top of the south dam levee.

Parowan

Problem Identification: Flooding within Parowan City limits, along the creek.

Goal I17 - Priority High

Objective I17.1-Reduce flood threat from Parowan Canyon within Parowan City.
Action: Maintain and improve flood channel.
Time Frame: 2004-2005
Funding: Parowan City
Estimated Cost:
Staff: Parowan City Public Works/Electrical Departments
Background: To maintain these flood channels on an annual basis and during storms.

Action: Maintenance of channels and bridge openings.
Time Frame: Immediate
Funding: Parowan City (minimal)
Estimated Cost:
Staff: Parowan City Public Works Crew
Background: Keep all bridge openings and upstream channels free of debris to prevent constriction during high flows.

Problem Identification: Existing flood maps are outdated and inaccurate.

Goal I18 - Priority High

Objective I18.1-Identify areas susceptible to flooding
Action: Work with DES on flood plain mapping study to determine areas of potential flood threat.
Time Frame: 3 to 5 years
Funding: unknown
Estimated cost: unknown
Staff: State and contractor
Background: Parts of Parowan City have been listed with FEMA as designated flood hazard areas.

<u>Earthquake</u>

Brian Head

Problem Identification: The U.S. Geological Survey, Geologic Map of Brian Head Town is Township 36-37 Range 09 W. These maps show that we have Geological Faults that transverse our area.

Goal I19 - Priority High

Objective I19.1-Minimize the damage caused by an earthquake of the destructive magnitude and provide the appropriate emergency response.

Action: Require construction of all structures requiring a building permit to be constructed according to the 2000 International Building Code structural design requirements.

Time Frame: As building permits are approved
Funding: Town General Fund
Estimated Cost:
Staff: Town Building Department Staff
Background: 2000 International Building Code and the U. S. Geological Survey, Geological Map of the Brian Head area.

Action: Provide the necessary emergency services to properly respond to earthquake damage.

Time Frame: In place
Funding: Brian Head and Iron County
Estimated Cost:
Staff: Brian Head Public Safety(Police, fire, EMS), and the Iron County Sheriff's Office, Iron County Ambulance and the Iron County Fire Department.
Background: We feel that emergency services will be adequate to respond to damages caused by the effects of an earthquake.

Cedar City

Problem Identification: The U.S. Geological Survey, Geologic Map of the Cedar City Quadrangle, Iron County, Utah show two Geologic Faults running through Cedar City. The Hurricane Fault runs along the toe of the mountain on the east side of the City, The North Hills Fault approximately parallels I-15. Both faults run in an approximate north/south direction. Ground Motion Figures from the International Building Code indicate that the Cedar City area is susceptible to earthquake activity.

Goal I20 - Priority High

Objective I20.1-Minimize the damage caused by an earthquake of the destructive magnitude and provide the appropriate emergency response.
Action: Require construction of all structures requiring a building permit to be constructed according to the 2000 International Building Code structural design requirements.

Time Frame: As building permits are approved
Funding: City General Fund
Estimated Cost:
Staff: City Building Department Staff
Background: 2000 International Building Code and the U. S. Geological Survey, Geologic Map of the Cedar City Quadrangle, Iron County, Utah

Action: Provide the necessary emergency services to properly respond to earthquake damage.

Time Frame: In Place
Funding: Cedar City and Iron County
Estimated Cost:
Staff: Cedar City Fire Department and Police Department, Iron County Sheriff's Department and Ambulance Service
Background: While the timing of extent of earthquake damages cannot be predicted, it is felt the current level of emergency services would be adequate to respond to damages caused by a moderately significant earthquake.

Kane County

Natural Hazards Awareness

Countywide

Problem Identification: The citizens of Kane County need to be made aware of the natural hazards that exist in their area. Through public awareness program earthquake safety, Africanized bee issues, and general individual preparedness programs will be presented.

Goal K1 - Priority Medium

Objective K1.1: To increase the level of awareness for the residents of Kane County.

Action: Conduct a Countywide community awareness campaign
Estimated Cost: $10,000.00
Time Frame: 2 to 5 years
Funding: Public Funds
Staff: Emergency Services Personnel.
Background: Create a base of natural hazard identification, risk assessment, and planning. Incorporated planning objective Countywide.

Big Water

Problem Identification: The citizens of Big Water need to be made aware of the natural hazards that exist in their area. Through public awareness program earthquake safety, Africanized bee issues, and general individual preparedness programs will be presented.

Goal K2 – Priority Medium

Objective K1.2: To increase the level of awareness for the residents of Big Water.

Action: Conduct a Big Water community awareness campaign
Estimated Cost: $5,000.00
Time Frame: 2 to 5 years
Funding: Public Funds
Staff: Emergency Services Personnel.
Background: The Town of Big Water is a somewhat isolated community. There is a greater need for a specific awareness program.

Wildfire

Countywide

Problem Identification: Specific areas of the county are susceptible to Wildland Fire threat. Specific areas of concern include: Glendale, Alton, Duck Creek, Strawberry Valley, Navajo Lake, and Meadow Spring.

Goal K3 - Priority High

Objective K3.1 Protect residential areas from wildfire threat in the unincorporated areas of the county

Action Identify, develop and support Firewise communities
Time Frame: Ongoing
Funding: National Fire Plan Grant
Estimated Cost: $5,000.00 per plan
Staff: County, State Forestry Fire and State Lands, US Forest Service
Background: Firewise program is a community based fire mitigation program.

Action Implement fuel break, lot clean up and other recommendations of completed community fire plans
Time Frame: 5 years
Funding: Firewise grant
Estimated Cost: $80,000.00 per year
Staff: Local, Private, County
Background: Local support of Firewise communities is essential for a successful program.
Problem Identification: Beetle infestation is a concern in the areas of the County. Recent drought has weakened the trees allowing beetles to spread at an alarming rate. This is creating a fire hazard in the timber and in the pinion. This is also occurring in the subdivisions adjacent to areas of beetle kill.

Goal K4 - Priority High

Objective K4.1 Minimize the effects of bark beetle infestation in order to reduce wild fire danger

Action Identify those subdivisions that are impacted by beetle kill
Time Frame: 2 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Contractors, State and Federal Agricultural, USFS, State FFSL
Background: Primary and secondary residential structures continue to encroach in areas of fire.

Action Implement fuel break, lot clean up and other recommendations of completed community fire plans
Time Frame: 5 years
Funding: Unknown, Firewise, other grants
Estimated Cost: $80,000.00 per year
Staff: Private, County
Background: Bark beetle infestation has created a severe fire hazard in these areas

Alton

Problem Identification: The current water system in Alton is constructed with 4” lines. The system is not adequate to protect the structures in town from a wildfire threat. Alton is listed as a community at risk from Wildfire.

Goal K5 - Priority High

Objective K5.1 Improve Alton Town's ability to protect it's citizens and property from wildfire threat

Action: Upgrade the existing water distribution system to provide a capacity to fight Wildland Fires that threaten town

Time Frame: As soon as possible, 1 – 2 years
Funding: Unknown, possible grants
Estimated Cost: Unknown
Staff: Private Contractor, Town
Background: This is critical to the community' ability to fight fires.

Glendale

Problem Identification: Glendale is susceptible to wind driven Wildland Fire

Goal K6 - Priority High

Objective K6.1 Protect the community from a Wildfire threat

Action: Complete a community fire plan

Time Frame: 2-3 years
Funding: National Fire Plan Grant
Estimated Cost: $5,000.00
Staff: County, State
Background: Contact Keith Park to begin the planning process

Kanab

Problem Identification: Weeds and trees in and along Kanab Creek from 500 North to Airport have created a fire hazards

Goal K7 – Priority High

Objective K7.1 Protect area from wildland fire

Action Evaluate the use of controlled burns in this area

Time Frame: Winter Months
Funding: Unknown, possible County or State
Estimated Cost: Dependent upon scope of project
Staff: Fire Department.
Background: Every year or two a fire starts and is very hard to put out due to accessibility.

Action Build walking trails so fire department can us it to access area.

Time Frame: When funds are available.
Funding: Grants
Estimated Cost: $ 1,500,000
Staff: County, volunteers

Background: Access into area hinders firefighting efforts

Flood

Countywide

Problem Identification: Flood occurs primarily from spring snow-melt in the higher elevations and summer flash flooding. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.

Goal K8 – Priority High

Objective K8.1 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.

Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Objective K8.2 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County

Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective K8.3 Reduce flooding threat in Kanab, Orderville and Glendale

Action: Clear debris and other material from streams prior to spring snow melt.

Time Frame: Ongoing
Funding: None
Estimated Cost: Unknown
Staff: County Public Works
Background: Most flooding is attributed to debris-laden streams.

Objective K8.4 Ensure EOC(s) are equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.

Time Frame: 1 year
Funding: Federal Grants

Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: An alternate EOC(s) also need dequate communication capabilities is essential between all response agencies within the County.

Objective K8.5 Support updating of flood hazard data

Action: Support and encourage participation in the NFIP Flood Map Mod Program.
Time Frame: Ongoing
Funding: Federal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager
Background: Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.

Glendale

Problem Identification: There is a flood control problem on the east side of town.

Goal K9 - Medium

Objective K9.1 Evaluate current t flooding problems within Glendale Town

Action: Contract with engineering firm to evaluate flood hazard
Time Frame: 5 years
Funding: Grants, federal
Estimated Cost: $3,000,000.00
Staff: Contract
Background: More information is needed to assess the hazard and then develop a strategy and obtain fundning

Kanab

Problem Identification: 100 North Street to Toms Canyon. At the present time, one of the areas of greatest concern near existing development is along 100 North Street to Toms Canyon. The estimated 100-year flow (most of which originates in undeveloped areas) is 1.588 cfs. The flow capacity of 200 North Street at one foot above the top of curb is approximately 800 cls which leaves 788 efs which should be carried in a storm drain to reduce the danger and risk of damage during periods of high runoff.

Goal K10 - High

Objective K10.1 Reduce flood threat in Kanab.

Action: Install adequate storm drain for excess flows.
Time Frame: When funding is available.
Funding: Grants.
Estimated Cost $1,018,500.
Staff: Contract
Background: : An 84 diameter storm drain approximately 4,850 feet in length is needed to carry the 788 cfs discussed.

Problem Identification: Savage Point Drainage Basin. The Savage Point Drainage basin is comprised of 125 acres, the majority of which is steep, impervious areas.

Goal K11 - High

Objective K11.1 Reduce flood threat in Kanab below 300 S.

Action: Increase storage capacity of drainage basin
Time Frame: When funding is available.
Funding: Grants.
Estimated Cost: $150,000.00
Staff: Contract
Background: This detention basin is not designed to eliminate flooding potential but would alleviate the problem.

Problem Identification: The Heatons have allowed the city to direct storm water onto their field so they can irrigate with it. When there is more water than can be absorbed we need a pipe to take the excess to the creek.

Goal K12 - Low

Objective K12.1 Stop erosion to Heaton property.

Action: Install pipe to divert excess storm water
Time Frame: In the next two years.
Funding: Grants or general funds.
Estimated Cost: $60,000.00
Staff: Contract
Background: Make sure required permitting is in place prior to diverting storm water into the stream.

Problem Identification: Pugh Canyon This area has a runoff of (1,670 efs) and will need detention pond and storm drain facilities.

Goal K13 - High

Objective K13.1 Reduce flood threat to Highway 89 and land below.

Action: Install detention pond and storm drains
Time Frame: When funding is available.
Funding: Grants
Estimated Cost: $4,746,000
Staff: Contract
Background: This will protect structures and infrastructure from flooding.

Problem Identification: Kanab Creek Ranchos (Heaton Dr.) The run off from this area runs through most of the home and the City Park in the Ranchos.

Goal K14 - High

Objective K14.1 Reduce flood threat in Kanab Creek Ranchos

Action: Develop adequate storm water system in area
Time Frame: When funding is available.
Funding: Grants
Estimated Cost: $100,000.00 to $160,000.00
Staff: Contract
Background: Area is susceptible to storm water flooding following a severe thunderstorm

Orderville

Problem Identification: Runoff due to severe storms is a flooding problems which occurs somewhat regularly throughout the town.

Goal K15 - Medium

Objective K15.1 Minimize the effects of storm runoff

Action: Construct infrastructure improvements to contain storm runoff
Time Frame: Unknown
Funding: Unknown
Estimated Cost: $3,000,000.00
Staff: Contractors, City and County
Background: Construct curb & gutter, sidewalks with driveway access and line with concrete, and clean and maintain drainage washes, install debris grates on culverts

Severe Weather

Countywide

Problem: Winter storms, summer thunderstorms, hail, and high winds over southern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal K16 – Priority High

Objective K16.1 Protect County from adverse affects of severe weather

Action: County participation in the StormReady program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action: Encourage avalanche preparedness for county backcountry users in the northeastern portion of the County
Time Frame: 1 Year
Funding: Minimal

Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Kane County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time Frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Background: EOCs and alternate EOCs **,** Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.

Landslide

Countywide

Problem Identification: There is a potential risk to structures located in areas identified by the FCAOG GIS as landslide risk areas.

Goal K17 – Priority High

Objective K17.1 Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.

Action: Assess the probability of landslides and identify specific structures at risk
Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown
Background: Soil surveys and other engineering surveys are needed.

Problem Identification: Rockfall may impact structures within the County

Goal K18 – Priority Medium

Objective K18.1 Remove risk to homes by removing rocks.

Action: Remove large rocks overhanging existing developments.
Time Frame: Undetermined
Funding: Not applicable
Estimated Cost: Not applicable

Staff: City, County Planning
Background: There are several areas in Kanab and Johnson Canyon where rocks overhang existing structures. Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains.

Action: Remove potential rock hazards prior to building homes.
Time Frame: 5 year
Funding: None
Estimated Cost: Unknown
Staff: Planning Departments
Background: Prior to building, require builder/owner to secure or remove possible rock hazard.

Earthquake

Countywide

Problem Identification: Transportation and utilities services could be severely impacted.

Goal K19 – Priority High

Objective K19.1 Provide for emergency response and relief

Action: Identify and maintain critical transportation and utility services
Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: County and City staff.
Background: Critical transportation systems need to be maintained.

Problem Identification: Many communities within the County are surrounded by rocky slopes. Kanab Creek and the East Fork of the Virgin River run through areas with structures. There is a high probability of rockfall caused by seismic events and possible liquefaction along the river areas.

Goal K20 – Priority High

Objective K20.1 Raise awareness of problems that could occur as a result of an earthquake.

Action: Maintain adherence to Land Use codes and restrictions to building in sensitive areas.
Time Frame: Immediate and ongoing
Funding: Not applicable
Estimated Cost: Not applicable
Staff: Town staff.
Background: Some of the problems identified include falling rocks, diversion of the Kanab Creek and the Virgin River due to landslides.

Problem Identification: Damage to structures and utilities is likely during a seismic event.

Goal K21 – Priority High

Objective K21.1 Reduce threat to public safety during an earthquake

Action: Retrofit inadequate construction.
Time Frame: 10 years+
Funding: Private
Estimated Cost: Extreme
Staff: County Inspection Department, County Engineering Department, Private Engineers.
Background: Old and inadequate construction, buildings with unreinforced masonry to be mitigated.

Problem Identification: Lack of public awareness about earthquake damage prevention practices.

Goal K22 – Priority High

Objective K22.1 Educate community on earthquake damage prevention practices

Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness.
Time Frame: 1 year+
Funding: none identified
Estimated Cost: $50,000
Staff: Fire Department, Inspection Department
Background: Having a community with residents educated on earthquake damage prevention practices will ensure greater safety of all residents of the County.

Objective K22.2 Educate community on earthquake damage prevention practices

Action: Educate the public on damage prevention practices for earthquakes
Time Frame: 2 years
Funding: Grants from state and Federal governments
Estimated Cost: $50,000-$75,000
Staff: Emergency Management and volunteers
Background: Continue to establish a C.E.R.T. program in the County Earthquakes are taught as being the biggest hazard facing those in the area. Teaching the C.E.R.T. class should get the message out to residents.

Drought

Countywide

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal K23 – Priority High

Objective K23.1 Conserve culinary water by educating the public

Action: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: City funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: Use a newsletter to educate the public

Objective K23.2 Conserve culinary water by conservation

Action: Maintain and enforce rate policies that encourage water conservation
Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water purveyor and newsletter editor
Background: County should evaluate a tiered water system.

Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

Goal K24 – Priority High

Objective K24.1 Meet current and future water needs of community

Action: Develop additional source and storage as well as implement conservation plans implemented.
Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: County Staff, Professional Services, Contractors
Background: To meet the needs of a community's residential and businesses water users, vigilance in locating new and additional sources as well as increasing storage capacity to meet current needs as well as future need is a must.

Insect Infestation

Countywide

Problem Identification: Mormon crickets, cutworms and mosquito are a problem

Goal K25 – Priority Low

Objective K25.1 Reduce the impact and severity of insects

Action: Spread insect bait and spray for mosquitoes
Time Frame: When required
Funding: City and County funds, Mosquito abatement funds come from property tax
Estimated Cost: Approximately $3.00 per property owner per month
Staff: Abatement District
Background: Abatement Districts are critical in the controlling of insects

Action: Conduct aerial spraying to reduce infestations

Time Frame: As infestations occur

Funding: By private individuals in most cases

Estimated Cost: Varies, depending on acreage treated

Staff: Contractor

Background: Agricultural fields are been subject to insect infestation especially during the recent years of drought.

Paiute Indian Tribe of Utah

Wildfire

Cedar Band

Problem Identification: Man-made or lightening caused fires have occurred at times on the Hurricane Hills about 8 miles South of Cedar City on the East side of I-15

Goal P1- Priority High

Objective P1.1 Reduce the threat of Wildfire
Action: Draft a Community Fire Plan
Time Frame: next fiscal year
Funding: Tribal and Federal funds
Estimated Cost: minimal
Staff: Regional Fire Planner
Background: Contact Keith Parke

Indian Peaks Band

Problem Identification: Man-made or lightening caused fires have occurred at times on the Hurricane Hills about 8 miles South of Cedar City on the East side of I-15

Goal P2- Priority High

Objective P2.1 Reduce the threat of Wildfire
Action: Draft a Community Fire Plan
Time Frame: next fiscal year
Funding: Tribal and Federal funds
Estimated Cost: minimal
Staff: Regional Fire Planner
Background: Contact Keith Parke to draft the Plan, include firebreaks in Plan

Shivwits Band

Problem Identification: A wildfire threatened the residential area of the Shivwits Band during the summer of 2003 which included evacuation of the community

Goal P3- High Priority

Objective P3.1 Reduce the negative impacts of wildfire on the residents of the Shivwits Band
Action: Complete a Community Fire Plan of the Shivwits residential area
Time Frame: 6mo.-1 year
Funding:
Estimated Cost: minimal or no cost
Staff: BLM/State/Tribe

Background: Contact Keith Parke to draft the Plan

Flood

Cedar Band

Problem Identification: The Cedar Band land including homes is located in a watershed area which floods regularly on normal years

Goal P4- Priority High

Objective P4.1 Minimize flooding on the West side of the Hurricane Hills located on Tribal land
Action: Create a diversion channel and retention basin along dry creek
Time Frame: next fiscal year
Funding: Tribal & federal
Estimated Cost: unknown
Staff: Tribal & county staff
Background: construct a diversion channel and retention basin

Indian Peaks Band

Problem Identification: The roadway leading to the water tank washes out regularly

Goal P5- Priority High

Objective P5.1 Prevent future roadway erosion
Action: Add culverts to keep water off of the road
Time Frame: 3 years
Funding: state & federal
Estimated Cost: unknown
Staff: state & federal
Background: dig and add culverts to divert water, pave the road to the water tank

Problem Identification: Increase threat of flooding due to drought conditions

Goal P6- Priority Medium

Objective P6.1 minimize flooding
Action: Conduct a study to determine the location of flood water flows
Time Frame: 3 years
Funding: state & federal
Estimated Cost: unknown
Staff: state & federal
Background: contact state and federal agencies, contract for the study

Shivwits

Problem Identification: Wildcat Wash has the potential to impact Shivwits residents with flood waters.

Goal P7- Priority High

Objective P7.1 Reduce the threat of flooding along Wildcat Wash
Action: To store and carry flood waters safely through the residential area
Time Frame: 6 mo. To 3 years
Funding: UDOT, Washington County
Estimated Cost: undetermined
Staff: Washington County/UDOT
Background: Enlarge culverts carrying Wildcat Wash flows under Old Highway 91, repair and/or replace the detention basin on the Wash

Problem Identification: After a significant rainstorm the area near the turn off to Anasazi Valley along Highway 91 becomes inundated and blocks access to the Shivwits Band community

Goal P8- Priority Medium

Objective P8.1 To reduce the threat of flood water inundation along Highway 91 at the Anasazi Valley turn off
Action: Provide a way for flood waters to travel from one side of the highway to the other without threatening the roadway
Time Frame: 2-5 years
Funding: UDOT, Washington County
Estimated Cost: undetermined
Staff: UDOT, Washington County
Background: Install a culvert under the roadway

Earthquake

Cedar Band

Problem Identification: The Cedar band is located along the Hurricane Fault and is therefore subject to earthquake at any time

Goal P9- Priority High

Objective P9.1 Reduce threat from earthquakes
Action: Continue to follow building codes in construction techniques
Time Frame: ongoing
Funding: Tribal source
Estimated Cost: minimal
Staff: Tribal, counties, state
Background: Continue to use Tribal Housing office to conduct building inspections

Indian Peaks Band

Problem Identification: The Hurricane fault branches off onto Reservation Land. The lower southeast corner of the Reservation, where homes are proposed, may be subject to liquefaction

Goal P10- Priority High

Objective P10.1 Protect structures and utilities from earthquake damage
Action: Have a study done to determine liquefaction danger and severity of the fault
Time Frame: undetermined
Funding: federal grant
Estimated Cost: unknown
Staff:
Background: Contact FEMA to initiate a discussion about the study

Problem Soils

Shivwits Band

Problem Identification: Blue clay has been a problem in the residential area of the Shivwits Band

Goal P11- High Priority

Objective P11.1 To reduce structural damage to residences
Action: Require or request basic soil suitability testing for any new development
Time Frame: on-going
Funding: Tribe
Estimated Cost: minimal
Staff: Tribe
Background: inform home-owner of the potential problem, suggest a contact with a soils engineer to perform testing

Radon Gas

Cedar Band

Problem Identification: The Cedar Band is sitting on a moderate to low Radon area

Goal P12- Priority High

Objective P12.1 Minimize radon gas levels in existing and future homes
Action: Conduct field test of radon levels in homes
Time Frame: next fiscal year
Funding: Tribal
Estimated Cost: minimal
Staff: Tribal
Background: obtain testing hardware to test each home on band land.

Indian Peaks Band

Problem Identification: The Indian Peaks Band is sitting on a moderate to low Radon area

Goal P13- Priority Medium

Objective P13.1 Minimize radon gas levels in existing and future homes
Action: Conduct field test of radon levels in homes
Time Frame: next fiscal year

Funding: Tribal
Estimated Cost-minimal
Staff: Tribal
Background: obtain testing hardware to test each home on band land.

Washington County

<u>Wildfire</u>

County-wide

Problem Identification: Continuing non-compliance with existing building codes and fire codes.

Goal W1 – Priority High

Objective W1.1 Increase compliance with existing building and fire codes.
Action: Develop and enforce current local, state and national codes
Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Enterprise

Problem Identification: Approximately 10 homes are at risk from wildfire

Goal W2 – Priority High

Objective W2.1 Educate homeowners on how to reduce risk of wildfire damage
Action: Conduct an education program on reducing wildfire risks
Time Frame: ongoing
Funding: City
Estimated Cost: minimal
Staff: Fire Chief
Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes

Hurricane

Problem Identification: Fire is a threat to power facilities and transmission lines

Goal W3 – Priority High

Objective W3.1 Reduce threat of utilities interruption due to a wildland fire
Action: Safeguard facilities and poles
Time Frame: Ongoing

Funding: Local
Estimated Cost: Undetermined
Staff: Public Works Crews, Hurricane City Fire Department, 138 Task Force
Background: Power and telephone transmission lines in Hurricane City travel via overhead lines through many developed and undeveloped areas. A wildland fire could disrupt services to customers by igniting poles or arcing. Facilities and transmission lines need to be evaluated and plans implemented to safeguard facilities and poles. Plans must be developed to isolate affected areas and maintain services by rerouting services to customers.

Ivins

Problem Identification: Wildfire is a threat to the west side of the City (west end of Kayenta)

Goal W4 – Priority High

Objective W4.1 Reduce threat of damage due to a wildland fire
Action: Develop a fire break road between Ivins and the Shivwits Indian Reservation
Time Frame: 1 year
Funding: Private, City, State, Federal
Estimated Cost: $10,000 with survey
Staff: Private land owners, Ivins, Reservoir water users, Ivins Public Safety
Background: Past wildfires have been a threat from the west end of the county. A fire access road needs to be provided between Ivins City and the Shivwits Indian Reservation. This will assist in protecting the community by providing a fire break.

New Harmony

Problem Identification: Wildfire is a threat to several large tracts of property in the community

Goal W5 – Priority High

Objective W5.1 Reduce threat of damage due to a wildland fire
Action: Educate the residents of the community on how to make their properties fire safe.
Time Frame: Periodic
Funding: U.S. Forest Service
Estimated Cost: Minimal to town
Staff: Town Staff, U.S. Forest Service
Background: Wildfire is a periodic problem in the New Harmony area, with the Sequoia Fire in 2002 burning 8,200 acres nearby. A few large tracts in town containing residences could have problems from similar fires in the future. The residents of the Town need to be alerted to the dangers of wildfire and be given measures which they can utilize to minimize damage.

Rockville

Problem Identification: Wildfire is a threat due to grasslands drying out during extended dry periods.

Goal W6 – Priority High

Objective W6.1 Reduce threat of damage due to a wildland fire
Action: Educate residents of the value of maintaining firebreaks around their homes
Time Frame: Immediate
Funding: Local, BLM
Estimated Cost: Minimal
Staff: Town, BLM
Background: Rockville lies at the west end of Zion Canyon and is an area of large trees surrounded by open fields of grass bordered by rocky slopes. During extended dry periods the grasslands dry out and represent a potential fire hazard.

St. George

Problem Identification: Interface zones along the Virgin River and other river drainages are causing an exposure to wildfire threat.

Goal W7 – Priority High

Objective W7.1 Reduce threat of damage due to a wildland fire
Action: Thin or remove vegetation causing exposure problem.
Time Frame: 1 year
Funding: Moderate, no local funds
Estimated Cost: Moderate
Staff: No local, possible assistance with BLM/U.S. Forest Service
Background: Vegetative areas along the Virgin River have been subjected to several fires over a number of years. The most recent one damaged several properties and structures. This interface area needs to be thinned and separated from exposure to structures.

Virgin

Problem Identification: The Zion River RV park and power facilities and telephone poles are at greatest risk from wildfire.

Goal W8 – Priority High

Objective W8.1 Reduce threat of damage due to a wildland fire
Action: Thin vegetation along river or create a fire break to protect nearby facilities.
Time Frame: Ongoing
Funding: Moderate, BLM, local funds
Estimated Cost: Moderate
Staff: No local, possible assistance with BLM
Background: The dense river bottom cover provides an ideal location for a wildfire. This interface area needs to be thinned and separated with a firebreak to reduce or eliminate exposure to structures. Redundant communications systems should be installed to provide necessary coverage.

Washington City

Problem Identification: Thick vegetation, mostly tamarisks, along Virgin River near homes.

Goal W9 – Priority High

Objective W9.1 Thin out Virgin River vegetation (tamarisks) and create fire breaks
Action: Cut and chip tamarisks for fire breaks.

Time Frame: 2 years
Funding: Grants
Estimated Cost: $30,000 - $40,000
Staff: Washington City Fire Dept. and BLM fuels crew
Background: Cut 50 ft. to 60 ft. fire breaks from banks to river. Thin out vegetation near homes by river. Major issues surrounding this objective are that the U.S. Army Corps of Engineers wants to preserve vegetation for bank stabilization and it would reduce wildlife habitat. The general public will support fire safety, but those concerned with the existing environment will likely not favor the reduction of wildlife habitat. The tamarisks, however, are an introduced, water-guzzling, weed-type tree. While this project is good for fire safety of the homes nearby, the U.S. Army Corps of Engineers will likely want to preserve vegetation for bank stabilization.

<u>Landslide</u>

County-wide

Problem Identification: There is a potential risk to structures located in areas identified by the FCAOG GIS as landslide risk areas.

Goal W10 – Priority High

Objective W10.1 Reduce potential landslide risk on commercial and residential structures in areas of known landslide potential.
Action: Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown
Background: Soil surveys and other engineering surveys are needed.

La Verkin

Problem Identification: There is potential risk of landslide affecting Toquerville Spring which would severely impact water delivery.

Goal W11 – Priority High

Objective W11.1 Provide for a second means of supplying culinary water to the residents of La Verkin.
Action: Establish and maintain a means to readily connect the City's culinary water users to alternative water sources.

Time Frame: Undetermined
Funding: Local Governments and possible grants/loans
Estimated Cost: To be determined
Staff: LaVerkin City, Toquerville City, Hurricane City
Background: In case Toquerville Springs is damaged, the communities of LaVerkin and Toquerville would need to connect to Cottam Well and Hurricane City water sources. Use of water would need to be curtailed to essential services only.

Rockville

Problem Identification: Several homes within Rockville are located close to rocky slopes and are subjected to potential landslides and rockfalls.

Goal W12 – Priority High

Objective W12.1 Minimizing construction in areas of rockfall and landslides.
Action: Continue to modify land use code to reduce threat to residences.

Time Frame: Undetermined
Funding: Not applicable
Estimated Cost: Not applicable
Staff: Rockville Town Planning Commission, Rockville Town Council
Background: In October 2001, a 16 foot wide boulder that came loose from a nearby hillside rolled into a home in Rockville. The huge rock destroyed the homeowner's bedroom and bathroom and came with 2ft of his head as he slept. According to Dixie State College geologist Professor Kelly Bringhurst, the rock beneath the sandstone is a shale and is very weak and boulders break off and just occasionally tumble down.

St. George

Problem Identification: Rockfall areas are next to residential areas.

Goal W13 – Priority High

Objective W13.1 Remove risk to homes by removing rocks.
Action: Remove large rocks overhanging existing developments.

Time Frame: Undetermined
Funding: Not applicable
Estimated Cost: Not applicable
Staff: City Community Development Staff,Planning Commission, City Council
Background: There are several areas in St. George where rocks overhang existing developments, i.e. in the Bloomington development. Developments should include removal or remediation of large rock areas from being dislodged by earthquake or rains.

Problem Identification: Rockfall areas are next to residential areas.

Goal W14 – Priority Medium

Objective W14.1 Remove rockfall risk to areas being considered for new development.
Action: Remove potential rock hazards prior to building homes.

Time Frame: 5 year
Funding: None
Estimated Cost: Unknown
Staff: City Planning Department
Background: Prior to building, require builder/owner to secure or remove possible rock hazard.

Toquerville

Problem Identification: There is potential risk of landslide affecting Toquerville Spring which would severely impact water delivery.

Goal W15 – Priority High

Objective W15.1 Provide for a second means of supplying culinary water to the residents of Toquerville.
Action: Establish and maintain a means to readily connect the City's culinary water users to alternative water sources.

Time Frame: Undetermined
Funding: Local Governments and possible grants/loans
Estimated Cost: To be determined
Staff: Toquerville City, LaVerkin City, Hurricane City
Background: In case Toquerville Springs is damaged, the communities of Toquerville and LaVerkin would need to connect to Cottam Well and Hurricane City water sources. Use of water would need to be curtailed to essential services only.

Virgin

Problem Identification: There is potential risk of landslide on the hillside along S.R. 9 near the Jesse Lee residence and the 101 Rancho area of Virgin, as well as the well at Anderson Junction along with the water lines running from there to the town.

Goal W16 – Priority High

Objective W16.1 Provide for a secondary means of providing water and essential services
Action: Develop plan for providing essential services should access be disrupted and water disrupted.

Time Frame: Ongoing
Funding: Local Governments and possible grants
Estimated Cost: To be determined
Staff: Town of Virgin, Utah Department of Transportation
Background: In case damage to the Anderson Junction well/spring, the communities of Virgin, LaVerkin and Toquerville would be curtailed to use of water for essential services only. The potential for damage to the 101 Rancho area would necessitate a plan to reroute traffic and repair the damage to S.R. 9. Damage repair would be coordinated as needed.

Flood

County-wide

Problem Identification: Control flooding in unincorporated residential areas of Washington County, (Approximately 12 areas). Flooding occurs from heavy rains and fast moving thunderstorms.

Goal W17 – Priority High

Objective W17.1: Obtain Aerial photography with contours of each residential area in Washington County.
Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: 3 months to 2 years (depending on number of areas).
Funding: Local, State and Federal grants.
Estimated Cost: $7000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Aerial Topography is needed for master storm drainage design.

Objective W17.2: Design master storm drainage plans for residential areas.
Action: Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Engineers design master storm drainage plans for the residential areas.

Objective W17.3: Implement storm drainage plans throughout the residential areas of Washington County.
Action: Implement storm drainage plans throughout the residential areas of Washington County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the final plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Problem Identification: Control flooding in the Diamond Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms. Aerial photography completed and the planning phase is almost completed.

Goal W18 – Priority High

Objective W18.1: Implement storm drainage plans throughout the residential areas of Diamond Valley.

Action: Implement storm drainage plans throughout the residential areas of the Diamond Valley subdivision.

Time Frame: 2 years
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the final plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Problem Identification: Control flooding in the Winchester Hills subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms. Aerial photography completed and the planning phase is almost completed.

Goal W19 – Priority High

Objective W19.1: Implement storm drainage plans throughout the residential areas of Winchester Hills.

Action: Implement storm drainage plans throughout the residential areas of Winchester Hills.

Time Frame: 2 years
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the final plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Problem Identification: Control flooding in the Apple Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.

Goal W20 – Priority High

Objective W20.1: Obtain Aerial photography with contours of each residential area in Apple Valley.

Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: 3 months to 2 years (depending on funding).
Funding: Local, State and Federal grants
Estimated Cost: $7,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Aerial Topography is needed for master storm drainage design.

Objective W20.2: Design master storm drainage plans for residential areas.

Action: Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Engineers design master storm drainage plans for the residential areas.

Objective W20.3: Implement storm drainage plans throughout the residential areas of Washington County.

Action: Implement storm drainage plans throughout the residential areas of Washington County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the final plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Problem Identification: Control flooding in the Dammeron Valley subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.

Goal W21 – Priority High

Objective W21.1: Obtain Aerial photography with contours of each residential area in Dammeron Valley.

Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: 3 months to 2 years (depending on funding).
Funding: Local, State and Federal grants
Estimated Cost: $7,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Aerial Topography is needed for master storm drainage design.

Objective W21.2: Design master storm drainage plans for residential areas.

Action: Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on completion of photography)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Engineers design master storm drainage plans for the residential areas.

Objective W21.3: Implement storm drainage plans throughout the residential areas of Washington County.

Action: Implement storm drainage plans throughout the residential areas of Washington County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the final plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Problem Identification: Control flooding in Sky Ranch Subdivision of Washington County. Flooding occurs from heavy rains and fast moving thunderstorms.

Goal W22 – Priority High

Objective W22.1: Obtain Aerial photography with contours of each residential area in Sky Ranch.

Action: Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: 3 months to 2 years (depending on number if areas).
Funding: Local, State and Federal grants
Estimated Cost: $7000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Aerial Topography is needed for master storm drainage design.

Objective W22.2: Design master storm drainage plans for residential areas.

Action: Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.
Background: Engineers design master storm drainage plans for the residential areas.

Objective W22.3: Implement storm drainage plans throughout the residential areas of Washington County.

Action: Implement storm drainage plans throughout the residential areas of Washington County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants

Estimated Cost: unknown, will depend on the finals plans and what is required for facilities
Staff: County and contracted staff
Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Enterprise

Problem Identification: There is localized flooding near 100 East Main Street and 300 South Center Street. These threaten 2 commercial buildings and 3 residences.

Goal W23 – Priority High

Objective W23.1 Reduce the threat of flood damage to structures in the City

Action: Catch and channel flood waters from the high school and send them to Spring Creek.
Time Frame: 3-5 years
Funding: Washington County School District, FEMA funds, City Funds
Estimated Cost: $70,000-$90,000
Staff: City and Contractor
Background: This will help alleviate both the 100 East and the 300 South problems.

Problem Identification: There is localized flooding near 100 East Main Street and 300 South Center Street. These threaten 2 commercial buildings and 3 residences.

Goal W24 – Priority Medium

Objective W24.1 Reduce the threat of flood damage to structures in the City

Action: Divert storm water at 200 East and Main Street into existing storm drain catch basin at 200 East 100 North.
Time Frame: 1-5 years
Funding: City Funds and grants
Estimated Cost: $12,000-$15,000
Staff: City and Contractor
Background: This will help alleviate only the 100 East Main Street problem.

Hurricane

Problem Identification: Ashcreek Springs has been contaminated by flooding from time to time.

Goal W25 – Priority High

Objective W25.1 Insure that the water from Ashcreek Springs and the Ashcreek Drainage remain a quality source of culinary water.

Action: Protect the spring source and install and maintain anti-backflow valves.
Time Frame: On-going

Funding: Local governments and possible grants
Estimated Cost: Undetermined
Staff: Hurricane City Public Works, LaVerkin City Public Works, Contractor
Background: Hurricane City has experienced contamination of the culinary water system due to flooding during heavy rain storms in the Ash Creek Drainage. Ongoing maintenance of facilities needs to be done to protect the source.

Ivins

Problem Identification: There is flooding in the "Old Town" area of Ivins.

Goal W26 – Priority High

Objective W26.1 Reduce flooding at the "Old Town" drainage area located between 200 East and 200 West.
Action: Create a Special Improvement Project for storm drainage and roadway improvements.
Time Frame: On-going
Funding: Special Improvement District
Estimated Cost: $2,046,000
Staff: Ivins City
Background: This will eliminate flooding to the homes in the area.

Problem Identification: The roadway and homes on the south side of Center Street between 500 and 600 East in Ivins floods with mud and debris.

Goal W27 – Priority High

Objective W27.1 Reduce flooding in the area 500 East and 600 West along Center Street.

Action: Retain storm water in the street.
Time Frame: On-going
Funding: Special Improvement District
Estimated Cost: $15,000
Staff: Ivins City
Background: Construct settling ponds off of Center Street, increase the size of boxes, divert water along the street through construction of curb and gutter.

LaVerkin

Problem Identification: Area around 200 West and 100 North subject to flooding from storm runoff.

Goal W28 – Priority High

Objective W28.1 Preventing flooding in area near 200 West and 100 North.

Action: Upgrade and expand storm drain system. Keep said systems clear and clean.
Time Frame: On-going
Funding: Local governments
Estimated Cost: To be determined
Staff: LaVerkin City

Background: Upgrading and expanding the storm drain system and ensuring it is kept clear will eliminate flooding to the homes in the area.

New Harmony

Problem Identification: Flooding in the Prince Subdivision is a problem.

Goal W28 – Priority High

Objective 1.1 Reduce flooding threat in portions of New Harmony.

Action: Acquire a sandbagging machine along with empty bags and sand.

Time Frame: immediate
Funding: Local governments
Estimated Cost: $1,500-$2,000
Staff: Residents, Boy Scouts, Other volunteers
Background: Flooding has been a problem in the Prince Subdivision since the subdivision was developed prior to New Harmony adopting a Subdivision Ordinance and Zoning Ordinance. Other developed areas in town are also subject to occasional flooding. Having ability to fill sandbags will provide short-term solution to preventing damage to residences.

Problem Identification: Flooding throughout town caused by clogged channels and bridge openings in town.

Goal W29 – Priority High

Objective 2.1 Reduce flooding threat in New Harmony.

Action: Maintain channel and bridge openings in town.

Time Frame: Ongoing
Funding: Local governments
Estimated Cost: Unknown, Minimal to moderate
Staff: Residents
Background: If the drainages in and around the Town are kept clear on an ongoing basis the likelihood of flooding is diminished.

Problem Identification: Specific flooding threats throughout town have not been quantified and thoroughly studied by a qualified engineering professional.

Goal W30 – Priority High

Objective 3.1 Reduce flooding threat in New Harmony.

Action: Commission an engineering study to determine the feasibility of implementing flood and drainage control measures for the town of New Harmony.

Time Frame: 6 months to 1 year
Funding: Local and grant funds (unknown source)
Estimated Cost: Approximately $15,000 (local $1,000; grant $14,000)
Staff: Town staff and Consulting Engineer
Background: Project will include floodplain mapping and study to determine specific flood threats in town.

Problem Identification: Problems quantified in engineering studies need to be implemented to alleviate flooding problems in town.

Goal W31 – Priority High

Objective 4.1 Reduce flooding threat in New Harmony.

Action: Implement flood control project(s) identified by consulting engineer to reduce flooding in town.

Time Frame: 1-1 ½ years
Funding: Grant from unknown source
Estimated Cost: $70,000-$100,000
Staff: Contractor
Background Specific flood control projects will not be able to be identified until engineering studies determine what needs to be done.

Rockville

Problem Identification: While the Virgin River poses a potential flood threat to the community, the drainage ditches from the tops of the surrounding plateaus represent a real flood hazard.

Goal W32 – Priority High

Objective 1.1 Reduce flooding threat in Rockville.

Action: Keep ditches clean.

Time Frame: immediate and ongoing
Funding: Local governments
Estimated Cost: minimal
Staff: Town personnel, residents
Background: Not much can be done by the community to lessen the threat of the Virgin River, but the town can ensure that the ditches in town are kept free from obstructions.

St. George

Problem Identification: Heavy rains in the City limits along the drainages can cause problems by damaging homes and property by overflowing of the Santa Clara and Virgin Rivers.

Goal W33 – Priority High

Objective 1.1 Reduce flooding threat in St. George.

Action: Clear debris and other material from river beds.

Time Frame: within 2 years
Funding: none
Estimated Cost: use volunteer groups or persons performing mandated civic time.
Staff: City personnel, volunteers

Background: Homeowners and other small groups can be responsible for areas near their homes.

Problem Identification: The Santa Clara River and Virgin River cannot carry capacity due to silt build up.

Goal W34 – Priority High

Objective 2.1 Reduce flooding threat in St. George.

Action: Dredge out river bottoms.
Time Frame: 5 years
Funding: Federal government
Estimated Cost: unknown
Staff: U.S. Army Corps of Engineers
Background: Dredge these two river channels. The Army Corps of Engineers has worked on the Fort Pierce River (Wash) in the past.

Toquerville

Problem Identification: There are drainage problems along Pecan Drive.

Goal W35 – Priority High

Objective 1.1 Improve drainage conditions along Pecan Drive in Toquerville.

Action: Install curb and gutter on Pecan Street.
Time Frame: 3 months
Funding: Class C road funds and general funds
Estimated Cost: $60,000
Staff: City Staff, contractor
Background: Improving Pecan Street will control water flow and protect residences.

Problem Identification: There are drainage problems along Pecan Drive.

Goal W36 – Priority Medium

Objective 2.1 Improve drainage along S.R 17 in Toquerville.

Action: Install additional drain pipe.
Time Frame: 3 months
Funding: Class C road funds and general funds
Estimated Cost: $60,000
Staff: City Staff, contractor
Background: Some work has been done by Toquerville City. Additional issues need to be addressed.

Problem Identification: There are drainage problems in the Chola Creek Subdivision.

Goal W37 – Priority Medium

Objective 3.1 Resolving drainage issues in Chola Creek Subdivision.

Action: Implement the drainage work needed in the subdivision.
Time Frame: immediate
Funding: private developer
Estimated Cost: unknown
Staff: private developer
Background: Toquerville City is currently working with the land owner regarding drainage situation in the subdivision.

Virgin

Problem Identification: The sites identified for greatest risk is the property located at the 101 Rancho area, the Zion River RV Park, the North Creek area, and other property along the Virgin River flow.

Goal W38 – Priority High

Objective 1.1 Reduce flooding threat in portions of the town of Virgin.

Action: Clear debris and other material from waterways.
Time Frame: Ongoing
Funding: Local government and possible grants
Estimated Cost: To be determined.
Staff: Virgin town and any other professional assistance needed.
Background: Keeping the waterways clear of sludge buildup will help protect portions of the town from flooding.

Washington

Problem Identification: Property owners/developers wanting to develop within flood plains of the Virgin River, Mill Creek, and along storm washes.

Goal W39 – Priority High

Objective W39.1 Reduce potential flood risks.

Action: Update FEMA Flood Insurance Rate Maps.
Time Frame: 5 years
Funding: Grants
Estimated Cost: $50,000
Staff: FEMA
Background: FEMA flood maps are inaccurate and out of date. The City is experiencing development pressures along the floodplains. Funding of this activity would be positively pursued if grants are received. Otherwise may be cost prohibitive to update maps all at once.

Action: Require Letter of Map Amendment (LOMA)/Letter of Map Revision (LOMR) for suspected inaccurate floodplains prior to development design.
Time Frame: On-going
Funding: Developers
Estimated Cost: case by case

Staff: Developer's consulting engineers with review by FEMA and Washington City Community Development Department.
Background: Allow developers to submit LOMAs/LOMRs to FEMA for approval for a more accurate delineation of floodplain and their design development. Property owners and developers may feel that this requirement for LOMAs/LOMRs may be too restrictive.

Action: Do not allow development in the Virgin River and Mill Creek floodplains
Time Frame: On-going
Funding: N/A
Estimated Cost: N/A
Staff: Washington City Community Development Department
Background: Do not allow major development in the Virgin River and Mill Creek floodplains, other than open space and recreational uses and possible floodplain stabilization.

Earthquake

La Verkin

Problem Identification: Transportation and utilities services could be severely impacted.

Goal W40 – Priority High

Objective W40.1 Provide for emergency response and relief

Action: Identify and maintain critical transportation and utility services
Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: City staff.
Background: Critical transportation systems need to be maintained.

Rockville

Problem Identification: Rockville is surrounded by rocky slopes and the Virgin River runs through the town. There is a high probability of rockfall caused by seismic events and possible liquefaction along the river areas.

Goal W41 – Priority High

Objective W41.1 Raise awareness of problems that could occur as a result of an earthquake.

Action: Maintain adherence to Land Use codes and restrictions to building in sensitive areas.
Time Frame: immediate and ongoing
Funding: Not applicable
Estimated Cost: Not applicable
Staff: Town staff.

Background: Some of the problems identified include falling rocks, diversion of the Virgin River due to landslides.

Problem Identification: Lack of public awareness about earthquake damage prevention practices.

St. George

Problem Identification: Damage to structures and utilities is likely during a seismic event.

Goal W42 – Priority High

Objective W42.1 Reduce threat to public safety during an earthquake.

Action: Retrofit inadequate construction.
Time Frame: 10 years+
Funding: Private
Estimated Cost: Extreme
Staff: City Inspection Department, City Engineering Department, Private Engineers.
Background: Old and inadequate construction, buildings with unreinforced masonry to be mitigated.

Problem Identification: Lack of public awareness about earthquake damage prevention practices.

Goal W43 – Priority High

Objective W43.1 Educate community on earthquake damage prevention practices

Action: Produce and/or distribute handouts and provide inspections to identify shortcomings in earthquake preparedness.
Time Frame: 1 year+
Funding: none identified
Estimated Cost: $50,000
Staff: Fire Department, Inspection Department
Background: Having a community with residents educated on earthquake damage prevention practices will ensure greater safety of City residents.

Action: Educate the public on damage prevention practices for earthquakes
Time Frame: 2 years
Funding: Grants from state and Federal governments
Estimated Cost: $50,000-$75,000
Staff: Emergency Management and volunteers
Background: Starting up a C.E.R.T. program in the St. George City area. Earthquakes are taught as being the biggest hazard facing those in the area. Teaching the C.E.R.T. class should get the message out to residents.

Washington

Problem Identification: There are unmapped earthquake faults and ground shaking hazard areas.

Goal W44 – Priority High

Objective W44.1 Map all earthquake faults in Washington City and groundshaking hazard areas

Action: Create a Geologic Hazards Map showing earthquake faults and groundshaking hazard areas.

Time Frame: 6 months – 1 year
Funding: City General Fund
Estimated Cost: $5,000
Staff: Consultants, Washington City Public Works and Community Development Depts.
Background: Not all earthquake faults within the city have been mapped. For public safety, need to map faults and areas that could be impacted with rockfall, etc. due to groundshaking. The map will be a guide for siting homes and buildings

Capability Assessment

Introduction
This portion of the Plan assesses Beaver, Iron, Garfield, Kane, and Washington Counties, in Utah's current capacity to mitigate the effects of the natural hazards. The assessment includes a comprehensive examination of the following local government capabilities:

1. Staff & Organizational Capability
2. Technical Capability
3. Policy & Program Capability
4. Fiscal Capability
5. Legal Authority
6. Political Willpower

The purpose of conducting this capabilities assessment is to identify potential hazard mitigation opportunities available to the Five County's through its operation as a local government. Analysis should detect any existing gaps, shortfalls or weaknesses within existing government activities that could exacerbate community vulnerability. The assessment will also highlight the positive measures already in place or being done at the County level, which should continue to be supported and enhanced if possible through future mitigation efforts. The capabilities assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for each County to pursue under this Plan, but ensures that those goals and objectives are realistically achievable under given local conditions.

Beaver County has three incorporated towns: Beaver, Milford, and Minersville, and four unincorporated communities: Elk Meadows, Manderfield, Greenfield, and Adamsville. The population of the county is approximately 6,000. Beaver County has in land mass of 1,660,137 total acres, only 6.9% of which is under private ownership. The remaining 93.1% is state and federally owned.

Garfield County has eight incorporated towns: Panguitch, Hatch, Antimony, Escalante, Boulder, Henrieville, Cannonville, and Tropic – and one unincorporated city of Ticaboo. The population of the county is approximately 4,600. Garfield County has a land mass of 3,372,717 total acres, only 4% of which is under private ownership. The remaining 96% is state and federally owned.

Iron County is the only county of the five counties that shares a border with all four other counties. It has six incorporated towns: Cedar City, Enoch, Parowan, Kanarraville, Paragonah, and Brian Head, and several unincorporated communities including: Newcastle, Beryl Junction, Modena, and Summit. The population of the County is approximately 43,000. Iron County has a land mass of 3,300 sq. miles.

Kane County is located in South Central Utah on the border with Arizona. With 3,992 square miles Kane County has a population of 6,062 (2000 census). Elevations range from 3700 feet above sea level on the Eastern border to 10,000 plus in the North Western corner of the County. Only 4% of the land area of Kane County is owned by private individuals with the remaining 96% owned by the State and Federal governments. 108 miles of Highway 89 run through Kane County representing the major transportation route between Salt Lake City and Phoenix. The Glen Canyon National Recreation Area and Lake

Powell are on the Eastern Border with Bryce Canyon National Park and Zion National Park in the Western portion of the County. The Grand Staircase Escalante National Monument and Paria Wilderness Area are also located in Kane County. Tourism is a major impact to the County with literally millions of visitors traveling through the County to visit the numerous National Parks, Wilderness Area's, Monument's or the several Marina's on Lake Powell.

Washington County occupies the extreme southwest corner of the State of Utah. With a land area of 2427 square miles with a population of 105,000 (2003 est.), It is the 15th largest by area and 5th largest by population. There are fourteen cities with St. George City being the largest with a population of 60,000 (2003 estimate). The Bureau of Land Management is the largest land holder in the county. There is also the Shivwits Indian Reservation to the west of Ivins City which encompasses 36 square miles. Washington County is bisected by Interstate 15 highway going north to south with tourism being a large part of the economy.

1. Staff & Organizational Capability

All five Counties have limited staff and organizational capability to implement hazard mitigation strategies. Each County is governed by a three-member Board of Commissioners who bear the responsibility of serving the people and improving the quality of life in the county. Terms on the board are staggered with elections held every two years. The County Commission directs and supervises the administration of all county offices, boards, commissions and agencies. The County has a number of professional staff departments to serve their residents and to carry out day-to-day administrative activities. The county also contracts with outside agencies and private entities to fill gaps and to increase their capabilities.

The full time county departments include the following: Assessor – All Counties
Attorney – All Counties
Building – All Counties
Clerk/Auditor – All Counties
Geographic Info. Systems – Washington Information Technology - All Counties
Justice Court – All Counties
Library - Washington
Mosquito Abatement - Washington
Planning – All Counties
Public Works – Washington
Recorder – All Counties
Roads – All Counties
Sheriff – All Counties
Treasurer – All Counties
Emergency Services – All Counties
County Public Health Dept. – All Counties
Cooperative Extension Services – All Counties
Special Service Districts – All Counties

The Assessor's Office is responsible to assess and value real and personal property within the county keeps records and, creates the tax role.

The County Attorney's Office provides legal advice to the county and prosecutes criminal activities.

The Clerk/Auditor's Office handles the registration of voters and elections throughout the county, provides passport applications and audits county departments.

Geographic Information Systems provides mapping and geographical analysis for county agencies and departments.

Emergency Services is responsible for the mitigation, preparedness and response operations that deal with both natural and man-made disasters.

The Treasurer's Office is responsible for the oversight and management of the County's budget and fiscal programs, including the administration of state and federal grants.

Information Technology provides for the hardware and software support throughout the county for computers, telephones, networks and e-mail services.

The Justice Court Assists Law Enforcement in administering equitable justice in the enforcement of local and state laws.

The County Library system has four libraries throughout the county to provide services to the population of the county.

The Planning Department among other things oversees the unincorporated areas of the county. Providing building permits, zoning ordinances and is the first step in obtaining business licenses.

Public Works coordinates public involvement with the physical infrastructure of the county. Also oversees GIS and Planning.

The Office of Recorder is a repository of local records.

The Roads Department maintains the roads throughout the county, through maintenance and implementation of engineering standards.

The Washington County Sheriffs Office maintains law enforcement throughout the unincorporated areas of the county and by contract for several of the incorporated municipalities. The Sheriffs office also maintains the jail in Washington County.

The County Treasurer receives and disburses monies for the county, its agencies and departments.

Health Department functions are provided by The Southwest Utah Health Department of the State of Utah.

The Utah State University Cooperative Extension office seeks to help individuals, families, and communities put research-based knowledge to work to improve their lives.

Special Service Districts provide various functions and services to the citizens of the county.

2. Technical Capability

Beaver, Kane, and Garfield Counties have limited technical capability to implement hazard mitigation strategies.

Iron County has some technical capability to implement hazard mitigation strategies.

Washington County has the technical capability to implement some of the hazard mitigation strategies planned.

Technical Expertise

Beaver and Garfield Counties have three deputies certified for clandestine lab detection, cleanup, etc.
Beaver and Garfield Counties have Information Technology departments that includes a Geographic Information Systems (GIS) Specialist. Beaver and Garfield Counties have been collecting GPS and photographic data on County C and D roads for the past four years and has made inroads into converting property description information contained in the Counties tax program into computer-generated plats.

Iron County has four deputies certified for clandestine lab detection, cleanup, etc.
Iron County has an Information Technology department that includes a Geographic Information Systems (GIS) Specialist. Iron County has been working on a county wide addressing system.

Kane County has numerous talented employees that assist with Hazard mitigation. The lack of financial resources limits the capabilities of these individuals. Kane County currently has limited GIS capability in its Road Department.

Washington County has a full-time emergency manager, planner, building inspector, and public works manager on staff to administer the County's hazard mitigation programs. The County has a licensed engineer on staff, and has in the past and currently relies upon outside contractors and consultants to perform a majority of any required technical work. Washington County does have a department responsible for Information Technology (IT) to enhance local government operations and the County's ability to develop and maintain a state-of-the-art hazard mitigation program.
Washington County does currently have GIS capability.

Geographic Information Systems (GIS)
GIS systems can best be described as a set of tools (hardware, software and people) used to collect, manage, analyze and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations.

Internet Access
Beaver County provides the majority of its employees with high speed broadband internet access through State of Utah routers, gateways, and TCP/IP ranges. Internet access opens up an enormous door for local officials and departments to keep abreast of the latest information relative to their work and makes receiving government services more affordable and convenient. The State ITS also hosts Beaver County's website at www.beaver.state.ut.us. Garfield County provides the majority of its employees with high speed broadband internet access through State of Utah routers, gateways, and TCP/IP ranges. Internet access opens up an enormous door for local officials and departments to keep abreast of the latest information relative to their work and makes receiving government services more affordable and convenient. The State ITS also hosts Garfield County's website at *www.brycecanyoncountry,com.*

Iron County provides the majority of its employees with high speed broadband internet access through State of Utah routers, gateways, and TCP/IP ranges. Internet access opens up an enormous door for local officials and departments to keep abreast of the latest information relative to their work and makes receiving government services more affordable and convenient. The State ITS also hosts Iron County's website at www.Ironcounty.net

Kane County provides high speed broadband internet access to all county departments and employees by tying in to the State of Utah routers, gateways, and TCP/IP ranges or through a local ISP. Local citizens of the county have access through a variety services, ranging from dial-up services to Local T-1 services. The County is very fortunate to have several proactive local vendors that provide and support computer services.

Washington County provides high speed broadband internet access to all county departments and employees by tying in to the State of Utah routers, gateways, and TCP/IP ranges. Local citizens of the county have access through a variety services, ranging from dial-up services to Local T-1 services. Washington County's website is www.washco.state.ut.us

3. Fiscal Capability

All the Five Counties have limited fiscal capability to implement hazard mitigation strategies.

The following budgeted sums of money are from Beaver County's 2003 budget year.

Civil Defense	$12,000
Planning, Building, & Zoning	60,000
Public Health Department	28,000
Sheriff Training	8,000
Fire Suppression	36,000

The following budgeted sums of money are from Garfield County's 2003 budget year.

Civil Defense	$12,000
Planning, Building, & Zoning	3,500
Public Health Department	20,187
Sheriff Training	5,500
Fire Suppression	60,459

The following budgeted sums of money are from Iron County's 2003 budget year.

Civil Defense	$18,000
Planning, Building, & Zoning	75,000
Public Health Department	35,000
Sheriff Training	8,000
Fire Suppression	50,000

These amounts reflect the actual cost of maintaining the services. Any large scale, traumatic natural or man-made disaster would be only minimally covered by these funds.

Kane County has limited fiscal capability to implement hazard mitigation strategies. The County's annual budget is less than 4,000,000 and only 750,000 of that is a result of property taxes. Any large scale, traumatic natural or man-made disaster would be only minimally covered by these funds.

For Fiscal Year 2003, Washington County has a budget of $17,274,500, of which half are directly obligated to public safety, health and welfare for its citizens. Washington County receives most of its revenues through taxes.

These amounts reflect the actual cost of maintaining the services. Any large scale, traumatic natural or man-made disaster would be only minimally covered by these funds. It is highly unlikely that Iron County could afford to implement additional hazard mitigation programs.

It is highly unlikely that any of the Five Counties could afford to implement all of the planned hazard mitigation grant programs.

Under the Disaster Mitigation Act of 2000, FEMA has made special accommodations for "small and impoverished communities", who will be eligible for a 90% Federal share,10% non-Federal cost split for projects funded through the Pre-Disaster Mitigation Grant Program.

4. Policy & Program Capability

This part of the capabilities assessment includes the identification and evaluation of existing plans, policies, practices, programs, or activities that either increase or decrease the community's vulnerability to natural hazards. A complete review of all activities needs to be conducted throughout each county. Positive activities, which decrease hazard vulnerability, should be sustained and enhanced if possible. Negative activities which increase hazard vulnerability should become targeted for reconsideration, and be thoroughly addressed within the Mitigation Strategy for each of the Five Counties.

Recent Hazard Mitigation Efforts

Beaver and Garfield Counties have undertaken a few specific hazard mitigation efforts in the past. Activities include:

- Forming of the Local Emergency Planning Committee (LEPC), under the direction of the Beaver County Sheriff
- Establishment and implementation of Enhanced 911 services through Beaver County Sheriff Dispatch
- Practical training inside the county's (disaster drills) at least annually, with all emergency personnel, paid and volunteer, including Search and Rescue, EMTs, Fire District Personnel, Sheriff Department Personnel, and Hospital Personnel
- Practical training by professional programs outside the county's
- Implementation of Certified Emergency Response Team (CERT) program in the County's

Iron County has undertaken a few specific hazard mitigation efforts in the past. Activities include:

- Forming of the Local Emergency Planning Committee (LEPC), under the direction of the Iron County Sheriff
- Establishment and implementation of Enhanced 911 services through Dept. of Public Safety Dispatch
- Practical training inside the county (disaster drills) at least annually, with all emergency personnel, paid and volunteer, including Search and Rescue, EMTs, Fire Dept. Personnel, Sheriff Department Personnel, and Hospital Personnel
- Practical training by professional programs outside the county
- Implementation of Certified Emergency Response Team (CERT) program in the County

Kane County has a long history of Hazard Mitigation efforts through training and programs. These mitigation efforts are summarized as follows:

- Practical training inside the county (disaster drills) on a four year exercise schedule, with all emergency personnel, paid and volunteer, including Search and Rescue, EMS, Fire, Law Enforcement, and Hospital Personnel
- Practical training by professional programs outside the county
- Implementation of Certified Emergency Response Team (CERT) program in the County
- E911 implemented in the Kane County Sheriff's dispatch center in 1993
- An active Local Emergency Planning Committee since the early 1990's

Washington County has undertaken a few specific hazard mitigation efforts in the past. Activities include:

- Cleaning of culverts and drainage areas
- Transportation routes and maintaining roads

These recent mitigation efforts are summarized as follows:

- Washington County is subject to flash flooding due to its geography and weather patterns. The county has an ongoing mitigation project throughout the county keeping areas prone to flooding clear of debris.
- Washington County is in the process of identifying transportation routes that would be used in an evacuation. The Roads Department is in the process of upgrading roads that have been identified as major evacuation routes and upgrading signage

Washington County has five areas which are in need of mitigation planning and actions. These areas are:

- Flooding in Diamond Valley
- Flooding in Winchester Hills
- Flooding in Apple Valley
- Flooding in Dammeron Valley
- Flooding at Sky Ranch

Community Rating System Activities
Communities that regulate development in floodplains are able to participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally-backed flood insurance policies available for properties in the community. The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes: class 1 requires the most credit points and gives the largest premium reduction; class 10 receives no premium reduction.

Currently only Washington County has two communities that are participating in this program; St. George City and Santa Clara City. See appendix.

General Plan

Beaver and Iron Counties General Plan were originally completed in 1993 and amended in 1999. Additionally, their County's Zoning Ordinance was implemented in 1993. These plans have been reviewed for purposes of this Hazard Mitigation Plan, with special attention paid to those portions that address natural hazards. According to the Plans, there are no significant man-made hazards in either Beaver or Iron Counties.

Garfield County's General Plan was originally completed in 1984 and amended in 1999. Additionally, Garfield County's Zoning Ordinance was implemented in 1984. These plans have been reviewed for purposes of this Hazard Mitigation Plan, with special attention paid to those portions that address natural hazards. According to the Plans, there are no significant man-made hazards in Garfield County.

Kane County's General Plan was originally completed in the mid 1990's. Additionally, Kane County's Zoning Ordinance was amended in the late 1990's. These plans have been reviewed for purposes of this Hazard Mitigation Plan, with special attention paid to those portions that address natural hazards. According to the Plans, there are no significant man-made hazards in Kane County.

Beaver, Iron and Kane Counties' general vision statements under their General Plans include the following four main themes:

- *Beaver/Garfield/Iron/Kane Counties' desire to preserve the rural appearance of each respectable county*

- *Beaver/Garfield/Iron/Kane County's envision the protection of the natural environment through the provision of the public water and sewer infrastructure*

- *Beaver/Garfield/Iron/Kane County's desire to create more job opportunities to entice County young people to stay and live in each County or return to the County to work after attending college/university or serving in the military or on a Church Mission*

- *Beaver/Garfield/Iron/Kane County's envision a greater focus on developing their tourism industry*

After completing a thorough review of the *Beaver/Garfield/Iron/Kane* County General Plan and the *Beaver/Garfield/Iron/Kane* County Zoning Ordinance, it was determined that there are no pending hazard mitigation strategies for the County's to implement, and, considering this current mitigation planning effort, there are no foreseeable conflicts with the goals previously established under plans. There is, however, a significant opportunity to enhance hazard mitigation objectives for Beaver/Garfield/Iron/Kane County within this Hazard Mitigation Plan - objectives that go beyond any content within the General Plans and the Subdivision Ordinances.

In summary, the *Beaver/Garfield/Iron/Kane* County's General Plans and the Zoning Ordinances provide some general information with regard to natural hazards and post-disaster recovery procedures but do not specifically recommend hazard mitigation strategies for *Beaver/Garfield/Iron/Kane* County to implement. Rather, these documents serve to underscore and reiterate the following main points under what has been classified as either resource protection or storm hazard mitigation:

- *Beaver/Garfield/Iron/Kane County's generally support, but reserve the right to object to amendments and/or changes thereto, the guidelines of the State of Utah and the efforts and programs of the incorporated areas are to each County*

- *Beaver/Garfield/Iron/Kane County's support enforcement of the Utah State Building Code, particularly requirements of construction standards to meet wind resistive factors, i.e., design wind velocity. The County's will also support provisions in the State Building Code requiring tie-downs for mobile homes, which help resist wind damage.*

- *Beaver/Garfield/Iron/Kane County's support the National Flood Insurance Program*

- *Beaver/Garfield/Iron/Kane County's support the use of best management practices recommendations of the United States Soil Conservation Service*

Washington County's General Plan was originally completed in 1994, then again in 2003. The General Plan has been reviewed for purposes of this Hazard Mitigation Plan, with special attention paid to those portions which address natural hazards.

Washington County's general vision statement under the General Plan includes the following main themes:

- Washington County desires to preserve the rural way of life that is currently within the county.

- Washington County desires to create more job opportunities to entice County young people to stay and live in the County or return to the County to work after attending college or university or serving in the military.

- Washington County envisions a greater focus on developing its tourism industry.

Emergency Operations Plan

Kane County's Emergency Operations plan was first adopted in the late 1980's. It was revised in 1992 and has been reviewed several times since. The plan is currently being re-written to include a Terrorism Annex. For the most part, the Plan describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster. The Plan does not specifically address hazard mitigation, but it does identify the operations to be undertaken by the County to protect lives and property immediately before, during and immediately following an emergency.

Washington County's Emergency Operations plan was first adopted in the early 1990s. It was revised in 1998 and completely rewritten in 2003. For the most part, the Plan describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster. The Plan does not specifically address hazard mitigation, but it does identify the operations to be undertaken by the County to protect lives and property immediately before, during and immediately following an emergency.

5. Legal Authority

Local governments in Utah have a wide range of tools available to them for implementing mitigation programs, policies and actions. A hazard mitigation program can utilize any or all of the four broad types of government powers granted by the State of Utah, which are (a) Regulation; (b) Acquisition; (c) Taxation; and (d) Spending. Thus, this portion of the capabilities assessment will summarize the Counties enabling legislation which grants the four types of government powers listed above within the context of available hazard mitigation tools and techniques.

General Police Power

Utah's local governments have been granted broad regulatory powers in their jurisdictions. Utah General Statutes bestow the general police power on local governments, allowing them to enact and enforce ordinances that define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people and to define and abate nuisances, including public health nuisances. Since hazard mitigation can be included under the police power (as protection of public health, safety and welfare), towns, cities, and counties may include requirements for hazard mitigation in local ordinances. Local governments may also use their ordinance-making power to abate Nuisances, & which could include, by local definition, any activity or condition making people or property more vulnerable to any hazard.

Title 3, Fire Health, Safety, and Welfare, of Beaver County's Revised Ordinances as of September 30, 2003, includes Chapter 3-100, Nuisances; Chapter 3-200, Licensing and Regulation of Large Public Assemblies; Chapter 3-300, Flying Vehicles; Chapters 3-420

through 3-440, Adopting Mechanical Code, Plumbing Code, and National Electrical Code; and Chapter 3-500, Fires - Department - Code.

Residents of Beaver County are served by the Beaver County Sheriff's Department, the Minersville Town Marshall, and the Utah Highway Patrol. The Beaver County Sheriff's Department consists of a sheriff and thirteen full-time deputies, all of whom are certified peace officers. Their training and duties cover all facets of law enforcement from routine traffic control to criminal investigation. Continuous training is available to assist in upgrading the skills of the department. Deputies are assigned to strategic locations in the county, which serves to minimize response time. To assist in responding to emergencies or other needs, the department is staffed with four fully-trained and certified dispatchers. The department is in constant communication with other law enforcement agencies.

In addition, Beaver County operates a Public Safety Facility, under the direction of the Beaver County Sheriff, that includes a 197-bed jail that houses county and state inmates. Twenty-three full-time Corrections Officers that are fully trained through Peace Officers Standards Training (POST) staff the jail.

Beaver City and Milford contract with the Beaver County Sheriff's Department for Law Enforcement, while Minersville has a Town Marshall who serves as a deputy sheriff.

The Utah Highway Patrol has six full-time troopers, including a K-9 unit, stationed within Beaver County. They are certified and trained police officers with state-wide jurisdiction. Each trooper has assigned to him a police vehicle that is fully equipped. Their basic assignment is traffic enforcement within Beaver County.

Residents of Garfield County are served by the Garfield County Sheriff's office, and the Utah Highway Patrol. The Garfield County Sheriff's Office consists of a sheriff and six full-time deputies, and four part-time deputies all of whom are certified peace officers.
Their training and duties cover all facets of law enforcement from routine traffic control to criminal investigation. Continuous training is available to assist in upgrading the skills of the department. Deputies are assigned to strategic locations in the county, which serves to minimize response time. The department is in constant communication with other law enforcement agencies.

In addition, Garfield County operates a Public Safety Facility, under the direction of the Garfield County Sheriff, which includes a 115-bed jail that houses county and state inmates. Nineteen full-time Corrections Officers that are fully trained through Peace Officers Standards Training (POST) staff the jail.

The Cities of Panguitch and Escalante contract with the Garfield County Sheriff's Office for Law Enforcement.

The Utah Highway Patrol has three full-time troopers stationed within Garfield County. They are certified and trained police officers with state-wide jurisdiction. Each trooper has assigned to him a police vehicle that is fully equipped. Their basic assignment is traffic enforcement within Garfield County.

Residents of Iron County are served by the Iron County Sheriff's Department, the Brian Head Town Marshall, Enoch Police Department, Cedar City Police Department, and the Utah Highway Patrol. The Iron County Sheriff's Department consists of a sheriff and thirteen

full-time deputies, all of whom are certified peace officers. Their training and duties cover all facets of law enforcement from routine traffic control to criminal investigation. Continuous training is available to assist in upgrading the skills of the department. Deputies are assigned to strategic locations in the county, which serves to minimize response time.

The cities/towns of Kanarraville, Paragonah, Summit, New Castle, and outlying communities in the county contract with the Iron County Sheriff's Department for Law Enforcement.

The Utah Highway Patrol has six full-time troopers stationed within Iron County. They are certified and trained police officers with state-wide jurisdiction. Each trooper has assigned to him a police vehicle that is fully equipped. Their basic assignment is traffic enforcement within Iron County.

Land Use

Regulatory powers granted by the state to local governments are the most basic manner in which a local government can control the use of land within its jurisdiction. Through various land use regulatory powers a local government can control the amount, timing, density, quality, and location of new development. All these characteristics of growth can determine the level of vulnerability of the community in the event of a natural hazard. Land use regulatory powers include the power to engage in planning, enact and enforce zoning ordinances, flood plain ordinances, and subdivision controls. Each local community possesses great power to prevent unsuitable development in hazard-prone areas.

A large portion of Washington/Kane County that is identified as open space is also land that is under jurisdiction of one of the public agencies, i.e. The National parks, National Forest, Bureau of Land Management, Indian Reservation, State Lands and State Parks. Over the years there has been good cooperation between these Federal and State agencies with Washington/Kane County.

A sizable amount of private land within the County is located in identified flood plain areas. Floodplain ordinances have been enacted to eliminate and mitigate losses in those areas.

Planning

In order to exercise the regulatory powers conferred by the General Statutes, local governments in Utah are required to create or designate a planning agency. The planning agency may perform a number of duties, including: make studies of the area; determine objectives; prepare and adopt plans for achieving those objectives; develop and recommend policies, ordinances, and administrative means to implement plans; and perform other related duties. While the ordinance itself may provide evidence that zoning is being conducted in accordance with a plan, the existence of a separate planning document ensures that the government is developing regulations and ordinances that are consistent with the overall goals of the community.

Beaver and Garfield County's Planning and Zoning Department and the Planning and Zoning Commissions have put together a comprehensive Zoning Ordinance and General Plans for Beaver and Garfield County's, approved by their County Commissions. Beaver and Garfield County's have also formed a Local Emergency Planning Committee with county-wide membership, under the direction of the Beaver and Garfield County's Sheriff, which has adopted and is in the process of updating, a comprehensive emergency management plan for each County.

Iron County's Planning and Zoning Department and the Planning and Zoning Commission have put together a comprehensive Zoning Ordinance and General Plan for Iron County, approved by the County Commission. Iron County has also formed a Local Emergency Planning Committee with county-wide membership, under the direction of the Iron County Sheriff, which has a comprehensive emergency management plan for the County.

Kane County has enacted a Planning Commission to oversee zoning and building in the unincorporated parts of the county. The planning commission may perform a number of duties, including: make studies of the area; determine objectives; prepare and adopt plans for achieving those objectives; develop and recommend policies, ordinances, and administrative means to implement plans; and perform other related duties

Washington County has enacted a Planning Department to oversee zoning and building in the unincorporated parts of the county.

Building Codes & Inspection

Many structural mitigation measures involve constructing and retrofitting homes, businesses and other structures according to standards designed to make the buildings more resilient to the impacts of natural hazards. Many of these standards are imposed through the building code.

Beaver County has adopted the state building code and has established a Building Inspections Department to carry out its building inspections in the unincorporated area of the County and Milford and Minersville municipalities. Beaver City has its own Building Inspector.

Garfield County has adopted the state building code and has established a Building Inspections Department to carry out its building inspections.

Iron County has adopted the state building code and has established a Building Inspections Department to carry out its building inspections in the unincorporated area of the County. Cedar City has its own Building Inspector.

Kane County has adopted by ordinance The International Building Code (IBC).

Washington County has adopted by ordinance The International Building Code (IBC).

Zoning

Zoning is the traditional and most common tool available to local governments to control the use of land. The statutory purpose for zoning is to promote health, safety, morals, or the general welfare of the community. Land "uses" controlled by zoning include the type of use (e.g., residential, commercial, industrial) as well as minimum specifications for use such as lot size, building height and set backs, density of population, etc.

Subdivision Regulations

Beaver County has adopted the Beaver County Subdivision Ordinance, as revised, November, 1996. This ordinance regulates the divisions of land for the purpose of complying with the Beaver County General Plan.

Garfield County has adopted the Garfield County Subdivision Ordinance, as revised, April, 2003. This ordinance regulates the divisions of land for the purpose of complying with the Garfield County General Plan.

Flood Plain Regulations
The Flood Insurance Rate Map (FIRM) produced by FEMA on September 19, 1987, determines that the entire community of unincorporated areas in Beaver County are rated Zone D, areas of undetermined but possible flood hazards.

Iron County has several Zone A areas within incorporated and unincorporated parts of the county.

Washington County has several Zone A areas within incorporated and unincorporated parts of the county.

6. Political Willpower
Most Beaver and Garfield County residents are quite knowledgeable about the potential hazards that their community faces, and in recent years they have become more familiar with the practices and principles of mitigation. Flood prone structures have become elevated and/or acquired and relocated or replaced out of harm's way. Classes in Fire Prevention, Brush Clearing, Tree Trimming, and Burning of Slash are available to Beaver and Garfield County residents through the Beaver Fire District. It is strongly believed that such tangible and visual changes within the community have created a greater sense of awareness among local residents, and that hazard mitigation is a concept that they are beginning to readily accept and support. Because of this fact, coupled with Beaver and Garfield County's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

Most Iron County residents are quite knowledgeable about the potential hazards that their community faces, and in recent years they have become more familiar with the practices and principles of mitigation. Flood prone structures have become elevated and/or acquired and relocated or replaced out of harm's way. Classes in Fire Prevention, Brush Clearing, Tree Trimming, and Burning of Slash are available to Iron County residents through the State Fire Warden. It is strongly believed that such tangible and visual changes within the community have created a greater sense of awareness among local residents, and that hazard mitigation is a concept that they are beginning to readily accept and support. Because of this fact, coupled with Iron County's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

The Kane County government is quite knowledgeable about the potential hazards that their community faces, and in recent years, they have become more familiar with the practices and principles of mitigation. It is strongly believed that such tangible and visual changes within the community have also created a greater sense of awareness among local residents, and that hazard mitigation is a concept that they are beginning to readily accept and support. Because of this fact, coupled with Kane County's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

The Washington County government is quite knowledgeable about the potential hazards that their community faces, and in recent years, they have become more familiar with the practices and principles of mitigation. It is strongly believed that such tangible and visual changes within the community have also created a greater sense of awareness among local residents, and that hazard mitigation is a concept that they are beginning to readily accept and support. Because of this fact, coupled with Washington County's history with natural disasters, it is expected that the current and future political climates are favorable for supporting and advancing future hazard mitigation strategies.

Plan Maintenance
Monitoring, Evaluating and Updating the Plan

Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for the Five County (FCAOG) Region are kept current and that local mitigation efforts are being carried out. The Plan has therefore been designed to be user-friendly in terms of monitoring implementation and preparing regular progress reports.

Annual Reporting Procedures

The Plan shall be reviewed annually, as required by the Steering Committee, or as situations dictate such as following a disaster declaration. Each year the FCAOG Community & Economic Development Department Staff will review the plan and ensure the following:

1. The Executive Director and the Steering Committee will receive an annual report and/or presentation on the implementation status of the Plan at the January Steering Committee Meeting.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan.

If the FCAOG Steering Committee determines that a modification of the Plan is warranted, the Council may initiate a Plan amendment.

Revisions and Updates

Periodic revisions and updates of the Plan are required to ensure that the goals and objectives for the Southwest Region are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review

The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the Southwest Region that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the Plan.
The Natural Hazard Mitigation Plan Regional Team, with a potential membership representing every jurisdiction in the FCAOG area, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the Plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review should become summarized in the annual report prepared for this Plan under the direction of the Community & Economic Development Director. The annual report will include an evaluation of the effectiveness and appropriateness of the Plan, and will recommend, as appropriate, any required changes or amendments to the Plan.

If the Steering Committee determines that the recommendations warrant modification to the Plan, the Council may either initiate a Plan amendment as described below, or, if conditions justify, may direct the FCAOG Community & Economic Development Department to undertake a complete update of the Plan.

Plan Amendments

An amendment to the Plan should be initiated only by the Steering Committee, either at its own initiative or upon the recommendation of the Executive Director, Community & Economic Development Director or Mayor of an affected community.

Upon initiation of an amendment to the Plan, Five County AOG will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full Regional Team may be reconstituted. At a minimum, the information will be made available through public notice in a newspaper of general circulation as well as on the Five County AOG Website at www.fcaog.state.ut.us Information will also be forwarded to the Utah Department of Public Safety, Division of Emergency Services and Homeland Security. This information will be sent out in order to seek input on the proposed Plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Executive Director (or his/her designee) for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Executive Director (or his/her designee) will review the proposed amendment along with comments received from other parties and submit a recommendation to the Steering Committee within sixty (60) days.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the Plan; and/or

3. There has been a change in information, data or assumptions from those on which the Plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, the Steering Committee will hold a public meeting. The Steering Committee will review the recommendation (including the factors listed above) and any oral or written comments received at the public meeting. Following that review, the Steering Committee will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Refer the amendment request back to the Executive Director for further consideration.

4. Defer the amendment request for further consideration and/or meeting.

5. Reject the amendment request.

Implementation through Existing Programs

Process

The Five County Association of Governments Natural Hazard Mitigation will be implemented in each community by local ordinances. These ordinances include the Zoning Ordinance and the Subdivision Ordinance. Athough these two ordinance are widely used, other means of implementing the Plan are through the Capital Improvement Plans (CIPs)and the General (or Comprehensive) Plans of each local jurisdiction. Observance of these plans and ordinances will serve to coordinate implementation efforts. It will be the responsibility of the Mayor, Council or Commissioners of each jurisdiction, as he/she/they see fit, to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The Five County jurisdictions will continue to seek outside funding assistance for mitigation. This portion of the Plan identifies the primary Federal and State grant programs for Five County jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster

Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds

spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Drainage & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to properties owned by the businesses, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by the recipient to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

State Programs

Local Programs

Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

Non-governmental Programs

Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this Plan.

Continued Public Involvement

Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. On a yearly basis the plan will be profiled at a Five County Open House. The plan will also be available on the FCAOG website to provide additional opportunities for public participation and comment.

Five County Association of Governments staff has been designated by its Steering Committee as the lead agency in preparing and submitting the Five County Natural Hazard Mitigation Plan, which includes coverage for all incorporated cities and counties within the five county region, i.e. Beaver, Garfield, Iron, Kane and Washington Counties. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. All meetings directly related to the Natural Hazard Mitigation Plan process will be publicly advertised. Executive Council meetings where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings as they are public and open to all. The FCAOG will advertise each meeting and request for input at least seven days in advance of the activity and will publish notices of the event in The Spectrum newspaper. The notices will advertise both the meetings and the means of providing input outside the meetings if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Natural Hazard Mitigation Plan. Each identified agency or person will be mailed a notice of the meetings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the Natural Hazard Mitigation Plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the Plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcome as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public meetings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Natural Hazard Mitigation Plan will be presented to the Five County Executive Council at its regularly scheduled monthly meeting for adoption and approval to submit the document to State authorities. Executive Council policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the Plan, the Plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Hazard Mitigation Plan as open and convenient as possible:

A. Participation: All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings: Adequate and timely notification to all area residents will be given as outlined above to all forums, and meetings.

C. Access to Information: Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Natural Hazard Mitigation Plan, and/or any other documents prepared for distribution by the Five County Association of Governments that may be adopted as part of the plan by reference. The FCAOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance: Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public meetings: The AOG will plan and hold public meetings according to the following priorities: 1- Meetings will be conveniently timed for people who might benefit most from Mitigation programs, 2- Meetings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy), and 3- Meetings will be adequately publicized. Meetings may be held for a number of purposes or functions including to: a-identify and profile hazards, b-develop mitigation strategies, and c-review plan goals, performance, and future plans.

F. Comment Period: The AOG will sponsor a 30-day public comment period prior to final plan submission. The comment period will begin with a public meeting to open the 30-day solicitation of input. Comments may be made orally, or in writing, and as far as possible, will be included in the final Natural Hazard Mitigation Plan according to the outlined participation rules.

Appendices

Appendix A-Environmental Considerations

National Environmental Policy Act (NEPA) Words in *italics* have been taken directly from the 44Code of Federal Regulations Parts 201 and 206: 44 CFR 10.8(d)(2)(iii) excludes this rule from the preparation of an environmental assessment or environmental impact statement, where the rule relates to actions that qualify for categorical exclusions under 44 CFR 10.8(d)(2)(iii), such as the development of plans under this section.
Executive Order 12898, Environmental Justice: Section 323 requires compliance with applicable codes and standards in repair and construction, and use of safe land use and construction standards.

The following acts will be taken into consideration and will be incorporated when needed while organizing and implementing the PDM plan; Historic Preservation, Clean Water, Clean Air, Wetland Preservation 404, Endangered Species Act, Description of natural and beneficial functions of floodplains.

National Historic Preservation Act of 1966: This act was found and declared by Congress because "the spirit and direction of the Nation are founded upon and reflected in its historic heritage…the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people." Some of the other main points of the act include the awareness of historic properties that are being lost or substantially altered. The preservation will continue a legacy of cultural, educational, aesthetic, inspirational, economic, and energy benefits for future generations. The knowledge of historic resources and "the encouragement of their preservations will improve the planning and execution of Federal and federally assisted projects and will assist economic growth and development. The act would like to use measures that will foster conditions in which historic resources can exist in productive harmony with present and future generations.

Clean Water Act (CWA): The Federal Water Pollution Control Act or Clean Water Act provides environmental protection of U.S. surface waters. The Clean Water Act's mission is to "reduce and maintain the chemical, physical, and biological integrity of the nation's waters". This act established a priority to end the discharge of pollutants into waterways. The principle requirements of the law were that each state had to adopt water quality standards, design plans for limiting industrial and municipal discharges, and act to protect wetlands. Nearly every city in the United States was required to build and operate a wastewater treatment plant with most of the technical and financial assistance coming from the EPA.

Water Quality Act of 1987: The water quality act reaffirmed and supported the Clean Water Act by focusing on stringent regulations of toxic chemicals from industry, acid rain, and water pollution from dispersed sources such as agricultural runoff, sewage overflows during storms, and runoff from city streets.

Wetland Preservation, Section 404 of the Clean Water Act: This act regulates activities in wetland areas. Amendments have included exemption categories, the option of delegation to states, and enforcement powers. This act regulates the discharge of dredged or fill material into "waters of the United States", which include wetland areas. The discharge or dredged material requires a permit from the U.S.

Army Corps of Engineers (Corps) based on regulatory guidelines developed in coincidence with the EPA. The “veto authority” of the Corps gives them the power to prohibit or restrict a defined area as a disposal site if it is determined that the discharge may cause adverse effects on municipal water supplies, shellfish beds and fishery areas, wildlife, and/ or recreational areas.

1990 Clean Air Act: A federal law that covers the entire country under the Environmental Policy Act (NEPA). This law sets limits or standards on how much of a pollutant can be in the air anywhere in the United States, controlling the emissions of air pollutants. These limits ensure that all Americans have the same basic health and environmental protections. States may have stronger pollution controls on an individual basis. However, states are not allowed to have weaker pollutions controls than those set for the whole country. Each state explains how it will do its job under the Clean Air Act by developing a mandated “state implementation plan” (SIP). The SIP is a collection of the regulations a state will use to clean up polluted areas that fail to meet air quality standards and to maintain air quality in areas that have attained standards. These plans must be developed involving the public through meetings that allow for opportunities to comment. The SIP must be approved by the EPA. If it is not approved the EPA can enforce the Clean Air Act in that state. The United States government, through the EPA, assists the states with the SIP by providing scientific research, expert studies, engineering designs and money to support clean air programs.

Clean Air Act Amendments of 1990, Section 112r the Risk Management Plan (RMP) Program: This act requires facilities with large amounts of certain hazardous chemicals to have special emergency planning requirements. These requirements necessitate the facilities to assess their own potential for serious chemical spills, fires, and explosions. Based on these assessments they have to prepare an RMP. In the RMP vital information for workers and communities is included. Such information includes hazard identification, hazard assessments, the design and maintenance of a safe facility, taking the steps necessary to prevent releases and to minimize the consequences if an accidental release occurs. Other sections were added to the CAA for acid rain, the protection of the ozone layer, permits, and existing sections were strengthened to improve air pollution control.

Endangered Species Act of 1973: Congress finds and declares that various species of fish, wildlife, and plants in the United States have been caused to become extinct, or are so depleted in numbers they are in danger of becoming extinct, as a result of economic development and expansion without adequate concern for conservation. Aesthetic, ecological, educational, historical, recreational, and scientific importance come from these species and are a value to our nation and its people. The U.S. will conserve, to a practicable extent, the species that face extinction and will encourage the States through federal assistance to develop and maintain conservation programs. The reason for the Act is to provide a means in which ecosystems with endangered and threatened species will be conserved. It is also declared that all state and local agencies resolve water resource issues in connection with conservation of endangered species. (SOURCE: http://endangered.fws.gov/esa.html)

Description of natural and beneficial functions of floodplains

(SOURCE: http://www.usbr.gov/recman/cmp/cmp-p01.htm)

Floodplain Management Policy: To pursue and encourage appropriate use of floodplains. The main points of the policy are to reduce the loss of life and property and the disruption of societal and economic pursuits caused by flooding or facility operations as well as to restore, sustain, and enhance the natural resources, ecosystems, and other functions of the floodplains. Activities will search for a balance between the, sometimes competing, uses of floodplains in a way that makes the most benefit to society.

Appendix B-Public Participation & Planning Process

A public participation component is necessary, and should be a strong, component to any planning process. Public participation gives citizens the opportunity to voice their opinions and state their interests. The Five County Association of Governments Natural Hazard Mitigation Plan includes a public participation component. The Federal Emergency Management Agency also requires public input during the development of Natural Hazard Mitigation plans.

The Five County Association of Governments Natural Hazard Mitigation Plan incorporates a variety of citizen input representing a cross-section of our area population. To this end the Five County Association of Governments developed a four-tiered public participation process: (1) developing a Regional Natural Hazard Mitigation Planning Team, to act as project steering committee, comprised of knowledgeable individuals from the community; (2) soliciting information from community leaders through a “Natural Hazards Assessment Questionnaire”, (3) conducting stakeholder interviews to target the specialized knowledge of individuals working with populations or areas at risk from natural hazards; and (4) conducting County by County public workshops to identify common concerns and ideas regarding hazard mitigation and to discuss specific goals and actions of the mitigation plan. Within these four tiers, 12 steps are identified and outlined below:

Documentation of the Planning Process

This plan was prepared in the offices of the Five County Association of Governments by appointed staff members Curt Hutchings, Senior Planner and Project Manager, Gary Zabriskie, Associate Planner, and Ed Dickie, GIS Coordinator and was supported by Ryan Pietramali of DES. Other local agencies that aided in the process included city and county GIS departments in the Five County region. Elected officials including tribal leaders, local officials, emergency managers, police and fire staff members, planning departments, and local governmental agencies have all aided in the planning and implementation process. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 and supporting guidance documents developed by FEMA and the Utah Division of Emergency Services and Homeland Security. The planning process included the following steps.

1. Organize Resources
2. Public Officials Outreach
3. Establish Continuity in the Planning Process
4. Data Acquisition
5. Hazard Risk Identification & Analysis
6. County Vulnerability Assessment
7. County Goals Assessment
8. Contact Regional Mitigation Emergency Managers (County & Tribal)
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

Step l: Organize Resources The seven regional Associations of Governments (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah Division of Emergency Services and Homeland Security contracted the seven AOGs as sub-grantees to coordinate, develop, and write the seven multi-regional hazard mitigation plans under he planning guidelines included in the Disaster Mitigation Act of 2000.

The Five County Association of Governments established a regional planning team. The regional planning team, which was made up of individuals shown in Table 72, was the main constituent of the planning process from the initiation of the plan to the development and coordination to the resolution of the plan's adoption. Adjunct to the regional planning team a technical team comprised of representatives from all the various associations of governments was created on a technical level that is identified in Table 73. The Five County Association of Governments Steering Committee Table 74 was utilized to assure and affirm their respective county local inputs.

Table 72: Regional Planning Team

Member	Representing
Wayne Smith	Board of Commissioners-Iron County
Clare Ramsay	Board of Commissioners-Garfield County
Merrill Fisher	Mayor-Enterprise
Les Whitney	LEPC-Beaver County
Nathan Rousseau	LEPC-Garfield County
Charlie Morris	LEPC-Iron County
Dave Owens	LEPC-Kane County
Dean Cox	LEPC-Washington County
Mac Hall	Public Works-Hurricane City
Jim McGuire	Planning-Washington City
Bob Hansen	Fire/EMS-Santa Clara City
Bill Lund	Utah Geographical Survey
Steve Rundquist	Department of Emergency Services & Homeland Security
Keith Parke	Wild Land Fire Planning-FCAOG
Ed Dickie	GIS Coordinator-FCAOG GIS
Gary Zabriskie	Natural Hazard Mitigation Planning-FCAOG
Curt Hutchings	Project Manager-FCAOG

Table 73: Association of Governments Technical Team

Name	Organization
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council
Jeff Adarns	Southeastern Utah Association of Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Table 74: Five County Association of Governments Steering Committee (Current for 2003)

Member	Representing
Commissioner Patrick Yardley	Beaver County Commission
Mayor Eugene H. Mayer	Milford City Corporation
Richard DeArmitt	Beaver County School District
Commissioner Dennis Stowell	Iron County Commission
Mayor Connie Robinson	Town of Paragonah
Alan Adams	Iron County School District
Commissioner Maloy Dodds	Garfield County Commission
Mayor Jean Seiler	Tropic Town Corporation
Bart Palmer	Garfield County School District
Commissioner Ray Spencer	Kane County Commission
Mayor Kim Lawson	Kanab City Corporation
Colene Brinkerhoff	Kane County School District
Commissioner Jim Eardley	Washington County Commission
Mayor Dan McGuire	Rockville Town Corporation
Larry C. Stephenson	Washington County School District
Jill Elliss	Dixie State College (Ex-Officio member)
Mark Barton	Southern Utah University (Ex-Officio Member)

Step 2: **Public Officials Outreach** To ensure the planning process had backing from the elected officials a representative from Five County Association of Governments met with each County Commission and each city mayor to inform them of the need for the plan and how it can better help the communities.

Step 3: **Establish Continuity in the Planning Process** Mitigation planning within Five County Association of Governments was part of a Pre-Disaster Mitigation Planning initiative to meet the requirements of the Disaster Mitigation Act of 2000. To meet this requirement the seven Associations of Government were contracted by the Division of Emergency Services and Homeland Security to assist the 29 counties with completion of a mitigation plan, which meets the requirements of sections 322. The Seven Associations of Government formed an AOG Technical Team to share ideas and ensure the plans were similar and that there was little duplication of effort. Planners from the Five County Association of Governments were involved with this committee. Please refer to Table 73 above.

Step 4: **Data Acquisition** Contact was made with designated personnel in each city and county to assess what data was available on the local level. Agreements were put in place, where needed, to allow the Association of Governments planning staff use of county and city data. Data layers obtained included some or all of the following: local roads, plot maps, county assessor's tax assessment data, hazard data, flood maps, topographic data, aerial photographs, and land development data.

Step 5: **Hazard Risk Identification and Analysis** This step was conducted by gathering data on the hazards that occurred in the planning area. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations, surveys, interviews, and meetings with key informants within the planning area. Mitigation discussions were held during this process. During May and June 2003 the Association of Governments held public

forums in each county, in part to discuss with the local community what hazard events had occurred and which hazards may pose a problem in the future. During these meetings, attendees had the opportunity to review general information on previous hazards and were given the opportunity to comment on them in a more specific manner. These meetings provided a forum for discussion on background information needed by FCAOG planners to gain a better understanding of the geography, geology, recreation, natural resources, and water resources of the Planning Area. These initial contacts with local entities also provided visual illustration of the planning area for planners of the Core Planning Team.

Step 6: **County Vulnerability Assessment** This step was conducted through a review of local base maps, topographical maps, floodplain maps, and other data. A detailed vulnerability analysis was completed with the use of Geographic Information Systems for each county within the Five County Association of Governments. HAZUS MH was used to determine vulnerability to earthquakes, for the hazards such as floods, landslides, and wildfire of loss estimation methodology was developed by the core planning team, with assistance from the Technical Team, to determine vulnerability to hazards. During these meetings attendees had the opportunity to review the specific information on all GIS products and to review areas of vulnerability in association with specific hazards.

Step 7: **Community Goals Assessment** This step was conducted through a review of the governing documents of the planning area, as well as, conversations, interviews, and meetings with key responsible individuals within the planning area. This step identified what goals are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

Step 8: **Contact Regional Mitigation Emergency Managers (County & Tribal)** Beaver, Garfield, Iron, Kane, and Washington Counties along with their respective communities were contacted to ascertain mitigation strategies. These counties and communities have volunteers and individuals with an interest in mitigation and public employees with technical expertise pertinent to mitigation. They include elected officials, county/city planners, county staff, and emergency managers. County emergency managers and their assistants were tasked with completing the Mitigation Strategies Workbook issued by the State Division of Emergency Services and Homeland Security. The Paiute Tribal emergency response council was also assigned to complete the workbook.

Step 9: **Mitigation Strategy Development** Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each County that participated in the County Pre-Disaster Mitigation Planning Grant was asked to evaluate the vulnerability assessment completed by Five County Association of Governments and complete a Mitigation Strategies that are incorporated into the Mitigation Strategies portion of this plan.

Step 10: **Prioritization of Identified Mitigation Strategies** The Disaster Mitigation Act of 2000 requires state, tribal, and local governments show how mitigation actions were evaluated and prioritized. This was completed by the AOGs with assistance from each county and city. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, 386-3, April 2003.

Step 11: **State Review** The Division of Emergency Services and Homeland Security pulled together a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003

and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

Step 12: **Adoption** The plan went through a public adoption process on (date) and was adopted by:

Beaver County

- Beaver City, Town of Minersville, and Milford City.

Garfield County

- Panguitch City, Escalante City, Town of Cannonville, Town of Hatch, Town of Tropic, Town of Henrieville, Town of Boulder, and Town of Antimony.

Iron County

- Cedar City, Parowan City, Town of Paragonah, Town of Brian Head, Town of Kanarraville, and Enoch City.

Kane County

- City of Kanab, Town of Alton, Town of Glendale, Town of Orderville, and Town of Big Water.

Paiute Indian Tribe of Utah

- PITU Tribal Council, Cedar Band, Indian Peaks Band, Shivwits Band

Washington County

- City of St. George, Washington City, Santa Clara City, Town of Springdale, Town of Rockville, Town of New Harmony, Town of Leeds, Hildale City, Hurricane City, Ivins City, Toquerville City, Enterprise City, LaVerkin City, and the Town of Virgin.

A. **Public Involvement**

Public involvement opportunities were available throughout the design and completion of this plan. Such opportunities included: public forums in each county; completion of a hazards assessment questionnaire sent to each county and local government; various meetings with each county LEPC; meetings with each county's Mayors Association or Council of Governments; and other public meetings (refer to information provided below after step 12). Public comments taken from these public meetings were incorporated into the plan. Emergency managers, the Fire Department, Sheriff Department, State and Local Agencies, all community members that could be affected by a hazard within the region, business leaders, educators, non-profit organizations, private organizations, and other interested members were all a part of the planning process.

Information Sources

Many different sources of information were used in the development of this plan (see Appendix F for details).

Plan Methodology

The information in this mitigation plan is based on research from a variety of sources. FCAOG/DES conducted data research and analysis, facilitated steering committee meetings and public workshops, developed the final mitigation plan, and presented the plan for formal adoption with participating jurisdictions. The research methods and various contributions to the plan include:

State and federal guidelines and requirements for mitigation plans:

During the completion of this plan FCAOG examined and followed state and federal guidelines and requirements. These guidelines included FEMA planning standards, National Flood Insurance Program's Community Rating system, FEMA Flood Mitigation Assistance Program and various State reference material. A list of guidelines and requirements is as follows:

- FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12
- Disaster Mitigation Act of 2000
- 44 CRF parts 201 and 206, Interim Final Rule
- FEMA Region VIII "crosswalk"

Previous plans and studies:
FCAOG examined existing mitigation plans from around the country and incorporated numerous plans and studies from within the jurisdictions they serve.

Flood Damage Prevention Study Sevier River Basin Investigation, Utah US Army Corp of Engineers January 1994.
Utah Statewide Fire Risk Assessment Project
Natural Disaster Hazard Analysis, State of Utah Office of Emergency Services 1976
Salt Lake City Mitigation Plan 2002
State of Utah Mitigation Plan 1984, 1985, 1999 and 2001
State of Utah Wildfire Plan 2002
State of Utah Drought Plan
State of Utah Water Plan
Five County Flood Hazard Identification Study, August 2003
Emergency Operations Plans for Beaver, Garfield, Iron, Kane, and Washington Counties.
University of Utah Seismograph Stations History of Utah Earthquakes
National Weather Service "Flood and Flash Flood Deaths in Utah"
Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service Utah Avalanche Center.
Town of Merrimack, New Hampshire Hazard Mitigation Plan 2002
Clackamas County Mitigation Plan 2002
Dunn County North Dakota Multi-Hazard Mitigation Plan 2001

Hazard Specific Research and Vulnerability Analysis Methodology

Geographic Information Systems (GIS) were used as the basic analysis tool to complete the hazard analysis for the Five County Association of Governments Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. Fortunately digital data exist statewide for landslides, quaternary faults, wildfire, dam locations, and epicenter locations. The goal of the vulnerability study is to estimate the number of homes, and infrastructure vulnerable to each hazard and assign a dollar value to this built environment. To this end, census data and natural hazard maps are the basic information used in the analysis. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

Earthquakes

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS-MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters

Integrating public participation during the development of the Five County Association of Governments Natural Hazard Mitigation Plan has ultimately resulted in increased public awareness. Through citizen involvement, the mitigation plan reflects community issues, concerns, and new ideas and perspectives on mitigation opportunities and plan action items. What follows is an accounting of the meetings held during this process.

Detailed Accounting of Meetings

March 4, 2003
The Regional Natural Hazard Mitigation Planning Team met to discuss the basic format of the plan and to identify the hazard categories to be included within the plan. The team determined that hazard categories will include: Earthquake *(liquefaction, ground shaking, slope failure)*; Landslide *(slope failure, rock fall, problem soils, ground subsidence)*; Severe Storm *(avalanche)*; Wild Land Fire; Flooding; Drought; Volcanic Activity; and, Insect Infestation.

May 13, 2003
The Regional Team met to receive an update from Five County staff on what had been accomplished to date. The team was given a first run draft of the plan which included very rough outlines of the things that would be included in the plan. Maps which had been drafted to date were also presented to the group.

The Team expressed concerns over the types of hazards we are addressing in the plan. They were also concerned that the plan was titled “Pre-Disaster Mitigation” because some of the hazard areas which were previously agreed upon had very slim likelihood of ever being a disaster. The Team decided to include the following hazards in the plan: Wildfire; Landslide; Earthquake; Flood; Volcanism; Drought; Problem Soils; Severe Weather; Insect Infestation; and Radon Gas. This change also included a decision not to include mitigation measures for Volcanoes.

Of the hazard areas to be included, Wildfire, Landslide; Earthquake and flood will be addressed on a county level while the other areas will be analyzed on a region-wide level.

Natural Hazards Assessment Questionnaire

February 24, 2003
The “Natural Hazards Assessment Questionnaire” was mailed out to all County Commissions, County Clerks, City and Town Mayors, and Town Clerks. The questionnaire asked the recipient to utilize the best local information available to them to answer questions related to the occurrence and location of natural hazard events in their communities and the

likelihood of future events. A copy of the questionnaire is included in Appendix B. Maps were also included with the questionnaire with a request to identify the location of "Critical Facilities" in the community. A listing of critical facilities was included:

1 Hospital/Clinic
2 Fire Station
3 Sheriff/Police Station
4 School
5 Town Hall/Community Center
6 Airport
7 Bus Station
8 Water Tank
9 Sewer Facility
10 TV/Radio Facilities
11 Other Facilities, writing in the type of "other" facility)

March 24, 2003
Three copies, to accommodate the three bands located in our district, of the "Natural Hazards Assessment Questionnaire" were provided to the Paiute Indian Tribe of Utah (PITU) with a request and maps as given to the other communities.

County Workshops

April 14th through April 22nd, 2003
During this time period, a series of County meetings were held in conjunction with the Five County Association of Governments annual Human Services Public Forum. The purpose of the meetings was to inform the citizenry about the Natural Hazard Mitigation Planning Process, to solicit input regarding natural hazard events, and to gain information on types of mitigation policies and plans that would lessen the future impacts of hazard events. A map for each county was provided and the facilitator noted information received on the maps and flipcharts.

Notice and flyers were sent to County Commissioners, Mayors, County Emergency Managers, the Five County FEMA board, and the Human Services Council. Notice of the meetings was also provided to newspapers in each county.

During these workshops information was gathered on a number of hazard events which had occurred including earthquakes, fires, landslides, problem soils, karst, volcanic cones, insect problems, radon gas, flooding, drought, severe weather. Additionally, information was gathered as possible mitigation activities.

Planning

On March 6, 2003 Five County staff attended a meeting in Richfield with Six County staff and Ryan Pietramali to learn more about the requirements and process of Natural Hazard Mitigation planning. Five County staff left the meeting with a better understanding and several sources of information including two sections of a seven section Hazard Mitigation How-To booklet. Staff also received contact information and an outline of what should be included in the Plan

On March 24, 2003, staff met with Paiute Tribe representative Tara Marlow to ask for her response to a Natural Hazard questionnaire and for help in identifying Tribal Critical

Facilities. She said she will return them to us.

On April 8, 2003 the Five County Area Natural Hazard Mitigation Team met to give staff an opportunity to brief them on the requirements and process of the Natural Hazard Mitigation Plan. In addition, we discussed what hazards to include in the plan and to what degree they should be evaluated. A list of the members of the team is included in the acknowledgements.

During April & May, 2003 staff met with the Beaver, Garfield, Kane and Washington Counties Local Emergency Preparedness Committees (LEPC) to brief them on the requirements and process of the Natural Hazard Mitigation Plan and to ask for their assistance in drafting and reviewing the plan. Each group is agreeable to help with the project.

On June 10, 2003 staff met with the Five County Area Natural Hazard Mitigation Team. At this meeting the Team decided to change focus on the planning effort. The team questioned the overall direction of the plan and had some concerns. Five County staff agreed to have a state representative come to the next meeting of the team to help clear up confusion.

On July 1, 2003 Ryan Pietramali from DESHS addressed the Regional Team to help answer the teams concerns. The team left the meeting with a clearer focus and understanding of the requirements of the plan and of their role in the effort.

On July 17, 2003 staff met with the AOG Technical Team made up of members from each of the seven AOGs in the state. We discussed the flood study that is going forward through the Army Corp of Engineers and DESHS. We were told that a draft is pending and we should have it soon. We discussed the earthquake hazard analysis that is to be prepared by DESHS using “HAZUS” software and were told that the software has some bugs that are being worked out. We also discussed the budget and the possibility of funds being offered to each County EM, from the state, to help draft mitigation projects for the plan.

On July 25, staff met with the Iron County Local Emergency Preparedness Committees (LEPC) Co-chairman to brief him on the requirements and process of the Natural Hazard Mitigation Plan and to ask for their assistance in drafting and reviewing the plan. They are agreeable to help with the project.

On July 28, 2003 staff met with six County staff, the Army Corp of Engineers and state staff to go over a draft of the Flood study. The flood study covers areas of the state that are not mapped (flood areas) by FEMA and gives some possible mitigation measures to consider.

During the month of August, staff met with the LEPCs of all five counties. The main focus of these meetings was to determine the willingness of each group to help staff by drafting Mitigation Projects for their respective counties and communities. Staff stressed that, in order to make the process meaningful, individuals with knowledge about specific hazard areas and City and County representatives should be invited to participate. These meetings went very well in each county. Each LEPC will help to organize the meetings and Five County staff will be on hand to assist.

During the Month of September, staff met with the LEPCs of all five counties. These

meetings were focused on beginning the process of drafting the Mitigation project portion of the plan. At the Beaver County meeting a large portion of the total mitigation projects were identified and drafted. Staff asked the members to contact City officials to get input on projects as no city representation was present. Garfield County LEPC members, at their meeting determined that they would assign each member a specific hazard to investigate and draft projects. Iron County also decided to give assignments similar to Garfield County. At the Kane County meeting more instruction was given and a target in October was scheduled to begin the project development process. Washington County participants decided to send the information out to individual communities and ask for input.

On October 3, 2003 staff met with the Washington County LEPC, and representatives from each community, to collect Mitigation project information that had been generated to date. The participants also met in small groups to prioritize individual community projects.

Public Participation- Mayors' Association, Tribal Council

On April 1 and 2, 2003 staff met with the Washington County Mayors' Association and the Iron County Coordinating Council respectively, to give an update on the Natural Hazard Mitigation process. A first draft of the plan was handed out. The draft was briefly discussed and an explanation of the purpose of the plan, highlighting the possibility of funding to accomplish mitigation projects, was given.

On October 1, 2003 staff met in conjunction with Six County staff, with the Tribal Council of the Paiute Indian Tribe of Utah to give an update on the Natural Hazard Mitigation process, and to discuss the best way to proceed with getting assistance from each Band in developing the Hazard Mitigation Projects for Tribal Lands. Staff was instructed to meet with each Band to get their input and help in drafting the projects. Staff will then bring the product to the Tribal Council for input/approval. Staff also identified the funding that will be more accessible to the Tribe through participation in the Plan. Staff also informed them that they will be asked to adopt the finished plan by resolution when the time comes.

On October 6th staff meet with the Beaver County and Kane County Councils of Governments respectively, and then on October 29th with the Garfield County Mayors Meeting to provide updated information on the Natural Hazard Mitigation Plan. Part of the presentation was to inform the members that the next step in the process is to have representatives from the Counties and each community draft Mitigation strategies to include in the plan. It was mentioned that each county and the Paiute Indian Tribe have all applied for mitigation grant funds to help them to complete the process. Staff also reminded the COGs that when the draft has received preliminary approval from FEMA, we will be asking for each community to adopt the plan.

FEMA Preliminary Approval and Plan Adoption by Towns, Cities and Counties

On January 27th, 2004, Five County Association of Governments staff mailed a final draft version of the Five County Natural Hazard Mitigation Plan to Ryan Pietramali with the State Department of Emergency Services and Homeland Security. Ryan reviewed the Plan one more time and sent it off to FEMA for Preliminary Approval (approval lacking only adoption by local communities and counties). FEMA staff reviewed the document and let State staff know that Five County had received Preliminary Approval.. This approval was relayed to Five County staff via Ryan Pietramali on Monday April 19th, 2004.

Five County staff then set out to encourage all jurisdictions within our region to adopt the Plan by resolution. This was accomplished through a series of steps outlined below:

Staff advertised two Open Houses, one held in the Five County Association of Governments Offices in St. George and the other in our Offices in Cedar City. The advertisement was 14 days in advance of the Open Houses. The purpose of the Open Houses was to invite interested persons to review and comment on the Plan prior to adoption by local communities and counties. The outcomes of the two Open Houses are included as Appendix I.

Five County staff attended meetings of each county's Council of Governments, Coordinating Council, or Mayor's Association and the Paiute Tribe to let the Mayors, County Commissioners and Tribal Leaders know about the preliminary approval and to ask them to take the plan to a public meeting to adopt it by resolution.

Adoption sheets were retrieved from the communities and counties and were added to Appendix J of this Plan.

Mitigation Strategies Development

On September 17th (Beaver County), October 3rd (Washington County), October 8th (Kane County), October 9th (Paiute Tribe), October 16th (Garfield County), October 31st (Iron County) staff meet with county LEPCs to start the process of developing mitigation strategies for the Plan. Each County was reminded that to complete the requirements of the funding they had applied for, they need to develop strategies for the county and its communities, keep minutes of the meetings dealing with the strategies, and provide a listing of those involved in the process. Beaver County decided to complete as much as they could at that meeting and follow up with additional information from each community. Washington County opted to hold a series of meetings with representatives from each community to provide input. Kane County determined to have each member of the committee follow up on specific issues with designated communities. The Paiute Tribe decided to have the Paiute Emergency Response Committee help draft the strategies and them bring the information before each band to get approval. After band approval the information will be presented to the Tribal Council during the approval process. Garfield County opted to have there committee members work with specific communities and Iron County held a series of meetings with city and town representatives to provide input.

Each County held subsequent meetings to get all the needed information and to draft the strategies. The AOG received strategies from each jurisdiction as a result.

Appendix C-Detailed Census Data

Profile of General Demographic Characteristics: 2000

Table DP-1. Profile of General Demographic Characteristics: 2000
Geographic Area: Beaver County, Utah

[For information on confidentiality protection, non sampling error, and definitions, see text

]Subject	Number	Percent
Total population	**6,005**	**100.0**
SEX AND AGE		
Male	3,090	51.5
Female	2,915	48.5
Under 5 years	558	9.3
5 to 9 years	551	9.2
10 to 14 years	557	9.3
15 to 19 years	512	8.5
20 to 24 years	396	6.6
25 to 34 years	690	11.5
35 to 44 years	753	12.5
45 to 54 years	704	11.7
55 to 59 years	257	4.3
60 to 64 years	192	3.2
65 to 74 years	430	7.2
75 to 84 years	304	5.1
85 years and over	101	1.7
Median age (years)	30.8	(X)
18 years and over	3,994	66.5
Male	2,059	34.3
Female	1,935	32.2
21 years and over	3,733	62.2
62 years and over	949	15.8
65 years and over	835	13.9
Male	376	6.3
Female	459	7.6
RACE		
One race	5,899	98.2
White	5,599	93.2
Black or African American	16	0.3
American Indian and Alaska Native	54	0.9
Asian	37	0.6
Asian Indian	1	-
Chinese	11	0.2
Filipino	11	0.2
Japanese	4	0.1
Korean	1	-
Vietnamese	1	-
Other Asian 1	8	0.1
Native Hawaiian and Other Pacific Islander	5	0.1
Native Hawaiian	1	-
Guamanian or Chamorro	-	-
Samoan	1	-
Other Pacific Islander 2	3	-
Some other race	188	3.1
Two or more races	106	1.8
Race alone or in combination with one or more other races:	***3***	
White	5,687	94.7
Black or African American	23	0.4
American Indian and Alaska Native	113	1.9
Asian	59	1.0
Native Hawaiian and Other Pacific Islander	19	0.3
Some other race	226	3.8

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**6,005**	**100.0**
Hispanic or Latino (of any race)	333	5.5
Mexican	277	4.6
Puerto Rican	4	0.1
Cuban	1	-
Other Hispanic or Latino	51	0.8
Not Hispanic or Latino	5,672	94.5
White alone	5,491	91.4
RELATIONSHIP		
Total population	**6,005**	**100.0**
In households	5,803	96.6
Householder	1,982	33.0
Spouse	1,329	22.1
Child	2,200	36.6
Own child under 18 years	1,905	31.7
Other relatives	175	2.9
Under 18 years	85	1.4
Nonrelatives	117	1.9
Unmarried partner	52	0.9
In group quarters	202	3.4
Institutionalized population	202	3.4
Noninstitutionalized population	-	-
HOUSEHOLD BY TYPE		
Total households	**1,982**	**100.0**
Family households (families)	1,531	77.2
With own children under 18 years	819	41.3
Married-couple family	1,329	67.1
With own children under 18 years	686	34.6
Female householder, no husband present	138	7.0
With own children under 18 years	94	4.7
Nonfamily households	451	22.8
Householder living alone	406	20.5
Householder 65 years and over	226	11.4
Households with individuals under 18 years	865	43.6
Households with individuals 65 years and over	565	28.5
Average household size	2.93	(X)
Average family size	3.42	(X)
HOUSING OCCUPANCY		
Total housing units	**2,660**	**100.0**
Occupied housing units	1,982	74.5
Vacant housing units	678	25.5
For seasonal, recreational, or occasional use	399	15.0
Homeowner vacancy rate (percent)	4.8	(X)
Rental vacancy rate (percent)	19.5	(X)
HOUSING TENURE		
Occupied housing units	**1,982**	**100.0**
Owner-occupied housing units	1,566	79.0
Renter-occupied housing units	416	21.0
Average household size of owner-occupied units	2.99	(X)
Average household size of renter-occupied units	2.69	(X)

- Represents zero or rounds to zero. (X) Not applicable.
1 Other Asian alone, or two or more Asian categories.
2 Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
3 In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000.

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Garfield County, Utah

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**4,735**	**100.0**
SEX AND AGE		
Male	2,421	51.1
Female	2,314	48.9
Under 5 years	405	8.6
5 to 9 years	396	8.4
10 to 14 years	418	8.8
15 to 19 years	455	9.6
20 to 24 years	238	5.0
25 to 34 years	505	10.7
35 to 44 years	591	12.5
45 to 54 years	652	13.8
55 to 59 years	195	4.1
60 to 64 years	213	4.5
65 to 74 years	377	8.0
75 to 84 years	222	4.7
85 years and over	68	1.4
Median age (years)	33.8	(X)
18 years and over	3,190	67.4
Male	1,612	34.0
Female	1,578	33.3
21 years and over	3,018	63.7
62 years and over	791	16.7
65 years and over	667	14.1
Male	301	6.4
Female	366	7.7
RACE		
One race	4,665	98.5
White	4,496	95.0
Black or African American	8	0.2
American Indian and Alaska Native	87	1.8
Asian	19	0.4
Asian Indian	7	0.1
Chinese	1	-
Filipino	1	-
Japanese	8	0.2
Korean	1	-
Vietnamese	-	-
Other Asian 1	1	-
Native Hawaiian and Other Pacific Islander	2	-
Native Hawaiian	-	-
Guamanian or Chamorro	-	-
Samoan	1	-
Other Pacific Islander 2	1	-
Some other race	53	1.1
Two or more races	70	1.5
Race alone or in combination with one or more other races:	***3***	
White	4,562	96.3
Black or African American	9	0.2
American Indian and Alaska Native	119	2.5
Asian	35	0.7
Native Hawaiian and Other Pacific Islander	3	0.1
Some other race	85	1.8

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**4,735**	**100.0**
Hispanic or Latino (of any race)	136	2.9
Mexican	96	2.0
Puerto Rican	1	-
Cuban	3	0.1
Other Hispanic or Latino	36	0.8
Not Hispanic or Latino	4,599	97.1
White alone	4,440	93.8
RELATIONSHIP		
Total population	**4,735**	**100.0**
In households	4,607	97.3
Householder	1,576	33.3
Spouse	1,047	22.1
Child	1,711	36.1
Own child under 18 years	1,430	30.2
Other relatives	157	3.3
Under 18 years	91	1.9
Nonrelatives	116	2.4
Unmarried partner	55	1.2
In group quarters	128	2.7
Institutionalized population	121	2.6
Noninstitutionalized population	7	0.1
HOUSEHOLD BY TYPE		
Total households	**1,576**	**100.0**
Family households (families)	1,199	76.1
With own children under 18 years	605	38.4
Married-couple family	1,047	66.4
With own children under 18 years	508	32.2
Female householder, no husband present	107	6.8
With own children under 18 years	67	4.3
Nonfamily households	377	23.9
Householder living alone	323	20.5
Householder 65 years and over	159	10.1
Households with individuals under 18 years	644	40.9
Households with individuals 65 years and over	451	28.6
Average household size	2.92	(X)
Average family size	3.43	(X)
HOUSING OCCUPANCY		
Total housing units	**2,767**	**100.0**
Occupied housing units	1,576	57.0
Vacant housing units	1,191	43.0
For seasonal, recreational, or occasional use	965	34.9
Homeowner vacancy rate (percent)	4.6	(X)
Rental vacancy rate (percent)	8.9	(X)
HOUSING TENURE		
Occupied housing units	**1,576**	**100.0**
Owner-occupied housing units	1,247	79.1
Renter-occupied housing units	329	20.9
Average household size of owner-occupied units	2.91	(X)
Average household size of renter-occupied units	2.99	(X)

- Represents zero or rounds to zero. (X) Not applicable.
1 Other Asian alone, or two or more Asian categories.
2 Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
3 In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000.

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Iron County, Utah

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**33,779**	**100.0**
SEX AND AGE		
Male	16,757	49.6
Female	17,022	50.4
Under 5 years	3,166	9.4
5 to 9 years	2,792	8.3
10 to 14 years	2,773	8.2
15 to 19 years	3,851	11.4
20 to 24 years	4,919	14.6
25 to 34 years	4,219	12.5
35 to 44 years	3,736	11.1
45 to 54 years	3,266	9.7
55 to 59 years	1,199	3.5
60 to 64 years	967	2.9
65 to 74 years	1,634	4.8
75 to 84 years	941	2.8
85 years and over	316	0.9
Median age (years)	24.2	(X)
18 years and over	23,232	68.8
Male	11,231	33.2
Female	12,001	35.5
21 years and over	20,116	59.6
62 years and over	3,464	10.3
65 years and over	2,891	8.6
Male	1,316	3.9
Female	1,575	4.7
RACE		
One race	33,215	98.3
White	31,416	93.0
Black or African American	119	0.4
American Indian and Alaska Native	737	2.2
Asian	251	0.7
Asian Indian	19	0.1
Chinese	34	0.1
Filipino	19	0.1
Japanese	117	0.3
Korean	45	0.1
Vietnamese	1	-
Other Asian 1	16	-
Native Hawaiian and Other Pacific Islander	92	0.3
Native Hawaiian	15	-
Guamanian or Chamorro	6	-
Samoan	16	-
Other Pacific Islander 2	55	0.2
Some other race	600	1.8
Two or more races	564	1.7
Race alone or in combination with one or more other races:	***3***	
White	31,916	94.5
Black or African American	184	0.5
American Indian and Alaska Native	958	2.8
Asian	350	1.0
Native Hawaiian and Other Pacific Islander	139	0.4
Some other race	822	2.4

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**33,779**	**100.0**
Hispanic or Latino (of any race)	1,383	4.1
Mexican	1,005	3.0
Puerto Rican	44	0.1
Cuban	5	-
Other Hispanic or Latino	329	1.0
Not Hispanic or Latino	32,396	95.9
White alone	30,829	91.3
RELATIONSHIP		
Total population	**33,779**	**100.0**
In households	33,086	97.9
Householder	10,627	31.5
Spouse	6,822	20.2
Child	11,839	35.0
Own child under 18 years	9,900	29.3
Other relatives	1,157	3.4
Under 18 years	463	1.4
Nonrelatives	2,641	7.8
Unmarried partner	278	0.8
In group quarters	693	2.1
Institutionalized population	247	0.7
Noninstitutionalized population	446	1.3
HOUSEHOLD BY TYPE		
Total households	**10,627**	**100.0**
Family households (families)	8,073	76.0
With own children under 18 years	4,362	41.0
Married-couple family	6,822	64.2
With own children under 18 years	3,609	34.0
Female householder, no husband present	901	8.5
With own children under 18 years	574	5.4
Nonfamily households	2,554	24.0
Householder living alone	1,693	15.9
Householder 65 years and over	627	5.9
Households with individuals under 18 years	4,615	43.4
Households with individuals 65 years and over	1,973	18.6
Average household size	3.11	(X)
Average family size	3.45	(X)
HOUSING OCCUPANCY		
Total housing units	**13,618**	**100.0**
Occupied housing units	10,627	78.0
Vacant housing units	2,991	22.0
For seasonal, recreational, or occasional use	1,986	14.6
Homeowner vacancy rate (percent)	4.1	(X)
Rental vacancy rate (percent)	7.0	(X)
HOUSING TENURE		
Occupied housing units	**10,627**	**100.0**
Owner-occupied housing units	7,040	66.2
Renter-occupied housing units	3,587	33.8
Average household size of owner-occupied units	3.18	(X)
Average household size of renter-occupied units	2.98	(X)

- Represents zero or rounds to zero. (X) Not applicable.
1 Other Asian alone, or two or more Asian categories.
2 Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
3 In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000.

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Kane County, Utah

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**6,046**	**100.0**
SEX AND AGE		
Male	2,997	49.6
Female	3,049	50.4
Under 5 years	399	6.6
5 to 9 years	457	7.6
10 to 14 years	569	9.4
15 to 19 years	511	8.5
20 to 24 years	252	4.2
25 to 34 years	542	9.0
35 to 44 years	739	12.2
45 to 54 years	894	14.8
55 to 59 years	357	5.9
60 to 64 years	316	5.2
65 to 74 years	564	9.3
75 to 84 years	348	5.8
85 years and over	98	1.6
Median age (years)	39.1	(X)
18 years and over	4,269	70.6
Male	2,070	34.2
Female	2,199	36.4
21 years and over	4,047	66.9
62 years and over	1,183	19.6
65 years and over	1,010	16.7
Male	484	8.0
Female	526	8.7
RACE		
One race	5,961	98.6
White	5,804	96.0
Black or African American	2	-
American Indian and Alaska Native	94	1.6
Asian	13	0.2
Asian Indian	2	-
Chinese	3	-
Filipino	2	-
Japanese	4	0.1
Korean	-	-
Vietnamese	1	-
Other Asian 1	1	-
Native Hawaiian and Other Pacific Islander	3	-
Native Hawaiian	1	-
Guamanian or Chamorro	-	-
Samoan	1	-
Other Pacific Islander 2	1	-
Some other race	45	0.7
Two or more races	85	1.4
Race alone or in combination with one or more other races:	***3***	
White	5,882	97.3
Black or African American	6	0.1
American Indian and Alaska Native	146	2.4
Asian	24	0.4
Native Hawaiian and Other Pacific Islander	11	0.2
Some other race	67	1.1

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**6,046**	**100.0**
Hispanic or Latino (of any race)	140	2.3
Mexican	86	1.4
Puerto Rican	2	-
Cuban	4	0.1
Other Hispanic or Latino	48	0.8
Not Hispanic or Latino	5,906	97.7
White alone	5,724	94.7
RELATIONSHIP		
Total population	**6,046**	**100.0**
In households	5,979	98.9
Householder	2,237	37.0
Spouse	1,446	23.9
Child	1,945	32.2
Own child under 18 years	1,651	27.3
Other relatives	202	3.3
Under 18 years	101	1.7
Nonrelatives	149	2.5
Unmarried partner	71	1.2
In group quarters	67	1.1
Institutionalized population	36	0.6
Noninstitutionalized population	31	0.5
HOUSEHOLD BY TYPE		
Total households	**2,237**	**100.0**
Family households (families)	1,629	72.8
With own children under 18 years	721	32.2
Married-couple family	1,446	64.6
With own children under 18 years	612	27.4
Female householder, no husband present	134	6.0
With own children under 18 years	85	3.8
Nonfamily households	608	27.2
Householder living alone	522	23.3
Householder 65 years and over	228	10.2
Households with individuals under 18 years	776	34.7
Households with individuals 65 years and over	698	31.2
Average household size	2.67	(X)
Average family size	3.21	(X)
HOUSING OCCUPANCY		
Total housing units	**3,767**	**100.0**
Occupied housing units	2,237	59.4
Vacant housing units	1,530	40.6
For seasonal, recreational, or occasional use	1,256	33.3
Homeowner vacancy rate (percent)	4.2	(X)
Rental vacancy rate (percent)	11.8	(X)
HOUSING TENURE		
Occupied housing units	**2,237**	**100.0**
Owner-occupied housing units	1,743	77.9
Renter-occupied housing units	494	22.1
Average household size of owner-occupied units	2.74	(X)
Average household size of renter-occupied units	2.43	(X)

- Represents zero or rounds to zero. (X) Not applicable.
1 Other Asian alone, or two or more Asian categories.
2 Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
3 In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000.

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Washington County, Utah

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**90,354**	**100.0**
SEX AND AGE		
Male	44,561	49.3
Female	45,793	50.7
Under 5 years	8,229	9.1
5 to 9 years	7,413	8.2
10 to 14 years	7,682	8.5
15 to 19 years	8,598	9.5
20 to 24 years	6,755	7.5
25 to 34 years	10,202	11.3
35 to 44 years	10,019	11.1
45 to 54 years	8,632	9.6
55 to 59 years	3,654	4.0
60 to 64 years	3,827	4.2
65 to 74 years	8,255	9.1
75 to 84 years	5,562	6.2
85 years and over	1,526	1.7
Median age (years)	31.0	(X)
18 years and over	62,164	68.8
Male	30,179	33.4
Female	31,985	35.4
21 years and over	56,886	63.0
62 years and over	17,653	19.5
65 years and over	15,343	17.0
Male	7,258	8.0
Female	8,085	8.9
RACE		
One race	88,866	98.4
White	84,543	93.6
Black or African American	186	0.2
American Indian and Alaska Native	1,328	1.5
Asian	405	0.4
Asian Indian	55	0.1
Chinese	64	0.1
Filipino	78	0.1
Japanese	86	0.1
Korean	51	0.1
Vietnamese	27	-
Other Asian 1	44	-
Native Hawaiian and Other Pacific Islander	384	0.4
Native Hawaiian	74	0.1
Guamanian or Chamorro	5	-
Samoan	181	0.2
Other Pacific Islander 2	124	0.1
Some other race	2,020	2.2
Two or more races	1,488	1.6
Race alone or in combination with one or more other races:	***3***	
White	85,882	95.1
Black or African American	375	0.4
American Indian and Alaska Native	1,867	2.1
Asian	683	0.8
Native Hawaiian and Other Pacific Islander	663	0.7
Some other race	2,516	2.8

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**90,354**	**100.0**
Hispanic or Latino (of any race)	4,727	5.2
Mexican	3,299	3.7
Puerto Rican	78	0.1
Cuban	31	-
Other Hispanic or Latino	1,319	1.5
Not Hispanic or Latino	85,627	94.8
White alone	82,293	91.1
RELATIONSHIP		
Total population	**90,354**	**100.0**
In households	88,995	98.5
Householder	29,939	33.1
Spouse	20,230	22.4
Child	31,532	34.9
Own child under 18 years	26,280	29.1
Other relatives	3,588	4.0
Under 18 years	1,423	1.6
Nonrelatives	3,706	4.1
Unmarried partner	747	0.8
In group quarters	1,359	1.5
Institutionalized population	832	0.9
Noninstitutionalized population	527	0.6
HOUSEHOLD BY TYPE		
Total households	**29,939**	**100.0**
Family households (families)	23,429	78.3
With own children under 18 years	11,095	37.1
Married-couple family	20,230	67.6
With own children under 18 years	9,108	30.4
Female householder, no husband present	2,386	8.0
With own children under 18 years	1,546	5.2
Nonfamily households	6,510	21.7
Householder living alone	5,230	17.5
Householder 65 years and over	2,663	8.9
Households with individuals under 18 years	11,831	39.5
Households with individuals 65 years and over	9,769	32.6
Average household size	2.97	(X)
Average family size	3.36	(X)
HOUSING OCCUPANCY		
Total housing units	**36,478**	**100.0**
Occupied housing units	29,939	82.1
Vacant housing units	6,539	17.9
For seasonal, recreational, or occasional use	4,364	12.0
Homeowner vacancy rate (percent)	3.8	(X)
Rental vacancy rate (percent)	7.3	(X)
HOUSING TENURE		
Occupied housing units	**29,939**	**100.0**
Owner-occupied housing units	22,128	73.9
Renter-occupied housing units	7,811	26.1
Average household size of owner-occupied units	2.94	(X)
Average household size of renter-occupied units	3.05	(X)

- Represents zero or rounds to zero. (X) Not applicable.
1 Other Asian alone, or two or more Asian categories.
2 Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
3 In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000.

Appendix D - BCEGS Scores

Communities in the Five County Area Participating in the Building Code Effectiveness Grading Schedule

Community	County	BCEGS Classification	Date
BEAVER	BEAVER	BCEGS: PERS 04 COML 04	2000
BEAVER CO	BEAVER	BCEGS: PERS 03 COML 03	2002
BIG WATER	KANE	BCEGS: PERS 05 COML 05	1998
CEDAR CITY	IRON	BCEGS: PERS 04 COML 99	2000
ENOCH CITY	IRON	BCEGS: PERS 05 COML 05	2002
ENTERPRISE	WASHINGTON	BCEGS: PERS 03 COML 03	2002
GARFIELD CO	GARFIELD	BCEGS: PERS 06 COML 06	1997
HILDALE	WASHINGTON	BCEGS: PERS 99 COML 99	1999
HURRICANE	WASHINGTON	BCEGS: PERS 04 COML 04	2000
IRON CO	IRON	BCEGS: PERS 04 COML 04	2001
IVINS	WASHINGTON	BCEGS: PERS 04 COML 04	2002
KANAB	KANE	BCEGS: PERS 03 COML 03	2002
KANARRAVILLE	IRON	BCEGS: PERS 99 COML 99	1998
KANE CO	KANE	BCEGS: PERS 99 COML 05	2001
LA VERKIN	WASHINGTON	BCEGS: PERS 03 COML 03	2002
SPRINGVILLE	UTAH	BCEGS: PERS 04 COML 04	1999
ST GEORGE	WASHINGTON	BCEGS: PERS 04 COML 04	2000
WASHINGTON	WASHINGTON	BCEGS: PERS 05 COML 05	2002
WASHINGTON CO	WASHINGTON	BCEGS: PERS 03 COML 03	2000

Appendix E - NFIP Data

Communities in the Five County Area Participating in the National Flood Program

CID	Community Name	County	Date of Entry(Emer or Reg)	Current Effective Map
490243	Alton, town of	Kane County	(NSFHA)	07/10/85(R)
490001#	Beaver County*	Beaver County*	09/18/87(R)	09/18/87
490074#	Cedar City, city of	Iron County	10/16/84(R)	10/16/84
490067#	Escalante, town of	Garfield County	08/28/79(R)	08/28/79(m)
490065#	Garfield County *	Garfield County	08/05/86(R)	08/05/86(M)
490084A	Glendale, town of	Kane County	05/01/86(R)	05/01/86(L)
490068#	Hatch, town of	Garfield County	07/24/79(R)	07/24/79(M)
490069#	Henrieville, town of	Garfield County	09/25/79(R)	09/28/79(M)
490172	Hurricane, city of	Washington County	02/02/84(R)	(NSFHA)
490073#	Iron County *	Iron County	07/17/86(R)	07/17/86(M)
490173	Ivins, town of	Washington County	08/23/82(R)	(NSFHA)
490085#	Kanab, city of	Kane County	08/19/85(R)	08/19/85(M)
490077	Kanarraville, city of	Iron County	12/11/85(R)	(NSFHA)
490083#	Kane County *	Kane County	07/01/86(R)	07/01/86(L)
490174	LaVerkin, city of	Washington County	02/02/84(R)	(NSFHA)
490175	Leeds, town of	Washington County	(NSFHA)	02/02/84(R)
490003	Milford, city of	Beaver County	(NSFHA)	02/02/84(R)
490086	Orderville, town of	Kane County	(NSFHA)	02/02/84(R)
490070#	Panguitch, city of	Garfield County	08/28/79(M)	08/28/79(R)
490075#	Paragonah, town of	Iron County	09/24/84	09/24/84(R)
490076#	Parowan, city of	Iron County	03/18/86(M)	03/18/86(R)
490178#	Santa clara, city of	Washington County	12/06/99	08/05/86(R)
490180#	Toquerville, city of	Washington County	02/19/86(M)	02/19/86(R)
490071#	Tropic, town of	Garfield County	12/04179(M)	12/04/79(R)
490181A	Virgin, town of	Washington County	08/05/86(M)	08/05/86(R)
490224#	Washington County *	Washington County	03/18/86(M)	03/18/86(R)
490182#	Washington, city of	Washington County	09/30/93	07/01/87(R)

(R) - Indicates Entry In Regular Program
NSFHA - No Special Flood Hazard Area - All Zone C
> - Date Of Current Effective Map is after the Date Of This Report
* - Unincorporated Areas Only
Areas which have had special flood hazard areas identified --Not In The Program--

CID	community name	hazard area county	Identified	Date On Which Sanctions Apply
490066	antimony, town of	Garfield County	04/02/76	04/02/77
490002A	beaver, city of	Beaver County	04/01/77(F)	06/11/75
490171	hildale, town of	Washington County	06/04/76	06/04/77
490179#	springdale, town of	Washington County	05/10/77	05/10/78

N/A - Not Applicable At This Time
(S) - Suspended Community
(W) - Withdrawn Community
(F) - Effective Map Is A Flood Insurance Rate Map
* - Unincorporated Areas Only

Appendix F - Information Sources

Sources:

Map sources:

Regional Severe Weather – State of Utah Department of Emergency Services and Homeland Security

Regional Radon Gas – Utah Safety Council

Regional Insect Infestation – State of Utah Department of Emergency Services and Homeland Security

Regional Problem Soils – State of Utah Department of Emergency Services and Homeland Security

Regional Drought – State of Utah Department of Emergency Services and Homeland Security

Regional Earthquake – State of Utah Department of Emergency Services and Homeland Security

County Wildfire – Utah Division of Forestry, Fire and State Lands, Southwest Region

County Landslide – State of Utah Department of Emergency Services and Homeland Security

County Flood zone – FEMA, Digitized 100 year Flood zone maps.

Paiute Indian Tribe of Utah – FEMA, 100 year Flood zone maps. State of Utah Department of Emergency Services and Homeland Security. Utah Safety Council

Profile and History Sources:

Drought – U.S. Geological Survey Water-Supply Paper 2375, 591 p.

Landslides – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor.

Problem Soils – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor.

Floods – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor.

U.S. Geological Survey Water-Supply Paper 2375, 591 p.

Wildfire – State of Utah, Utah Division of Forestry, Fire and State Lands, Southwest Region

Insect Infestation – Utah Department of Agriculture and Food, 2002 Insect Report.

Radon Gas – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor. Utah Safety Council. Utah Safety Council

Severe Weather – NOAA

Earthquake – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor.

Volcanism – Engineering & Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21 – 1992 Field Symposium – Kim M. Harty, Editor.

Appendix G-List of Acronyms

Local and Regional

FCAOG	Five County Association of Governments
FCAOGGIS	Five County Association of Governments, Geographic Information System

State

DESHS	Department of Emergency Services & Homeland Security
PITU	Paiute Indian Tribe of Utah
SHMO	State Hazard Mitigation Officer

Federal

AASHTO	American Association of State Highway and Transportation Officials
ATC	Applied Technology Council
b/ca	benefit/cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CRS	Community Rating System
CVO	Cascade Volcano Observatory (USGS)
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United States, Department of Housing & Urban Development
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard Mitigation Team
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program

NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as “409 Plan”)
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
SBA	Small Business Administration
SEAO	Structural Engineers Association of Oregon
TDR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

Appendix H Federal funding Sources

The following grant sources may provide assistance to local governments or other eligible applicants for mitigation projects or planning.

- Hazard Mitigation Grant Program (HMGP)
  - Lead Agency: DES
  - Funding: Varies by disaster
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Natural Hazard Mitigation
  - Reference: www.fema.gov
- Pre-Disaster Mitigation Competitive (PDM-C) Grant Program
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Natural Hazard Mitigation, Planning
  - Reference: www.fema.gov
- Flood Mitigation Assistance (FMA) Program
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Sector (same as for Public Assistance)
  - Project Type: Flood Mitigation, Planning
  - Reference: www.fema.gov
- Disaster Resistant Universities (DRU) Program
  - Lead Agency: DES
  - Funding: Annual
  - Funding Formula: 75% federal: 25% non-federal
  - Funding Source: FEMA
  - Applicants: Public Post-Secondary Educational Institutions
  - Project Type: Natural Hazard Mitigation, Planning
  - Reference: www.fema.gov
- Small Business Administration (SBA) Pre-Disaster Mitigation Loans
  - Lead Agency: SBA
  - Funding: 5-year renewable
  - Funding Formula: Low interest loans (4% or less)
  - Funding Source: SBA
  - Applicants: Small Businesses
  - Project Type: General Natural Hazard Mitigation
  - Reference: Federal Register, Vol. 67, No. 194, pp 62335-62339
- State Fire Assistance – Wildland/Urban Interface (SFA-WUI)
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 50% federal : 50% non-federal
  - Funding Source: Combined Federal Agencies
  - Applicants: Public Sector

- Project Type: Wildland fire preparedness, prevention, and fuel reduction
- Reference: www.ffsl.utah.gov/communityfirepln.htm
- Contact davedalrymple@utah.gov

- Rural Fire Assistance (RFA)
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 90% federal : 10% non-federal
  - Funding Source: Department of the Interior
  - Applicants: Fire Departments
  - Project Type: Wildland fire education, training, equipment
  - Reference: www.ffsl.utah.gov/ufragrant.htm
  - Contact tracydunford@utah.gov
- Volunteer Fire Assistance (VFA)
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 90% federal : 10% non-federal
  - Funding Source: USFS
  - Applicants: Volunteer Fire Departments
  - Project Type: Organization, training, prevention, equipment
  - Reference: www.ffsl.utah.gov/ufragrant.htm
- Rural Community Assistance Economic Action Program (RCA EAP)
  - Lead Agency: FFSL
  - Funding: Annual
  - Funding Formula: 80% federal : 20% non-federal
  - Funding Source: USFS
  - Applicants: Public sector
  - Project Type: Utilization of forest products
  - Contact daveschen@utah.gov
- Forestland Enhancement Program (FLEP)
  - Lead Agency: FFSL
  - Funding: $100 Million over 5 years nationwide
  - Funding Formula: 75% federal : 25% non-federal
  - Funding Source: USFS
  - Applicants: Non-industrial private forest owners
  - Project Type: Forest ecosystem health (including fuel reduction)
  - Contact rongropp@utah.gov

Appendix I Open Houses

Appendix J Resolutions

RESOLUTION NO. _____

A RESOLUTION ADOPTING THE FIVE COUNTY ASSOCIATION OF GOVERNMENTS NATURAL HAZARD MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

WHEREAS, th President signed H.R. 707, the *Disaster Mitigation and Cost Reduction Act of 2000*, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Five County Association of Governments (FCAOG) has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the FCAOGArea, and

WHEREAS, the FCAOG Executive Council approved FCAOG Staff to write the plan, and

WHEREAS, ** is within the FCAOG Area, and

WHEREAS, the ** Council is concerned about mitigating potential losses from natural disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential loses and potential mitigation measures to limit loses, and

WHEREAS, the ** Council has determined that it would be in the best interest of the community as a whole to adopt the Pre-Disaster Hazard Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY THE ** COUNCIL THAT:

The attached “Five County Association of Governments Natural Hazard Mitigation Plan” be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This Resolution shall be effective on the date it is adopted.

DATED this _____ day of _____, 2004.

_____
**, Mayor
**

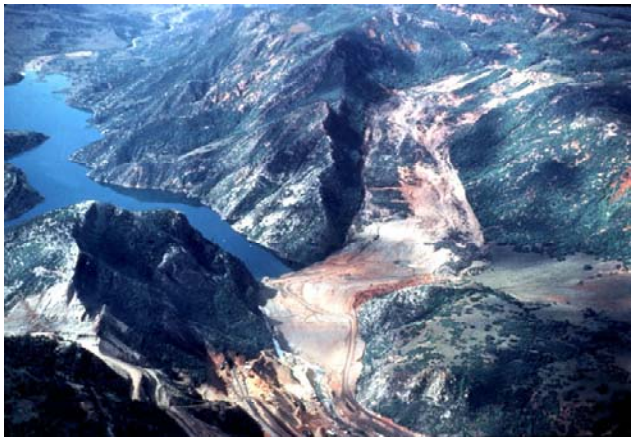
ATTEST:

_____
**, Recorded

Mountainland Association of Governments

Pre-Disaster Hazard Mitigation Plan

2004



Prepared by Mountainland Association of Governments

Executive Summary

Purpose

To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is an aid in enhancing city and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability and risk of each Utah jurisdiction.

Scope

Utah PDM Planning phase is statewide. The State of Utah will work with all local jurisdictions by means of the seven regional Association of Governments. The Mountainland Association of Governments area, which covers the counties of Summit, Utah and Wasatch, will have a plan completed by November 1, 2004 to give to the Utah Division of Emergency Services. Future monitoring, evaluating, updating and implementing will take place as new incidents occur and or every three to five years and will be included in the local mitigation plans as well. Natural hazards addressed are: Flooding; Wildland Fire; Landslide/Problem Soils; Earthquake; Drought; Severe Weather/Avalanche; and Infestation.

The Counties, Cities and Towns of the three-county Mountainland area are:

Summit County

Coalville, Francis, Henefer, Kamas, Oakley, and Park City.

Utah County

Alpine, American Fork, Cedar Fort, Cedar Hills, Eagle Mountain, Elk Ridge, Genola, Goshen, Highland, Lehi, Lindon, Mapelton, Orem, Payson, Pleasant Grove, Provo, Salem, Santaquin, Saratoga Springs, Spanish Fork, Springville, Vineyard, and Woodland Hills.

Wasatch County

Charleston, Heber, Midway, and Wallsburg.

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Part I
Introduction
General Regional Data

Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be lessened when attention is turned to mitigating their impacts and effects before they occur or re-occur.

What is Hazard Mitigation

Hazard mitigation is defined as any cost-effective action(s) that have the effect of reducing, limiting, or preventing vulnerability of people, property, and the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation measures, which can be used to eliminate or minimize the risk to life and property, fall into three categories. First; those that keep the hazard away from people, property, and structures. Second; those that keep people, property, and structures away from the hazard. Third; those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance or grants. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation measures must be practical, cost effective, and environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

The primary focus of hazard mitigation actions must be at the point at which capital investment decisions are made and based on vulnerability. Capital investments, whether for homes, roads public utilities, pipelines, power plants, chemical plants or warehouses, or public works, determine to a large extent the nature and degree of hazard vulnerability of a community. Once a capital facility is in place, very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which insure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

Previously, mitigation measures have been the most neglected programs within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures take time to implement. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to eliminating long-term risk to people and property living in Utah from hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

The State Division of Emergency Services and Homeland Security (DESHS) have identified the following hazards to be analyzed by each county. These hazards include avalanche, dam failure, debris flow, drought, earthquake, flood, flash flooding, infestation, landslide, problem soils, summer storm, tornado, urban and rural fires, and winter storm.

This regional/multi-jurisdictional plan evaluates the impacts, risks and vulnerabilities of natural hazards in a jurisdictional area affected by a disaster. The plan supports, provides assistance, identifies and describes mitigation projects for each annex. The suggestive actions and plan implementation for local and tribal governments could reduce the impact of future disasters. Only through the coordinated

partnership with emergency managers, political entities, public works officials, community planners and other dedicated individuals working to implement this program was it accomplished.

To develop the mitigation plan, The Utah DESHS, based on the Governor's Office of Planning and Budget, the Utah League of Cities and Towns, and the U.S. Department of Housing and Urban Development, chose to use the planning services of the Utah Association of Governments.

Seven regional Associations of Government:

Bear River Associations of Government
Wasatch Front Associations of Government / Wasatch Front Regional Council
Mountainland Associations of Government
Six County Associations of Government
Southeast Utah Associations of Government
Southwestern / Five County Associations of Government
Uintah Basin Associations of Government

Purpose
{tc "Purpose " \l 5}

To fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is an aid in enhancing city and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability and risk of each Utah jurisdiction.

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Utah County {tc "Utah County " \l 5}

Alpine, American Fork, Cedar Fort, Cedar Hills, Eagle Mountain, Elk Ridge, Genola, Goshen, Highland, Lehi, Lindon, Mapelton, Orem, Payson, Pleasant Grove, Provo, Salem, Santaquin, Saratoga Springs, Spanish Fork, Springville, Vineyard, and Woodland Hills.

Wasatch County {tc "Wasatch County " \l 5}

Charleston, Heber, Midway, and Wallsburg.

Authority

Federal: Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards risks and vulnerabilities in that plan.

State: The Governor's Emergency Operation Directive, The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title 44, CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code 53-2, 63-5, Disaster Response Recovery Act, 63-5A, Executive Order of the Governor, Executive Order 11, Emergency Interim Succession Act, 63-5B.

Local: Local governments play an essential role in implementing effective mitigation, both before and after disaster events. Each local government will review all damages, losses and related impacts to determine the need or requirement for mitigation action and planning whenever seriously effected by a disaster, or when applying for state or federal recovery assistance. In the counties and cities making up the MAG Region, the local executive responsible for carrying out plans and policies are the County Commissioners/Council Members and City Mayors. Local Governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

Association of Governments: The Association of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

Introduction to Region

Geography

The area's geography is quite varied with desert to the far west and high mountains in the east. The bulk of the population is found in the fertile valleys lying between mountains. Agricultural land supports mainly fruit orchards, some cattle and sheep ranches, grain farms, dairies, hogs, chickens and smaller individual farms. Pine clad slopes and oak brush foothills characterize much of the undeveloped mountain landscape that exists in the area. Development encroachment of hillsides is of real concern to environmentalists, planners, wildlife managers and fire marshals. Only a small percentage of the area's unincorporated land has been developed; however, a widespread feeling exists among planners, community leaders, and many residents that the preservation of open space within urban settings is very crucial to quality of life and community well being.

Population

The Mountainland area is comprised of three counties located in north central Utah having a combined population of 413,487 residents. Utah County, with 89% of the district's population (368,536), supports the bulk of the area's business activity which is largely driven by commerce and trade in the Lehi-Orem-Provo-Springville urban area. Just to the northeast of Utah County lies Wasatch County with a 2000 population of 15,215 persons. Heber City (pop. 7,291) is the prominent jurisdiction in the county from a size and business activity standpoint, partially because it is the county seat and lies at the crossroads of Wasatch County's two major highways, 40 and 189. To the north of Wasatch County lies Summit County with a 2000 population of 29,736 persons. Summit County is home to world famous Park City (pop. 7,371) and its ski resorts but also includes a number of smaller rural communities and pockets of unincorporated homes, cabins, farms and working ranches. Over half (58%) of the population in Summit County lives in the unincorporated area. A map of the area appears on the following page.

According to the 2000 Census, the Mountainland area encompasses 5,050 square miles of geography but, as discussed earlier, the population is mostly confined to incorporated areas.

Population Distribution in the Mountainland Region

	% Urban	%Rural	%Farm
Summit County	28.8	71.2	2.8
Wasatch County	47.4	52.6	1.8
Utah County	92.9	7.1	0.6
Mountainland Region	87.8	12.1	0.7

Source: *2001 Utah Agricultural Statistics*, Utah Department of Agriculture and Food Annual Report, State of Utah, 2001, p. 31. (2000 Census information will be available in the late fall of 2002.)

The resident population of the Mountainland Area has increased steadily since the last census was taken. The region, in 2000, showed an overall population of 413,487 residents, nearly 90% of which live within the boundaries of Utah County. With an annual growth rate of over 2.5% projected through the year 2020 for the region, the area ranks high in population growth compared to almost anywhere else in the United States. An interesting statistic generated by the State of Utah suggests that annual employment growth for the region hovers right at 3% for the same time period, suggesting a possible decrease in the already low unemployment rate, or a significant increase of in-migrating workers to fill the jobs becoming available. A third scenario could be a change in the mix of those in the workforce to include a number from the ranks of those not currently seeking employment, like the elderly, or possibly spouses not now working. Chances are good that the actual reason for the change will be a combination of all three possibilities.

Population by Race and Hispanic Origin
Mountainland Counties, 2000 (most recent available)

	White	Black	Amer. Indian Aleut, Eskimo	Asian or Pac. Isle	Hispanic	% Minority Pop
Summit	27,299	72	91	298	2,406	10.5
Utah	340,388	1,096	2,206	6,039	25,791	10.3
Wasatch	14,549	33	65	60	775	6.4
Region	382,236	1,201	2,362	6,397	28,972	10.2

Source: US Census Bureau, Census 2000

Mountainland Region Population
By County and Multi-County District
1980-2030

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
Mountainland	236,827	289,197	413,487	482,023	567,921	650,065	701,258	792,953	2.19%
Summit County	10,198	15,518	29,736	35,162	41,988	49,462	56,001	68,474	2.82%
Utah County	218,106	263,590	368,536	428,156	503,039	573,608	615,480	689,586	2.11%
Wasatch County	8,523	10,089	15,215	18,705	22,894	26,995	29,777	34,893	2.81%

Sources: http://www.governor.state.ut.us/projections/EDPT3.pdf;
U.S. Bureau of the Census; Utah Population Estimates Committee;
2002 Baseline Projections, Governor's Office of Planning and Budget, UPED Model System.
Notes: AARC is average annual rate of change. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations.

Economy

The economy of the area could be characterized as moderate in some sectors, but with several real concerns and challenges to be addressed. The first is the fact that the region has a very low per capita income level. Large families and low pay scales make for a somewhat unique situation which forces skilled labor out of the area, or in many cases, a second wage earner (usually the spouse) takes a low paying, low skill job to help make ends meet. There is a sense that underemployment is a related problem, although trying to measure underemployment is difficult and the usual data providers do not disseminate the numbers if they are tracked. The sense of home and community is strong in Utah and many seem willing to find alternate, less fulfilling employment rather than moving out of state for better positions.

Another challenge to the economy is the uneven distribution of businesses within the district. Utah County mostly drives the region's labor statistics, especially within the Provo-Orem geographical area; however, other parts of the district don't share much in this business boom. Smaller outlying communities in Summit and Wasatch County, and even southern Utah County, may be struggling to find new business growth and don't share in the prosperity of the sales activity and tax distribution of their neighbors. In other words, the district may experience a 4.9% unemployment rate, but a small rural town might struggle with a 10% or higher rate, taking little comfort in knowing the region is doing so well! With 57% of all labor force non-agricultural jobs showing up in the service and retail trade sectors, there is plenty of cause for concern in the future when the demand for such services could wane because personal spending is curtailed. The regional economy has moved forward in many important ways since district designation twenty-two years ago, but further diversification and balance in the types of jobs available within the region would certainly better stabilize the economy to some extent so that in a downturn, large layoffs and reductions in lower paying jobs would not affect so many workers.

The University of Utah's Bureau of Economic and Business Research publishes a report summarizing the economies of each of Utah's twenty-nine (29) counties. Excerpts of that study are shown in each county's section of the Plan to direct some focus on the economic growth that each Mountainland county has experienced in recent years. It shows a fairly substantial rise in income and sales in each case although there may be some signs of slowing, especially in Utah County, where new residential construction seems to be tapering off compared to preceding years. Some slowing of the region economy is likely to occur during the following decade, especially with the events of 9/11, the tech stock bust, corporate corruption and war with Iraq.

Part II
Plan Pre-Requisites

Prerequisite–Resolution by each Jurisdiction

The following table denotes the plan adoption status for all jurisdictions within the MAG Region. Following the table is an example of the adoption resolution. The Appendix contains copies of all adopted resolutions.

MOUNTAINLAND AOG
STATUS OF INDIVIDUAL COMMUNITY
PRE-DISASTER HAZARD MITIGATION ADOPTION RESOLUTION

Community	No Action	In Process	Completed / Not yet adopted	Completed and adopted
Alpine				
American Fork				
Cedar Fort				
Cedar Hills				
Charleston				
Coalville				
Eagle Mountain				
Elk Ridge				
Francis				
Genola				
Goshen				
Heber				
Henefer				
Highland				
Kamas				
Lehi				
Lindon				
Mapleton				
Midway				
Oakley				
Orem				
Park City				
Payson				
Pleasant Grove				
Provo				
Salem				
Santaquin				
Saratoga Springs				
Spanish Fork				
Springville				
Summit County				
Utah County				
Vineyard				
Wallsburg				
Wasatch County				
Woodland Hills				

RESOLUTION NO. _____

A RESOLUTION ADOPTING THE MOUNTAINLAND ASSOCIATION OF GOVERNMENTS PRE-DISASTER HAZARD MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

WHEREAS, President William J. Clinton signed H.R. 707, the *Disaster Mitigation and Cost Reduction Act of 2000*, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Mountainland Association of Governments (MAG) has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the MAG Area, and

WHEREAS, the MAG Executive Council approved MAG Staff to write the plan on February 21st 2002, and

WHEREAS, _____City is within the MAG Area, and

WHEREAS, the _____ City Council is concerned about mitigating potential losses from natural disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential loses and potential mitigation measures to limit loses, and

WHEREAS, the _____ City Council has determined that it would be in the best interest of the community as a whole to adopt the Pre-Disaster Hazard Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY THE _____ CITY COUNCIL THAT:

The attached "Mountainland Association of Governments Pre-Disaster Mitigation Plan" be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This Resolution shall be effective on the date it is adopted.

DATED this _____ day of _____, 2004.

Part III
Planning Process

Part III Planning Process

The Pre-Disaster Mitigation Plan process was presented to the MAG Executive Council (with elected officials for every jurisdiction) in early 2002. The Executive Council unanimously approved the process, which designated MAG staff (Andrew K. Jackson, Andrew Wooley, Jill Stark) to prepare a multi-jurisdictional plan for adoption by each community. A written invitation was sent to the Mayor of every community requesting participation in the planning process.

An Ad-Hoc Disaster Mitigation Plan Steering Committee was created to determine which hazard were applicable, to provide historical background, develop mitigation strategies and to review the draft plan. Letters were sent out to the mayors of each community requesting that they have someone attend the meetings. Committee Meetings were held on the fourth Thursdays of each month starting in early 2003 until the plan was completed. Approximately twenty of the thirty-six jurisdictions were represented at meetings. Nearly 70% of the total population of the area was represented at at least one meeting. Agendas of Ad-Hoc Committee Meetings are located in the appendix.

Table 3.1 Ad-Hoc Disaster Mitigation Plan Steering Committee

Name	Organization
Andrew K. Jackson, AICP	Mountainland Association of Governments
Andrew J. Wooley	Mountainland Association of Governments
Bonnie Lewis	Mountainland Association of Governments
Jill Stark	Federal Highway Administration
Alan Wakefield	Woodland Hills City Emergency Services
Craig Searle	Utah County Public Works
Dave Bennett	Utah County Sheriff's Office
Don Peterson	Lindon City Public Works
Don Thomas	Spanish Fork City Public Works
Howard Denny	American Fork City Engineering/Public Works
Jim Hewitson	Lehi City Public Works
Kevin Callahan	Summit County Public Works
Lloyd Evans	Park City Emergency Services
Matt Schmidlein	Provo City Project Impact
Rae Prescott	Francis City Council
Robert DeKorver	Eagle Mountain Emergency Services
Scott Kettle	Kamas and Francis Cities' Engineer
Seth Perrins	Orem City Emergency Planning
Stewart Lamb	Wasatch County Planning Department
Tricia Porter	Provo City Emergency Planning

Table 3.2 Ad-Hoc Disaster Mitigation Plan Steering Committee by Jurisdiction

Jurisdiction	Representative
Alpine	Written Comment
American Fork	Howard Denny
Cedar Fort	Utah County Sheriff
Cedar Hills	Written Comment
Charleston	Wasatch County
Coalville	Summit County
Eagle Mountain	Robert DeKorver
Elk Ridge	Utah County
Francis	Rae Prescott
Genola	Utah County Sheriff
Goshen	Utah County Sheriff
Heber	Written Comment
Henefer	Summit County
Highland	Written Comment
Kamas	Scott Kettle
Lehi	Jim Hewitson
Lindon	Don Peterson
Mapleton	Written Comment
Midway	Written Comment
Oakley	Summit County
Orem	Seth Perrins
Park City	Lloyd Evans
Payson	Written Comment
Pleasant Grove	Written Comment
Provo	Tricia Porter
Salem	Written Comment
Santaquin	Mountainland Association of Governments
Saratoga Springs	Written Comment
Spanish Fork	Don Thomas
Springville	Written Comment
Summit County	Kevin Callahan
Utah County	Craig Searle, Dave Bennett
Vineyard	Orem City
Wallsburg	Wasatch County
Wasatch County	Stewart Lamb
Woodland Hills	Alan Wakefield

Notice given to smaller communities–Some smaller communities did not have staff available to attend the ad-hoc meetings. These communities were given opportunities to participate by reviewing minutes and the draft plan on the web and making comments either in writing, e-mail or over the phone. These communities are listed in the table above as being represented by written comment. Other small communities contract with either the Sheriff's Office or other larger communities for Emergency Services. Since these communities would not be responding to events themselves, they were represented by the agency that actually knows the hazard needs of the community the best. These communities are listed above as being represented by another agency or jurisdiction.

Web Site–Information on the plan and the planning process was also available on MAG's web site. Interested parties could e-mail comments on the draft plan from the web site.

A concerned citizen identifies the location of her home as she reviews Dam Failure Map at Open House.

Open Houses–An Open House was held on October 22, 2003, in conjunction with a Transportation Open House. Over 250 people attended the Open House. There were also Public Hearings held in each of the counties covered by the plan.

Identifying Hazards–Mountainland Association of Governments identified several hazards that are addressed in the Hazard Mitigation Plan. The hazards were identified through a process that included input from the Plan Steering Committee, public input, researching past disasters and Geographic Information System (GIS) data.

A Pre-Disaster Mitigation Workbook was completed for Summit, Utah and Wasatch Counties by each counties' emergency manager. This workbook covers hazard identification and mitigation for communities within the county.

The State Division of Emergency Services has a list of all declared disasters in the state (1983, 1984, 1996, and 1999). The list was reviewed by the Plan Steering Committee and then modified to more closely reflect the experiences of Steering Committee members. Mountainland AOG also has a very sophisticated GIS that was used to overlay current development with hazard data. This data was used to identify which hazards had the greatest risk within the MAG area. These hazards were then presented in greater detail in the following county portions of this plan.

Part IV
Risk Assessment

Part IV Risk Assessment

Hazard Identification and Definitions

Identifying Hazards–Mountainland Association of Governments identified several hazards that are addressed in the Hazard Mitigation Plan. The hazards were identified through an extensive process that included input from the Plan Steering Committee, public input, researching past disasters and Geographic Information System (GIS) data.

The following table 4.1 identifies the hazards

Hazard	How Identified	Why Identified
Flood	• Review of Past Disasters • Review of FIRMs • Analysis of NSFHA by Army Corps of Engineers • Steering Committee Input • State database • GIS • Public Input	• Most Frequent Hazard • Historically Highest Cost • Readily available data • Successful Mitigation
Wildland Fire	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• Ever-present Danger • Current Development Patterns Increase likelihood • Historic Data • Potential Loss of Life • 90% Human Caused
Landslide/Problem Soils	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• Ever-present Danger • Current Development Patterns Increase likelihood • Historic Data • Recent Losses
Earthquake	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• High Potential • Public Awareness • Need for Preparation • Possible High Cost • Potential Increases with Time
Drought	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• High Potential • Public Awareness • Historic Data • Recent Losses
Severe Weather/Avalanche	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• High Frequency • Public Awareness • Successful Mitigation • Historic Data • Recent Losses

Infestation	• Review of Past Disasters • Steering Committee Input • State database • GIS • Public Input	• Historic Data • Public Awareness • Recent Events with crickets and West Nile Virus

Profiling Hazard Events

To provide more specific detailed information, the plan has been broken down into separate sections by county. These separate sections deal with *Profiling Hazard Events*, and *Assessing Vulnerability* in greater detail.

Hazard specific research and Vulnerability Methodology

MAG collected data and compiled research on nine hazards: dam failure, earthquake, flooding, slope failure, and wildfire. Research materials came from a variety of agencies including DES, AGRC, USGS, USACE, UGS, UFFSL, county GIS, city GIS, County Assessors, and County Emergency Managers. Historical data used to define historic disasters was researched through local newspapers, interviewing residents, local knowledge derived through committee meetings, historic state publications, Utah Museum of Natural History, and recent and historic scientific documents and studies.

Vulnerability Methodology

Geographic Information Systems (GIS) were used as the basic analysis tool to complete the hazard analysis for this plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. The Utah County recorders office provided a parcel shapefile with all pertinent assessment information. Fortunately digital data exist statewide for landslides, quaternary faults, wildfire, dam locations, and epicenter locations. County level data is available for Jordanelle and Deer Creek dam failure impact. The goal of the vulnerability study is to estimate the number of homes, and infrastructure vulnerable to each hazard and assign a dollar value to this built environment. To this end, census data and natural hazard maps are the basic information used in the analysis. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

Earthquakes

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS-MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS-MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.
Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS-MH Earthquake Model, possibly *at best* a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS-MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

Landslides and Wildfire

The methodology used to determined vulnerability for landslides and wildfire within the study area was almost identical. Demographic information from census 2000 was manipulated to obtain vulnerability numbers. The methodology used, assumes and even distribution of built housing across the county and each city within the county. Assuming even distribution a housing density was determined by dividing the total number of homes (census 2000) by the total number of acres.

From this point the number of acres of extreme, high, and moderate wildfire along with acres of historically active landslides was determined for each city and the unincorporated county and then analysis was done to find affected households, employment and utility infrastructure.

Transportation and utilities information was determined using the Geoprocessing Wizard an extension in ArcView 3.2. This extension allows the GIS user to clip one theme based on another. For example the roads theme was clipped by the landslide theme, resulting in a new shape file containing all of the roads within a historically active landslide area. The new database was then queried through several simple equations to determine the length in miles of each linear feature (pipelines, electric lines, and roads). Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These costs include:

Table 4.2 Costs

Item	Cost per Mile
Local Roads	2,000,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to the linear features point data such as critical facilities, dams, care facilities, schools, power generation facilities, and substations were analyzed to determine if the feature was within a hazard area. Where point data was determined to be within a hazard area the following values from HAZUS MH were assigned:

Table 4.3 Additional Costs

Item	Cost per Mile
Small Power Plant	100,000,000
Large Power Plant	500,000,000
Low Voltage Substation 115 KV	10,000,000
Medium Voltage Substation 230 KV	20,000,000
Large Voltage Substation 500 KV	50,000,000
Facility value was	

assigned based on Square footage.	

Limited availability of digital data represented a problem in completing the vulnerability assessment. Additional limitations to the above described analysis method includes:

Assuming random distribution
Limited data sets for water, gas, electrical, resulting in, incomplete numbers for these features.
Lack of digital parcels data from the Wasatch and Summit County Assessor's offices.
HASUZ MH is not designed for small population counties.
Relied on state wide data not intended for manipulation at the scale it was used.
Data was not field checked, resulting in an analysis wholly dependent on accuracy of data.
Meta data was lacking on some of the used data sets.

In terms of hazard mapping presentation in this document, simple, letter size maps were created to provide a graphical illustration of location. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool, to be used, by interested persons within Utah, Wasatch and Summit Counties in Utah. This information should not take the place of accurate field verified mapping from which ordinances need to be based off of. Owners of critical facilities should, and in most cases do, have detailed pre-hazard mitigation plans for their specific facilities.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas, which need additional research before development should be allowed.

The following table identifies the recurrence and frequency of hazards in Utah

Table 4.4 Probability

Hazard	Number of Events	Years in Record	Recurrence Interval (years)	Hazard Frequency and Probability/Year
Droughts	17	103	6.06	0.17
Earthquakes	30	133	4.43	0.23
Landslides	1	26	26.00	0.04
Floods	275	53	0.19	5.19
Tornadoes (all)	529	120	0.23	4.41
High wind	50	30	0.60	1.67
Windstorms	839	53	0.06	15.83
Severe Winter Storms	40	41	1.03	0.98
Wildfires	1,102	10	0.01	110.20
Urban Interface Fires	Unknown	Unknown	Unknown	Unknown
Volcanoes	700	5,000,000	7142.86	0.00
Thunderstorms and Lightning (fatalities)	53	19	0.36	2.79

Flooding

Flooding is a temporary overflow of water onto lands not normally inundated by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss, and interruption of business. Floods also increase the likelihood of hazard such as transportation accidents, contamination of water supplies, and health risk increase after a flooding event.

Several factors determine the severity of floods including rainfall intensity, duration and rapid snow melt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having, impermeable surfaces such as large parking lots, paved roadways, or post burned areas with hydrophobic soils. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

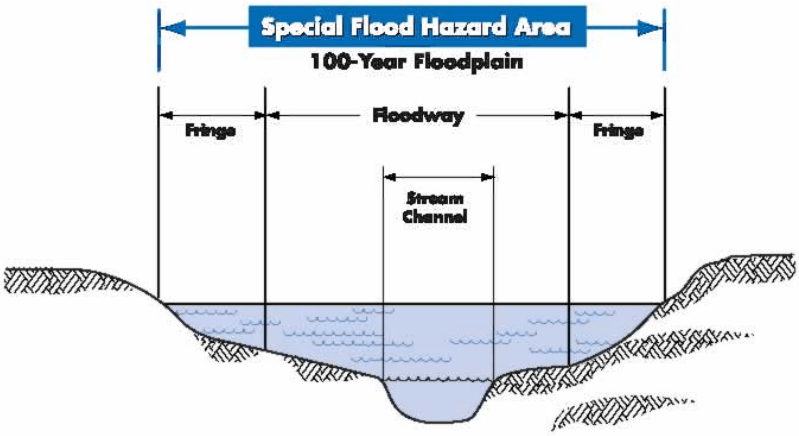
Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs during a particular season or in regions where annual flooding is due to spring melting of winter snow pack, areas at risk may be inundated nearly every year.

Conditions which may exacerbate floods:

- Impermeable surfaces
- Steeply sloped watersheds
- Constrictions
- Obstructions
- Debris
- Contamination
- Soil saturation
- Velocity

Explanation of Common Flood Terms

FIRM: Flood Insurance Rate Map



100-year flood: Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100 year-flood is also referred to as the base flood.

Base Flood: Is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

National Flood Insurance Program (NFIP): The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the VFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

Special Flood Hazard Area (SFHA): Is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

Floodway: Is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising that water surface elevation by more than one foot.

Dam Failure

Dam failures result from the failure of a man made water impoundment structure, which often results in catastrophic down grade flooding. Dam failures are caused by one or a combination of the following: "breach from flooding or overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, vegetation and rodents, poor construction, lack of maintenance and repair, misuse, improper operation, terrorism, or a combination of any of these" (Eldredge 46). The Utah State Engineer has been charged with regulating non-federal dams in the State since 1919. "In the late 1970's Utah started its own Dam Safety Section within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act (PL-92-367)" (Eldredge 46).

The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, the size, height, volume, and incremental risk/damage assessments of dams are all variables used to assign dam hazard ratings in the Dam Safety classification system. Using the hazard ratings systems developed by the Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years. There are 151 dams within the Mountainland Region of those 43 have received a high hazard rating by Dam Safety.

The following information regarding a failure of both Jordenelle and Deer Creek Dams and resulting loss was prepared by the United States Department of the Interior Bureau of Reclamation entitled "Dam Failure and Maximum Operational Release, Inundation Study: Deer Creek Dam" completed, February 2002.

Introduction and Purpose

On February 27, 1995, the Commissioner of the Bureau of Reclamation (Reclamation) issued a policy statement regarding establishing an Emergency Management Program at Reclamation dams. This policy stated that Reclamation would offer technical support and assistance to communities and jurisdictions downstream of Reclamation dams to ensure that adequate dam-specific emergency operation plans are in place. Directives for the emergency management program state that Emergency Actions Plans (EAP) shall be developed and are to contain descriptions of potentially affected areas in the flood plain with inundation maps wherever appropriate. This dam failure study was prepared to meet the goals and objectives of the Commissioner's directives.

The purpose of this study is to identify potential flood hazard areas resulting from the unlikely events of "sunny day" failure of Deer Creek Dam, the maximum operational release of Deer Creek Dam and the "sunny day" failure of Jordanelle Dam resulting in the failure of Deer Creek Dam due to overtopping.

These studies are standard practice within Reclamation and therefore do not reflect in any way upon the integrity of either Jordanelle or Deer Creek Dams.

Previous Studies

The Denver Office completed a previous Flood Inundation Study in June of 1990. It addressed two conditions, 1) a PMF (Probable Maximum Flood) causing the failure of Deer Creek Dam; and 2) a PMF (Probable Maximum Flood) causing the failure of Jordanelle Dam, which then results in the failure of Deer Creek Dam. Both scenarios were accomplished using the National Weather Service (NWS) DAMBRK model. Cross sections, and some dam breach parameters were obtained from these studies for use in this report.

Description of Jordanelle Dam

Jordanelle Dam and reservoir is located on the Provo River in Wasatch County in north central Utah about 5 miles north of Heber City, Utah. Jordanelle Dam is a rolled earthfill structure with a fuse plug emergency spillway and outlet works. The reservoir has a storage capacity of 311,000 acre-feet at active conservation, which is elevation 6,166.4 feet. The total reservoir storage capacity is 361,500 acre-feet at elevation 6,182.0.

The rolled earth embankment section of Jordanelle Dam has a structural height of 300 feet and a crest length of 3820 feet at elevation 6185.0 feet.

The emergency fuse plug spillway is located near the left abutment and consists of an unlined inlet channel, a concrete lined trapezoidal channel, an earthen plug section, a concrete chute, and a 9.5-foot by 10-foot concrete double box conduit. The design flow of the spillway is 5,510 cfs at elevation 6182.0 feet.

The outlet works is located within the left abutment and consists of two primary outlet works intake structures one (LLOW) Low level outlet works and one (SLOW) selective level outlet works merging into a common outlet pipe and a bypass system. The capacities for the outlet works are 3,269 cfs and 2,153 cfs respectively at elevation 6,086.7. The bypass system taps into both the SLOW and LLOW upstream of the emergency gates with a capacity of 300 cfs at elevation 6,166.0 feet.

The primary purpose of the reservoir is to provide M&I water for use in Salt Lake City and northern Utah County. Additional project purposes include flood control, recreation, Heber Valley irrigation water, and fish and wildlife enhancement.

Description of Deer Creek Dam

Deer Creek Dam and reservoir are located on the Provo River about 16 miles northeast of Provo, Utah and about 10 miles southwest of Heber City, Utah. Deer Creek Dam consists of a zoned earthfill structure, spillway and outlet works. The reservoir has a storage capacity of 152,570 acre-feet at the top of the gates, which is elevation 5,417 feet.

Deer Creek Dam has a structural height of 235 feet and a crest length of 1,304 feet at elevation 5,425 feet. There is a parapet wall, which extends 3.5 feet above the crest to elevation 5,428.5 feet.

The concrete chute spillway, located on the right abutment of the dam, is controlled by two 21- by 20-foot high radial gates. The spillway crest elevation is 5,397.0 feet and has a capacity of 12,000 cfs at elevation 5,420.1 feet.

The outlet works, located in the left abutment of the dam consists of: a drop type trashrack structure, a 12-foot-diameter circular tunnel, a gate chamber with two 5-foot by 6-foot high-pressure emergency gates side by side, an 11-foot 6-inch by 17-foot access tunnel which holds two 72-inch-diameter steel penstocks that carry water into the powerplant. The capacity of the outlet works is 1,500 cfs at elevation 5,420 feet.

Deer Creek Reservoir is part of a collection system, which stores and releases water from the Duchesne River, Weber River, and also the Provo River drainage. The primary recipients of the water are cities and farms along the Wasatch Front. It also provides year-round power generation and is used heavily for recreational purposes.

Method of Analysis

The primary purpose of the inundation maps is for warning and evacuation in the event of a dam failure or a large reservoir release. Values chosen to approximate physical characteristics such as dam failure breach parameters, channel roughness coefficients, etc., are based on assumptions and are used to produce best estimates of the downstream inundation. Thus, actual inundation were it to occur, could be greater or less than that indicated on the inundation maps.

For this study, the results of the one dimensional National Weather Service (NWS) DAMBRK model performed by the Denver Office was used to obtain the dam break flows from both Jordanelle Dam to Deer Creek Dam and from Deer Creek Dam to the mouth of Provo Canyon. However, the terrain beyond the mouth of Provo canyon is an alluvial fan, which unlike the narrow confined canyon, is a broad, flat plain. A two dimensional model is more appropriate for this type of terrain. It provides a more accurate depiction of the topography and allows for the water to spread and follow multiple drainage paths. The modeling tools used for the Orem/Provo areas utilized the Danish Hydraulic Institute's MIKE 21 two-dimensional hydrodynamic flow model. MIKE 21 is a 2-D finite difference model that simulates unsteady 2-D flows in (vertically homogeneous) fluids using the Saint Venant equations. ARCINFO GIS software is used as both a pre and post processor for the MIKE 21 model. Data used for the Deer Creek Dam models came from 7.5 minute, 10-meter resolution, digital elevation models (DEM) prepared by Land Info Inc., of Aurora, Colorado. The 10-meter data was then resampled at 30-meter cell size for use in the MIKE 21 models. The 10-meter elevation data appeared to be satisfactory for this study however for a more detailed study of the metropolitan area a better resolution of elevation data is recommended.

Study Details

Sunny Day Failure of Jordanelle Dam resulting in the failure of Deer Creek Dam due to overtopping.

The model using the National Weather Service DAMBRK program, with BOSS Corporation software enhancements, was used in the routing from Jordanelle Dam thru Deer Creek Reservoir and then to the mouth of the Provo canyon. The MIKE 21 two-dimensional (2-D) computer model was used in routing the releases from the mouth Provo canyon to Utah Lake.

Cross sections of the downstream areas of both Jordanelle and Deer Creek Dams that were used in the DAMBRK model were obtained from the 1990 study performed by the Denver Office.

The storage capacity for Jordanelle Reservoir was taken from the 1993 area capacity tables. Jordanelle reservoir water surface is assumed to be at active conservation, elevation 6166.4 feet, at the beginning of the piping failure simulation. The failure of Jordanelle Dam was assumed to develop in 2.0 hours, with piping beginning at elevation 6,000 feet. A bottom breach width of 500 feet was assumed, with side slopes of 1: 0.50, which resulted in a peak flow of 3,542,000 cfs.

Table 4.5 indicates the sensitivity of breach parameters by varying the time of dam breach formation and leaving the other parameters the same. The 2-hour breach time was assumed conservative considering the design and construction criteria of the dam.

Table 4.5 Breach Parameters of Jordanelle Dam

Time of Breach Formation (hours)	Bottom Breach Width (feet)	Breach Side Slopes	Maximum Flow at Jordanelle Dam (CFS)
1.0	500	1: 0.50	5,020,000
*2.0	500	1: 0.50	3,542,000
3.0	500	1: 0.50	2,806,000

The storage capacity for Deer Creek Reservoir was taken from the 1962 area capacity tables. Deer Creek reservoir water surface is assumed to be at top of conservation, elevation 5417 feet at the beginning of Jordanelle Dam Failure. Deer Creek Dam is assumed to fail when the water surface reaches 1 foot over the top of the parapet wall at elevation 5428.5 feet. The breach develops in 1 hour and achieves a bottom breach width of 300 feet. A DAMBRK hydrograph, was taken at the mouth of Provo Canyon at river mile 10.0, and used as input data for the MIKE 21 model. The MIKE 21 input parameters used in this routing are listed in Table 4.6.

Table 4.6 MIKE 21 input parameters

Flooding parameter*	0.15 meters
Drying parameter*	0.1 meters
Time step interval	1 second
Mannings "n" value	0.04

* The flooding parameter sets the minimum water depth required in a given cell in order for water to begin flowing into adjacent model cells. Conversely, the drying parameter sets a depth requirement below which the cell begins to dry out.

Sunny Day Failure of Deer Creek Dam due to piping

The model using the National Weather Service DAMBRK program, with BOSS Corporation software enhancements were used in the routing to the mouth of Provo canyon. The MIKE 21 two-dimensional (2-D) computer model was used in routing the releases from the mouth Provo canyon to Utah Lake. Cross sections of the downstream areas of both Jordanelle and Deer Creek Dams used in the DAMBRK model were obtained from the 1990 study performed by the Denver Office.

Deer Creek reservoir water surface is assumed to be at top of conservation, elevation 5417 feet at the beginning of the piping failure. The breach is assumed to develop in 1 hour and achieve a bottom breach width of 500 feet, which resulted in a peak flow of 1,550,000 cfs. Table 4.7 indicates the sensitivity of breach parameters by varying the time of dam breach formation and leaving the other parameters the same. The 1-hour breach time was assumed conservative considering the design and construction criteria of the dam.

Table 4.7 Breach Parameters of Deer Creek Dam

Time of Breach Formation (hours)	Bottom Breach Width (feet)	Breach Side Slopes	Maximum Flow at Deer Creek Dam (CFS)
0.5	500	1: 0.50	1,826,000
1.0	500	1: 0.50	1,550,000
2.0	500	1: 0.50	1,275,000

A DAMBRK hydrograph, was taken at the mouth of Provo Canyon at river mile 10.0, and used as input data for the MIKE 21 model. The MIKE 21 input parameters used in this routing are listed in Table 4.8.

Table 4.8 MIKE 21 input parameters

Flooding parameter*	0.3 meters
Drying parameter*	0.2 meters
Time step interval	1 second
Mannings "n" value	0.04

* The flooding parameter sets the minimum water depth required in a given cell in order for water to begin flowing into adjacent model cells. Conversely, the drying parameter sets a depth requirement below which the cell begins to dry out.

Deer Creek Dam Maximum Operational Release

The maximum operational release from Deer Creek Dam was modeled using a constant outflow of 13,500 cfs. The 13,500 cfs release was based on the maximum release from the dam and was used to indicate maximum water depths at each cross section using a constant flow. This was considered a conservative estimate based on the assumption that the flow would not generally maintain this volume at each cross section, but instead would decrease in depth as the reservoir emptied. The same constant flow of 13,500 cfs was used as input data for the MIKE 21 model, which begins at the mouth of Provo Canyon. MIKE 21 input parameters are listed in Table 4.9.

Table 4.9 MIKE 21 input parameters

Flooding parameter*	0.3 meters
Drying parameter*	0.2 meters
Time step interval	1 second
Mannings "n" value	0.04

* The flooding parameter sets the minimum water depth required in a given cell in order for water to begin flowing into adjacent model cells. Conversely, the drying parameter sets a depth requirement below which the cell begins to dry out.

Downstream routing and description

The study begins at Jordanelle Dam located on the Provo River about 5 miles north of Heber City, Utah, and extends through Deer Creek Reservoir and Dam to Utah Lake near Provo, Utah. Seven cross sections from the study performed in 1991 were used to identify the area below Jordanelle Dam. The cross sections extended along the Provo River approximately 9.0 river miles to Deer Creek Reservoir. Six cross sections from the study performed in 1991 were used to identify the area below Deer Creek Dam. The cross sections extended along the Provo River approximately 10 river miles to the mouth of Provo Canyon. The cross sections were obtained using U.S. Geological Survey Quadrangle maps (Scale 1:24000) consisting of 40-foot contours. The Manning's n value used to represent the roughness coefficient of the downstream channel to the mouth of the canyon was 0.04. Some minor adjustments were made to some of the cross sections in order to obtain numerical stability in the DAMBRK model. Beyond the mouth of the canyon, it flows through some of Orem and Provo, Utah and then into Utah Lake.

Study Results

The results indicate that flooding resulting from the sunny day failures of either Jordanelle or Deer Creek Dams will inundate the residential areas along the Provo Canyon corridor and in Orem and Provo, which could result in the loss of life. In addition, parts of Springville located within the flood plain south of Provo, Utah as well as major highways and road crossings would be heavily impacted by the floodwaters.

The routings of the floods were terminated at approximately 10 hours for the sunny day failure of Jordanelle and Deer Creek Dams. About 10 hours after flooding begins, most of the floodwaters are safely contained by Utah Lake. The results of the flood routing are listed in the attached tables.

Table 4.9A Sunny day failure of Jordanelle Dam resulting in the failure of Deer Creek Dam due to overtopping, identifies results obtained from the sunny day failure of Jordanelle Dam modeled as a piping failure. The table includes the maximum water surface, peak flows, and flood arrival times from the beginning of the failure of Jordanelle Dam to the flood arrival at the mouth of Provo Canyon.

Table 4.9A Sunny day failure of Jordanelle Dam

River Miles Downstream of Deer Creek Dam	Maximum Water Surface Elev (Feet)	Depth Above Streambed (Feet)	Arrival Time of Leading Edge (Hrs)	Arrival Time of Peak Flow (Hrs)	Maximum Flow (CFS)	Location
0.0	5439	165	River Miles Downstream of Deer Creek Dam	2.5	3,573,000	Deer Creek Dam
10.0	4926	104	2.0	2.9	3,124,000	Mouth of Provo Canyon

*****Arrival times are from the beginning of Jordanelle Dam failure
*****Mile 0.0 is at the downstream toe of Deer Creek Dam

Table 4.9B. Sunny day failure of Jordanelle Dam resulting in the failure of Deer Creek Dam identifies results obtained from the sunny day failure of Jordanelle Dam. The table covers the area from the mouth of Provo Canyon to Utah Lake. Maximum discharge and times, at Provo City, were extracted from the MIKE21 model output file for use in the table.

Table 4.9B. Sunny day failure of Jordanelle Dam

River Miles Downstream of Deer Creek Dam	Estimated Time to Leading Edge (Hrs)	Time to Maximum Discharge (Hrs)	Calculated Maximum Discharge (CFS)	Location
14.5	2.5	3.0	3,085,000	Provo City

*Times to discharges are from the beginning of Jordanelle Dam failure

Table 4.10A Sunny day failure of failure of Deer Creek Dam identifies results obtained from the sunny day failure of Deer Creek Dam modeled as a piping failure. The table includes the maximum water surface, peak flows, and flood arrival times from the beginning of the failure of Deer Creek Dam to the flood arrival at the mouth of Provo Canyon.

Table 4.10A . Sunny day failure of Deer Creek Dam

River Miles Downstream of Deer Creek Dam	Maximum Water Surface Elev (Feet)	Depth Above Streambed (Feet)	Arrival Time of Leading Edge (Hrs)	Arrival Time of Peak Flow (Hrs)	Maximum Flow (CFS)	Location
0.0	5381	107	0.1	0.7	1,550,000	Deer Creek Dam
10.0	4915	93	0.8	1.1	1,397,000	Mouth of Provo Canyon

*****Arrival times are from the beginning of Deer Creek Dam failure
*****Mile 0.0 is at the downstream toe of Deer Creek Dam

Table 4.10B. Sunny day failure of Deer Creek Dam, identifies results obtained from the sunny day failure of Deer Creek Dam. The table covers the area from the mouth of Provo Canyon to Utah Lake. Maximum discharge and times, at Provo City, were extracted from the MIKE21 model output file for use in the table.

Table 4.10B. Sunny day failure of Deer Creek Dam

River Miles Downstream of Deer Creek Dam	Estimated Time to Leading Edge (Hrs)	Time to Maximum Discharge (Hrs)	Calculated Maximum Discharge (CFS)	Location
14.5	0.9	1.2	1,386,000	Provo City

*Times to Maximum discharge are from the beginning of Deer Creek Dam failure

Table 4.11. Maximum operational release of Deer Creek Dam identifies the results of the maximum operational release from Deer Creek Dam to the mouth of Provo Canyon, based on the maximum release of 13,500 cfs. The table includes the maximum water surface, depth above streambed, and peak flows obtained at the cross sections modeled.

Table 4.11. Maximum operational releases of Deer Creek Dam (Releases are based on continuous flow of 13,500 cfs)

River Miles Downstream of Deer Creek Dam	Maximum Water Surface (Elev)	Depth Above Streambed (Feet)	Maximum Flow (CFS)
0.0	5289	15	13,500
10.0	4836	14	13,500

*****Mile 0.0 is at the downstream toe of Deer Creek Dam

Inundation Maps

Inundation maps produced from this study are shown on U.S. Geological Survey Quadrangle maps (Scale 1:24,000). They combine flood inundation boundaries from both the National Weather Service's (NWS) DAMBRK one dimensional model, which was used to route flows between Deer Creek Dam and the mouth of Provo Canyon, and MIKE 21, the two dimensional model which terminates at Utah Lake. The flood inundation boundaries shown on the maps for each scenario were taken from the 1993 study and are depicted in red from the dam to the mouth of Provo Canyon. The flood boundaries from the mouth of Provo Canyon to Utah Lake are color coded according to water depth. The water depths shown on the map represent an estimate of the maximum water depth that could occur at various locations within the inundated area. Also shown are colored lines that indicate the progression of the leading edge of the flooding at various time intervals. These time-sequenced flood-progression lines do not correlate directly to the water depths of the maximum inundation boundary. The inundation boundary for the 1-D operational release from Deer Creek Dam to the mouth of Provo canyon was not included on the maps due to the coarse topography indicated on the 1:24000 scale quadrangles.

The maps are located in the county annexes.

Wildland Fire

Identifying Hazards

A wildfire is an uncontrolled fire spreading through vegetative fuel often exposing or consuming structures. Wildfires often begin unnoticed and spread quickly and are usually sighted by dense smoke. Wildfires are placed into two classifications Wildland and Urban-Wildland Interface. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. URWIN areas are divided into three subclasses, each evident in counties within Mountainland:

Occluded

Occluded interface, are areas of wildlands within an urban area for example a park bordered by urban development such as homes.

Intermixed

Mixed or intermixed interface areas contain structures scattered throughout rural areas covered predominately by native flammable vegetation.

Classic

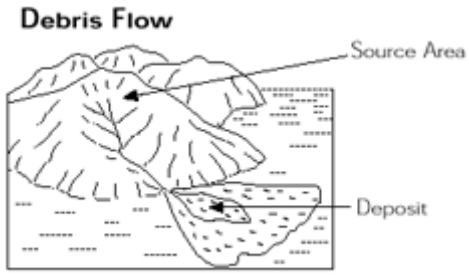
Classic interface areas are those areas where homes press against wildland vegetation along a broad front.

When discussing wildfires it is important to remember that fires are part of a natural process and are needed to maintain a healthy ecosystem. Three basic elements are needed for a fire to occur (1) a heat source (2) oxygen and (3) fuel. Two of the three sources are readily available in the counties making up the Mountainland region. Major ignition sources for wildfire are lightning and human causes such as arson, prescribed burns, recreational activities, burning debris, and carelessness with fireworks. On average, 65 percent of all wild fires started in Utah can be attributed to human activities. Once a wildfire has started, vegetation, topography and weather are all conditions having an affect wildfire behavior.

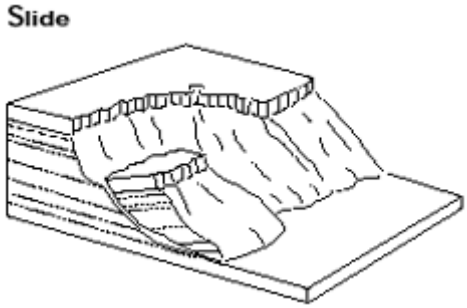
Landslides

Landslides are a "down slope movement of a mass of rock, earth, or debris". Landslides, often referred to as mass wasting or slope failures, are one of the most common natural disasters (Cruden 36). Slope failures can vary considerably in shape, rate of movement, extent, and effect on surrounding areas. Slope failures are classified by their type of movement, and type of material. The types of movement are classified as falls, slides, topples, and flows. "The types of material include rock, debris (coarse grained soil) and earth (fine grained soil)" (Eldredge 17). "Types of slope failures then are identified as rock falls, rock slides, debris flows, debris slides, and so on" (Eldredge 17). Slope failures occur because of either an increases in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). "Geology (rock type and structure), topography (slope gradient), water content, vegetative cover, and slope aspect are important factors of slope stability" (Eldredge 18).

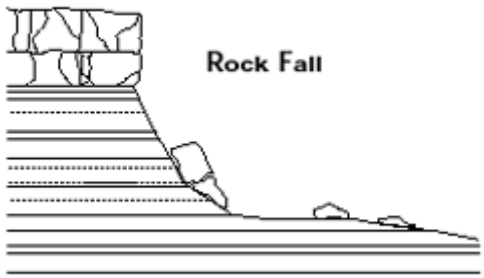
Three Common Types of Landslides in Utah



Debris flows consist of sediment-water mixtures that flow down a streambed or hillside, commonly depositing sediment at canyon mouths in fan like deposits know as alluvial fans.



Slides are down slope movements of soil or rock on slopes.



Rock falls consist of rock(s) falling from a cliff or cut slope and are very common in the canyon country of southern Utah.

Conditions That Make Slopes More Susceptible to Landslides

- Discontinuities: faults, joints, bedding surfaces.
- Massive Materials over soft materials.
- Orientations of dip slope: bedding plans that dip out of slope.
- Loose structure and roundness.
- Adding weight to the head of a slide area: rain, snow, landslides, mine waste piles, buildings, leaks from pipes, sewers, and canals, construction materials fill materials.
- Ground shaking: earthquakes or vibrations.
- Increase in lateral spread caused by mechanical weathering.
- Removal of lateral support.
- Human activities: cut and fill practices, quarries, mine pits, road cuts, lowering of reservoirs.
- Removing underlying support: under cutting of banks in a river.
- Increase in pore water pressure: snow melt, rain, and irrigation.
- Loss of cohesion.

Problem Soils

Problem soils and rock constitute a widespread geologic hazard in Utah, covering approximately 18 to 20 percent of the state, and underlie many urbanized areas. The nine types of problem soil and rock in Utah are:

- Expansive Soil
- Collapsible Soil
- Limestone and Karst Terrain
- Gypsiferous Soil
- Soil Subject to Piping
- Dunes
- Peat
- Mine Subsidence
- Sodium Sulfate

Problems soils affecting the Mountainland region include expansive and collapsible soils and Mine Subsidence.

Expansive Soil and Rock

Clay minerals found in soils and rock expand and contract due to changes in moisture content. The most common clay mineral associated with expansive soils in Utah is montmorillonite, "which expands up to 2,000 times its original size, and can exert pressures up to 11,000 pounds per square foot" (Eldredge 30). The cracks created by the expansion and contraction process create a positive feed back mechanism that allows more water to enter during the next storm cycle. Within the Mountainland Region expansive soils are found along the eastern foothills and within Utah County. Problems associated with expansive materials are cracked foundations, heaving and cracking of road surfaces, failure of wastewater disposal systems, and broken water lines.

Collapsible Soil

Collapsible soil causes ground-surface subsidence when loose, dry, low density deposits decrease in volume when saturated for the first time since deposition. Frequently the water introduced into these soils is from human sources such as irrigation, water impoundment, lawn watering, alterations to natural drainages, and/or wastewater disposal.

Mine Subsidence{tc "Mine Subsidence"}

Utah has a long history of mining and there are numerous mines within Utah. Mining removes rock and leaves voids that, if not supported, can collapse and cause subsidence of the ground surface and sinkholes. Subsidence can occur in both active and abandoned mines.

Earthquakes

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks when they can no longer withstand the stresses, which build up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. When rocks break they produce seismic waves that are transmitted through the rock outward producing ground shaking. Earthquakes are unique multi-hazard events, with the potential to cause huge amounts of damage and loss. Secondary effects of a sudden release of seismic energy (earthquake) include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, slope failure, and various types of flooding.

The Intermountain Seismic Belt

The Intermountain Seismic Belt (ISB), which Mountainland is part of, is a zone of pronounced earthquake activity up to 120 miles wide extending in a north south direction 800 miles from Montana to northern Arizona. The Utah portion of the ISB trends from the Tremonton Cache Valley area south through the center of the state, along the Wasatch Front, and the southwest through Richfield and Cedar City concluding in St. George. "The zone generally coincides with the boundary between the Basin and Range physiographic province to the west and the Middle Rocky Mountains and Colorado Plateau physiographic provinces to the east" (Eldredge 6).

Secondary Earthquake Threats

The major secondary effects of earthquakes include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, avalanches, rock fall, slope failure, and various types of flooding. Other sections discuss landslides, and flooding therefore they will not be discussed under secondary effects of earthquakes yet importance needs to be given to the fact that earthquakes can increase the likelihood of flooding and landslides.

Ground Shaking

Ground shaking causes the most impact during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated by earthquakes. Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves cause more damage to short stiff structures, were as low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity.

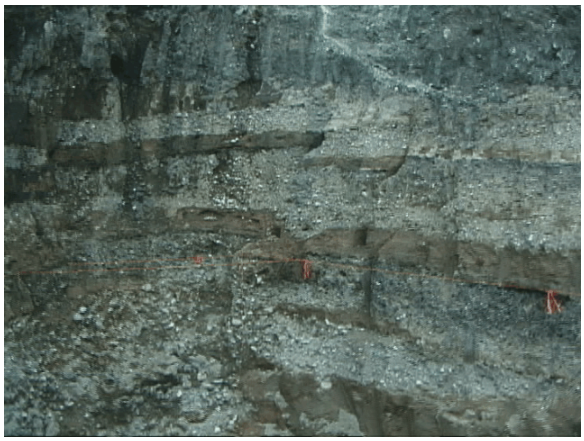
Local geologic conditions such as depth of sediment and sediment make up, affect earthquake waves. Deep valley sediments increase the frequency of seismic waves relative to bedrock. In general, ground shaking increases with increased thickness of sediments" (Eldredge 8). Findings in recent geologic research done by Ivan Wong indicate and earthquake in Salt Lake County would produce higher PGA values than previously expected near faults and areas of near surface bedrock.

Surface Fault Rupture

During a large earthquake fault movement may propagate along a fault plain to the surface, resulting in surface rupture along the fault plain. The Wasatch fault is a normal (mountain building) fault with regards to movement, meaning the footwall of the fault moves upward and the hanging wall moves in a down direction. Thus faulting is on a vertical plain, which results in the formation of large fault scarps. Surface fault rupture along the Wasatch fault is expected for earthquakes with magnitudes of 6.5 or larger. The largest probable earthquake that could strike the Mountainland region is an earthquake with an estimated magnitude between 7.0 and 7.5; an earthquake of this magnitude, based on current research,

would create "surface fault rupture with a displacement of between 16 to 20 feet in height with break segments 12 to 44 miles long" (Eldredge 10). In historic time surface fault rupture has only occurred once in Utah; the 1934 Hansel Valley earthquake with a magnitude 6.6 produced 1.6 feet of vertical offset.

Surface fault rupture presents several hazards, anything built on top of the fault or crossing the fault has a high potential to be destroyed in the event of displacement. Foundations will be cracked, building torn apart, damage to roads, utility lines, pipelines, or any other utility line crossing the fault. It is almost impossible to design anything within reasonable cost parameters to withstand an estimated displacement of 16 to 20 feet.



Picture 4.1 Displacement in excavation near Downtown Salt Lake.

Severe Weather

For the purpose of this mitigation plan the term "severe weather" is used to represent downbursts, lightening, heavy snowstorms, blizzards, avalanches, hail, and tornados.

Downbursts

A downburst is a severe localized wind, blasting from a thunderstorm. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories by size: microbursts, which cover an area less than 2.5 miles in diameter, and macrobursts, which cover an area with a diameter larger 2.5 miles.

Lightening

During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightening is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes to great, there is a discharge of electricity that we know as lightning.

Heavy Snowstorms

A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to twenty degrees Fahrenheit 20° F or lower. All winter storms make driving extremely dangerous.

Blizzards

A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit (10° F) or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Avalanches

Avalanches are a rapid down-slope movement of snow, ice, and debris. Snow avalanches are a significant mountain hazard in Utah, and nationally account for more deaths each year than earthquakes. Avalanches are the result of snow accumulation on a step slope and can be triggered by ground shaking, sound, or a person. Avalanches consist of a starting zone, a track, and a run-out zone. The starting zone is where the ice or snow breaks loose and starts to slide. The Track is the grade or channel down which an avalanche travels. The run-out zone is where an avalanche stops and deposits the snow.

The two main factors affecting avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Additional factors that contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

Topography plays a vital role avalanche dynamics. Slope angles between 30 to 45 degrees are optimum for avalanches with 38 degrees being the bulls-eye. Slopes with an angle above 45 degrees continually slough eliminating large accumulation. The risk of avalanches decreases on slope angles below 30 degrees.

Types of Avalanches Common in Utah:

Dry or slab avalanches occur when a cohesive slab of snow fractures as a unit and slides on top of weaker snow, breaking apart as it slides. Slab avalanches occur when additional weight is added quickly to the snow pack, overloading a buried weaker layer. Dry snow avalanches usually travel between 60-80 miles per hour, reaching this speed within 5 seconds of the fracture, resulting in the deadliest form of snow avalanche.

Wet avalanches: occur when percolating water dissolves the bonds between the snow grains in a pre-existing snow pack, this decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour.

Hail Storms

Hailstones are large pieces of ice that fall from powerful thunderstorms. Hail forms when strong updrafts within the convection cell of a cumulonimbus cloud carry water droplets upward causing them to freeze. Once the droplet freezes, it collides with other liquid droplets that freeze on contact. These rise and fall cycles continue until the hailstone becomes too heavy and falls from the cloud.

Tornados

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornados often occur at the edge of an updraft or within the air coming down from a thunderstorm. Tornadoes can have wind speeds of 250 miles per hour or more, causing a damage zone of 50 miles in length and 1 mile wide. Most tornados have winds less than 112 miles per hour and zones of damage less than 100 feet wide.

Waterspout

Waterspouts are simply tornadoes that form over warm water. This typically occurs in Utah during a cold fall or late winter storm.

Scale

Tornadoes are classified by wind damage using the Fujita Scale. The National Weather Service has used the Fujita Scale since 1973. This scale uses numbers from 0 through 5 with higher numbers assigned based on the amount and type of wind damage.

Table 4.12 Fujita Scale

Category F0	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lowers limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobiles-size missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Drought

Drought is a normal recurrent feature of climate, although many people in Utah erroneously consider it a rare and random event. It occurs in virtually all-climatic zones, while its characteristics vary significantly from one region to another. Droughts, simply put, are cumulative hazards, which result from long periods of below normal precipitation. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate.

The State or Utah, uses the Palmer Drought Severity Index or (PDSI) to quantify the existence of a drought. Using the PDSI, drought is expressed as a negative number. Much of the basis, used by the State, to determine drought years, or drought periods, comes from the PDSI. In addition, the State Climatologist, the National Geophysical Data Center of NOAA, and the National Drought Mitigation Center use the PDSI. Further information on the Palmer Drought Severity Index can be found in Appendix F.

For the most part droughts no longer affect the availability of drinking water, thus they no longer place peoples lives at risk, the same cannot be said for a person's livelihood. Numerous water projects throughout the state have placed enough water in storage to insure drinking water. Prolonged droughts have a significant affect on agricultural and agribusinesses, within the states dependent on irrigation water. Droughts also stress wildlife, and heighten the risk of wildfire.

Infestation

Infestation normally deals with insect infestations; however; infestations may also include rodent or other animal invasion. To infest means to spread or swarm over in a troublesome manner. The Mountainland Region has had two recent infestations. The most devastating invasion, in relation to cost, has been the Mormon Cricket. In June of 2003, Utah Governor Mike Leavitt declared a State of Emergency in 18 of Utah's 29 counties, where crickets and grasshoppers had eaten 1.5 million acres. Problems associated with cricket infestations usually deal with crop loss as well as loss of rangeland for cattle and sheep. Consumption of residential landscaping is also a problem and more homes are built in western Utah County in which is in the path of crickets. The crickets usually travel from west to east, starting in Nevada. In some instances the cricket mass is so large and dense that cars and trucks lose traction on roads. Vehicles sliding off of roads can cause property damage and personal injury.

The Mormon cricket has reached legendary status in the State of Utah. This devastating insect plagued the early pioneers. Today, 150 years later, the Mormon cricket still economically devastates some parts of Utah.

Economic Damage

The Mormon cricket is not a true cricket. The insect resembles more a lifestyle of a grasshopper. Mormon crickets are of economic importance in the fact that they destroy plants on rangeland, cropland, and vegetable gardens. Male and female Mormon crickets are large insects and can reach lengths of two and one-half inches during the adult stage. The female Mormon cricket is distinguished by the long ovipositor that also looks like a type of "stinger" located at the end of the abdomen. The male lacks this ovipositor. The Mormon cricket can be economically devastating. It has been calculated that a Mormon cricket at a density of one per square yard can consume 38 pounds of dry weight rangeland forage per acre. In Utah, the Mormon cricket destroys sagebrush, alfalfa, small grains, seeds, grasses, and vegetable crops.

Life Cycle and Characteristics

Mormon crickets hatch during the spring, and depending on elevation usually around the first few weeks of April. Young Mormon crickets are called nymphs. These nymphs develop during the spring months. They undergo seven stages of development called in-stars. It takes 60 to 90 days for the Mormon cricket to pass through these seven stages and obtain the adult stage. The female Mormon cricket lays its eggs during the summer months. The incubation of the eggs occurs during the fall and winter months. The eggs start hatching when soil temperatures reach 40 degrees Fahrenheit. The Mormon cricket cannot fly, but is still an extremely mobile insect. When the crickets are young, they do not migrate long distances. After about the fourth in-star and during the adult stage the Mormon crickets become ravenous and start banding together. Once the crickets have banded together, they begin migrating. During their migrations they destroy everything in their path. Mormon crickets are usually found migrating when skies are clear and temperatures are around 60 to 90 degrees Fahrenheit. In Utah, the crickets migrate under favorable conditions around 10:00 a.m. until about 2:00 p.m. Mormon crickets in the adult stage can cover a mile a

day and up to 50 miles in a single season. During the night and during cold, wet weather, Mormon crickets clump together and can be seen clinging together on grasses and brush. They will also burrow underneath grass and brush to keep warm. The Mormon cricket is a hearty insect. They have been seen feeding when temperatures were less than 35 degrees Fahrenheit.

Control Methods

The most effective way to reduce Mormon cricket populations is to use carbaryl bait. The trade name is Sevin bait. This is usually oatmeal coated with the chemical insecticide carbaryl. The recommended application rate is 10 pounds to the acre. Using hand-held fertilizer spreaders can spread the bait or large machines that blow the poisoned grain a long distance. The idea is to apply a barrier of bait around or in front of a band of migrating crickets. Once the first wave consumes the bait they will die within a few minutes. The crickets coming from behind will eat the dead crickets causing a chain reaction of crickets being killed by the bait. Mormon crickets do not fly so they will almost always hit the barrier of poisoned bait. Many ranchers and farmers will apply the bait around the perimeter of their fields to reduce the number of crickets invading. Bait is also applied along roadsides to reduce the risk of car accidents from large numbers of crickets crossing highways. It is best to apply the bait when the crickets are still young or in the developing stages. Insecticide sprays such as Malathion could be effective against the Mormon cricket if they were sprayed during the nymphal stage. These insecticide sprays usually aren't recommended. Sevin bait is the preferred control method at this time in Utah.

Costs vary but usually average about $5 an acre for a minimum of 5,000 acres being sprayed. Some years there are government cost share programs to help spray large acres of rangeland. Usually, the land needs to border Federal or State lands to qualify for government aid. The insecticide most commonly used on rangelands is Malathion ULV applied at 8 oz. to the acre. It is important that spraying takes place early in the grasshopper’s life. The younger the grasshoppers are the better the kill rate. The best time to usually spray rangeland is the first three weeks in June. This is referred to as the "window of opportunity."

Cropland

The most profitable crops in Utah are alfalfa, corn, oats, wheat, rye, and barley. Grasshoppers concentrate in these croplands and destroy all vegetation present. This can be economically devastating for a farmer. Control on agricultural croplands is essential. As with rangelands you must determine whether there is an infestation of eight or more grasshoppers per square yard. If there is, then the two most effective control methods are ground spraying or aerial spraying. Ground spraying is usually more expensive per acre, but there is less chance of killing non-target insects (bees). Aerial spraying is quick, usually less expensive, and has a high kill rate. The disadvantage is the potential damage to non-target insects. Usually, aerial spray applications are used when there are a higher number of acres to be sprayed. Malathion ULV and Dursban are two common insecticides used for grasshopper control on agricultural croplands. Justification for control depends on the crop, the crop's stage of growth, additional migration, and the type of damages being done to the crop. Grasshoppers hatch and migrate off bordering lands, and at times this is extremely frustrating to an agriculture grower trying to control grasshopper infestation. This is where the importance of communities pulling together to do a countywide spray program comes into play. The importance of government spraying of public lands bordering cropland cannot be stressed enough.

Lawns, Gardens, and Landscaping

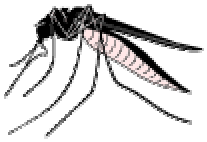
Homes are being built on lands that have produced grasshopper populations for many years. This causes problems for the homeowner. Grasshoppers are hatching and laying eggs in the lawns and gardens. This makes it possible for the grasshoppers to hatch on the same lawn year after year. Grasshoppers are

migrating out of vacant fields and low hills into the green, lawns and gardens. This results in thousands of dollars in damage to newly planted landscapes. It is very important that communities work together in controlling grasshopper outbreaks. If one person is spraying, and neighbors are not, then the grasshoppers will just continue migrating from adjacent property. Vacant lots and fields need to be tilled in late fall to expose the eggs. Eggs are destroyed when they are exposed to the cold environment. Lawns need to be raked to also expose the eggs. Flower gardens usually have a population of eggs, so the soil should be turned over to expose the eggs. If there is an outbreak of grasshoppers on your landscape during the summer, start spraying early. Once you see that grasshoppers have invaded, even the little ones, start spraying with Dursban (chlorpyrifos) for use on turf and ornamentals, Malathion for use on turf, ornamentals and vegetables, or liquid Sevin (carbaryl) for use on turf, vegetables, and ornamentals.

Insecticide baits that use insecticide such as Sevin have not been an effective barrier against the grasshoppers in Utah. Grasshoppers fly and jump great distances and more than likely will miss the barrier of bait completely. This bait is very effective for the Mormon crickets, common to the southern end of the county. READ AND FOLLOW THE INSTRUCTIONS ON PESTICIDE LABELS FOR REGISTERED USES, RATES, RESTRICTIONS, AND SAFETY PRECAUTIONS.
Conclusions

Grasshoppers are a recognized problem for Utah. The extreme infestations do not occur every year, but there are grasshoppers to some extent each year. Extreme infestations seem to come in cycles of seven years and last approximately three years. Everyone needs to recognize there is a problem, and take the steps each year to combat the insects. Expose the eggs as often as possible, start spraying late spring and early summer to kill the immature grasshoppers, make your spraying programs a community effort, and keep informed on government spray programs for your area. If everyone does their part we can greatly reduce the grasshopper populations, and strive for a county free of these devastating insects.

WEST NILE VIRUS



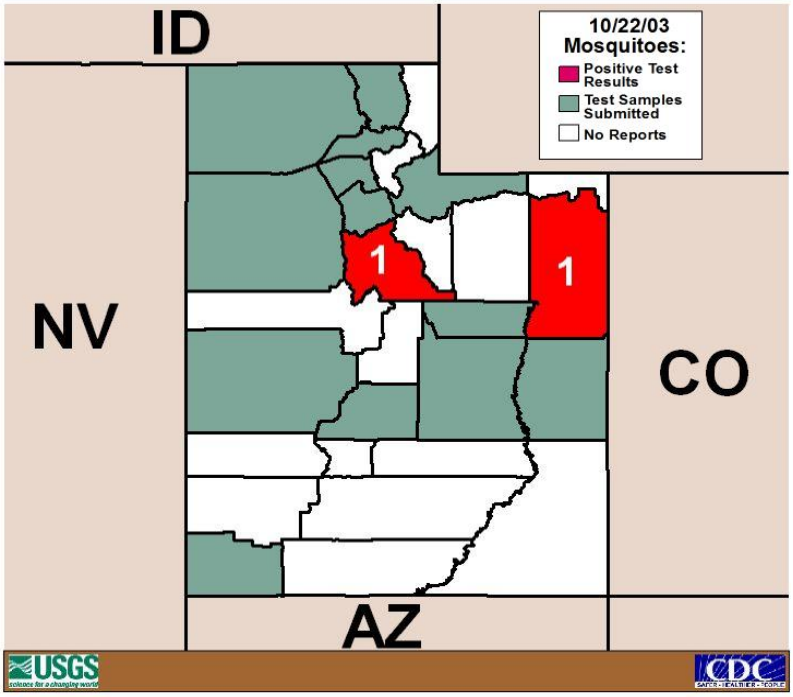
A second type of insect infestation is mosquito borne diseases. Most recently there has been significant news coverage of the West Nile Virus, although mosquitoes also carry other diseases. Other diseases carried by mosquitoes include various forms of encephalitis and dengue fever. The West Nile Virus and various forms of encephalitis may affect humans and animals.

Since West Nile virus (WNV) was first isolated in 1937, it has been known to cause asymptomatic infection and fevers in humans in Africa, West Asia, and the Middle East. Human and animal infections were not documented in the Western Hemisphere until 1999. In 1999 and 2000, outbreaks of WNV encephalitis (inflammation of the brain) were reported in persons living in the New York City metropolitan area, New Jersey, and Connecticut. In these two years, 83 human cases of West Nile illness were reported; 9 died. In 2001, human infection with WNV occurred in 10 states with 66 cases and 9 deaths. In 2002, WNV activity spread to 44 states, with 4,156 human cases and 284 deaths.

WNV is transmitted to humans through mosquito bites. Mosquitoes become infected when they feed on infected birds that have high levels of WNV in their blood. Infected mosquitoes can then transmit WNV when they feed on humans or other animals.

WNV is not transmitted from person to person and there is no evidence that handling live or dead infected birds can infect a person. But, to add a further level of safety, if birds or other potentially infected animals must be handled, a protective barrier (e.g., gloves, inverted plastic bags) should be used.

Most WNV infected humans have no symptoms. A small proportion develops mild symptoms that include fever, headache, body aches, skin rash and swollen lymph glands. Less than 1% of infected people develop more severe illness that includes meningitis (inflammation of one of the membranes covering the brain and spinal cord) or encephalitis. The symptoms of these illnesses can include headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis. Of the few people that develop encephalitis, a small proportion die but, overall, this is estimated to occur in less than 1 out of 1000 infections.



There is no specific treatment for WNV infection or vaccine to prevent it. Treatment of severe illnesses includes hospitalization, use of intravenous fluids and nutrition, respiratory support, prevention of secondary infections, and good nursing care. Medical care should be sought as soon as possible for persons who have symptoms suggesting severe illness.

Individuals can reduce their contacts with mosquitoes by taking these actions:

When outdoors, wear clothing that covers the skin such as long sleeve shirts and pants, apply effective insect repellent to clothing and exposed skin, and curb outside activity during the hours that mosquitoes are feeding which often includes dawn and dusk. In addition, screens should be applied to doors and windows and regularly maintained to keep mosquitoes from entering the home.

Regional Mitigation Goals

To coordinate with each participating local government to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document and any additional State planning expectation, both regionally and specifically, as needed, by gathering local input. And to also meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom. The goals were approved at

Local Goals

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result of identified hazards.
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources. If an earthquake occurs outside of Utah County it will still affect Utah County Communities this is similar to many natural hazards.

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agencies or organizations responsible for implementation of the goals.
- Projecting a time frame for implementation.
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available.
- Identifying alternative measures, should financing not be available.
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties.
- Be based on the Utah Vulnerability Analysis.
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters.
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options.
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal property, damage to critical facilities, economic loss, and hardship or human suffering.
- Meet applicable permit requirements.
- Not encourage development in hazardous areas.
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem.
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation.
- Have manageable maintenance and modification costs.
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement.
- Whenever possible, use existing resources, agencies and programs to implement the project

County Annexes

Summit County

Introduction

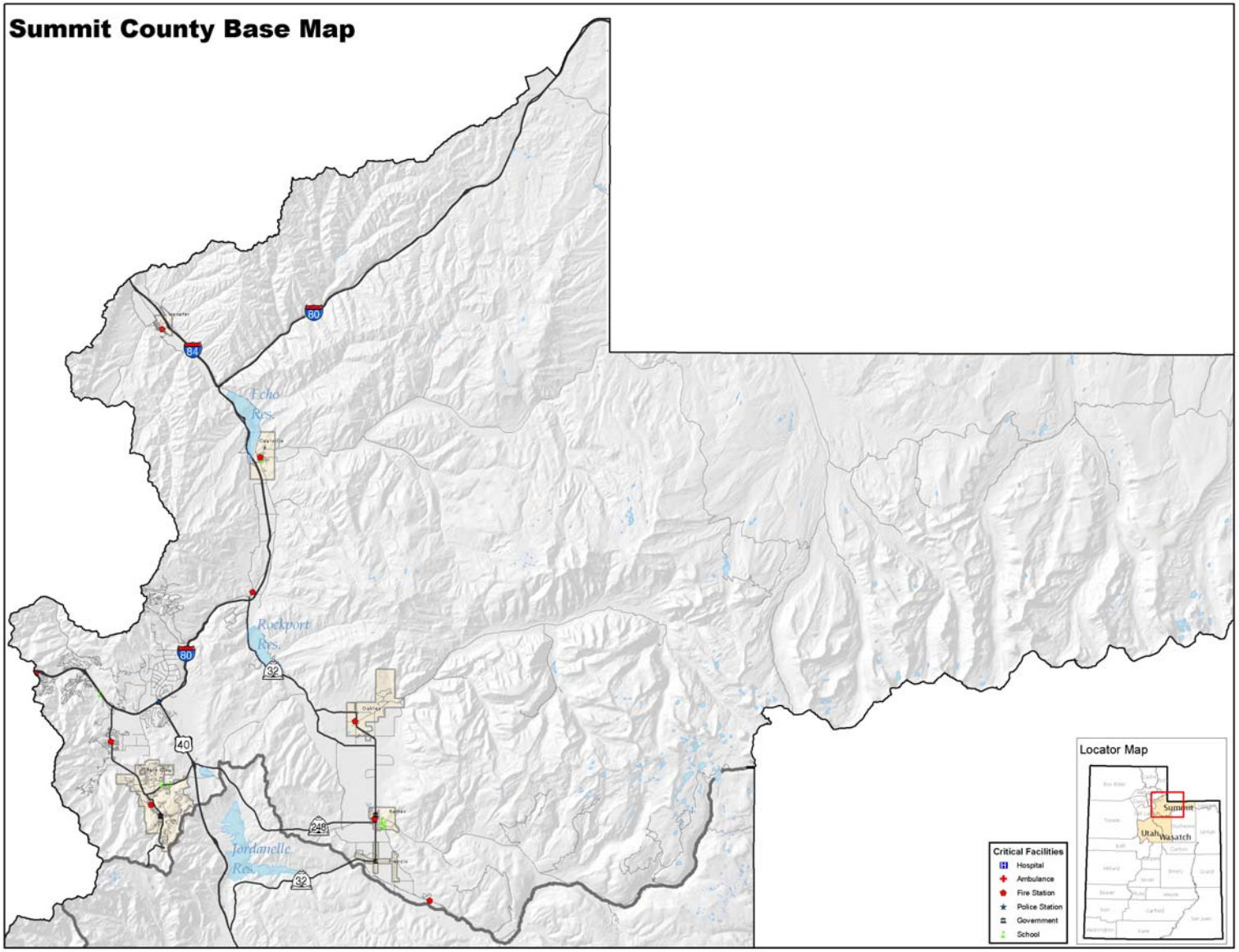
Area: 1,849 square miles; *population*: 29,736 (in 2000); *county seat:* Coalville; *origin of county name*: the county includes high mountain summits that form the divides of the Weber, Bear, and Green River drainage areas; *principal cities/towns*: Park City (7,371), Coalville (1,382), Kamas (1,274); *points of interest*: Park City area ski resorts, Park City Historic District, Rockport State Park, Echo Reservoir, High Uinta Wilderness Area; *economy*: skiing, tourism, lumbering, livestock.

Summit County was created in 1854 from Green River and Great Salt Lake counties. The Uinta Mountains dominate the eastern portion of the county, and the western section is a high back valley of the Wasatch Mountains.

The first white men to visit the area were fur trappers and traders in the 1820s and 1830s. Until the arrival of the Mormons in 1847, Summit County was hunting grounds for Northern Shoshone Indians. In 1846 Lansford W. Hastings, a California promoter, announced a new cutoff on the California Trail that would eliminate several hundred miles and many days of travel. The cutoff turned southwest from Fort Bridger, Wyoming, and entered Utah and the northeastern corner of Summit County through Echo Canyon. It followed the Weber River to Salt Lake Valley, went around the south shore of the Great Salt Lake, and then west into Nevada. The first group to take this new cutoff was the Donner-Reed party in 1846. Blazing a road through the Wasatch Mountains cost them many days, and when they reached the Sierra they ran into early snow, with well-known tragic results. Many lost their lives. A year later, the pioneering Mormons adopted part of the Hastings Cutoff, but when they reached the Weber River they turned southwest to Emigration Canyon. This became the main trail for the immigration of the Mormons to Utah. In 1869 the Union Pacific Railroad, builder of the eastern portion of the transcontinental railroad, followed the Hastings Cutoff, and today part of Interstate 80 follows the Hastings and Mormon trails and the Union Pacific route through northern Summit County.

The first settlers in Summit County arrived at Parley's Park in 1850. Wanship was settled in 1854, followed by Coalville, Hoytsville, and Henefer in 1859. When coal was discovered near Coalville, the Mormons established a mission there. During the 1860s, wagons hauled tons of coal from Coalville to the Salt Lake Valley settlements. In 1873 the Utah Eastern Railroad built a line from Echo Junction to Coalville to haul coal. This line eventually became part of the Union Pacific Railroad.

The discovery of silver, lead, and zinc in the Wasatch Mountains in the 1870s soon overshadowed the settlement and economic activities of the rest of the county. Park City, a mining town founded in 1872, continued to expand into the twentieth century. Many individuals made fortunes from the Park City mines. Mansions on South Temple in Salt Lake City reflect some of this wealth. Mining continued until the 1950s, at which time it no longer was profitable. For several decades Park City was on the verge of becoming a ghost town, but the area's rugged terrain and deep snow led to its rebirth as a winter sports center. Skiing currently is a major economic activity in western Summit County, while the rest of the county is still noted for its farming and ranching. Other recreational opportunities, including boating, fishing, and tourism add to the county's diversified economy. (Source: Utah Historical Encyclopedia, Craig Fuller, author)


Summit County Base Map
Echo Res.
Rockport Res.
Jordanelle Res.
80
84
32
40
248
Locator Map
Summit
Utah
Wasatch
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School

Population

The following table shows historic population data:

Table S-1

	1930	1940	1950	1960	1970	1980	1990	2000
Summit	9,527	8,714	6,745	5,673	5,879	10,198	15,518	29,736

Economy

Summit County has been the recipient of many new businesses, much residential and commercial development, and a thriving ski and tourism economy that defines its character and atmosphere. Summit County's local economy is largely driven by the activities of Park City and the Snyderville Basin. Its population has more than doubled since the initial OEDP was drafted. Eastern Summit County and its cities also face numerous growth and development pressures, although not exhibiting anywhere near the level of investment that is pushing the western half of the county. With numerous venues of the 2002 Winter Olympics within the Mountainland Region, economic growth should continue in the future.

Table S-2

Economic Indicators for Summit County 1997-2001						
Summit County	1997	1998	1999	2000	2001	% Change 00-01
Population	26,224	27,674	28,799	30,048	31,279	4.1
Employment						
-Avg civilian labor force	12,984	13,701	14,250	14,517	15,092	3.7
-Avg non-ag employment	13,765	14,339	14,558	15,221	15,844	4.0
Income						
-Avg monthly non-ag wage	1,807	1,932	1,996	2,143	2,224	3.8
-Annual non-ag payroll ($000)	298,428	322,820	348,677	391,378	422,950	8.1
Total personal income ($Mil)	960	1,066	1,153	1,283	1,295	6.6
Per capita personal income	36,049	38,767	40,528	41,405	43,200	2.2
Taxes						
-Total assessed value ($Mil)	4,610	5,967	5,544	6,172	6,963	12.8
-Prop taxes charged ($000)	52,255	56,673	58,537	63,595	68,057	8.5
-Gross taxable sales ($000)	585,961	631,299	685,940	742,862	828,955	11.6
-Net local sales tax ($000)	4,705	5,012	5,399	5,813	6,391	10.0
Construction (permitted)						
-New Dwelling Units (#)	791	796	665	533	900	68.9
-Value of new res. ($000)	117,350	133,882	111,751	101,495	144,414	42.3
-Value new non-res ($000)	21,730	71,936	86,780	40,669	37,067	-8.9
-Value of total constr. ($000)	152,663	227,176	218,883	163,151	206,029	26.3
Miscellaneous						
-Fed mineral royalties ($000)	1,273	1,515	1,522	1,665	367	-18.4
-Fed in lieu of taxes ($000)	324	324	346	381	524	37.5

Source: Bureau of Economic and Business Research, University of Utah. www.business.utah.edu/bebr/Counties/summit.htm

Risk Assessment

Flood

Table S-3

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Summit	Unincorporated	17379		490134 - 7/17/86(M)	Weber and Provo Rivers & Tributaries
Summit	Coalville	1382	D5	490135 - (NSFHA)	Chalk Creek
Summit	Francis	698	D5	Not Participating**	Provo River
Summit	Henefer	684	C5	490136 - 5/20/80(M)	Weber
Summit	Kamas	1274	D5	490137 - (NSFHA)	
Summit	Oakley	948	D5	490138 - 9/24/84(M)	Weber
Summit	Park City	7371	D5	490139 - 7/16/87	Mcleod & Others

Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.
* D = Detailed Study Report and Map Prepared.
** Has not had flood hazards mapped by FEMA. Not participating in NFIP

Summit County Flood and Dam Failure History

Table S-4

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Summit	September 8, 1940	Echo/Henefer	Damage to Weber Canyon Highway and railroad tracks	
Flood Summit	August 11, 1941	Echo	Highway and railroad tracks	Landslides cover highway and railroad in five locations
Flood Summit	August 6, 1945	Hoytsville	Extensive damage to roads, buildings, farmlands, and crops	
Flood Summit	August 16, 1950	Heneger	Damage to ranches in vicinity of town	
Flood Summit	August 12,1961	Hoytsville/Echo	Damage to highways 189 and 30, and railroad tracks	Source Cottonwood Creek and Echo Cliff Wash
Flood Summit Presidential	Spring 1983	County Wide	Damage to roads, bridges, and culverts.	Source Chalk Creek Several landslides
		Coalville	City park, roads, sewage pump station, and drainage ditches.	12 private homes damaged
		Kamas	Roads, bridges, and sewer systems compromised.	
		Park City	Daly Avenue damaged flooding in Thaynes Canyon Subdivisions.	
Flood Summit Presidential	Spring 1984	County wide	$368,850 in damage. Wooden Shoe Road and Chalk Creek Road washed out.	

(All dollar values for given are for year of disaster)
Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.

The following table represents the estimated damage from a flood in Summit County. The data was collected from MAG's GIS.

Table S-5

Name	County	Population	Households	Value	Employment
Summit	Summit	142	44	$6,600,000	8

Summit County Flood Mitigation Goals

County-wide

Problem Identification: Flood occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.

Goal 1 – Priority High

Objective 1.1 Encourage 100% participation in the National Flood Insurance Program (NFIP).

Action: Assist Town of Francis in joining NFIP
Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Engineer, State Floodplain Manager
Background: FEMA has yet to map the Town of Francis with Special Flood Hazards (SFHA). The community does not participate in the NFIP therefore flood insurance is not available.

Objective 1.2 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance.

Objective 1.3 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management

Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.4 Reduce flooding threat in Oakley, Woodland, Wanship, Hoytsville, Coalville, Peo, Francis and Henefer.

Action: Clear debris and other material from streams prior to spring snow melt.
Time Frame: Ongoing
Funding: None
Estimated Cost: Unknown
Staff: County Public Works
Background: Most flooding is attributed to debris-laden streams.

Objective 1.5 Ensure EOC(s) are equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.
Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: An alternate EOC is being considered in Kamas. Adequate communication capabilities are essential between all response agencies within the County.

Objective 1.6 Support updating of flood data

Action: Support and encourage participation in the NFIP Flood Map Mod Program.
Time Frame: Ongoing
Funding: Federal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager
Background: Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.

Mitigation Strategies

The following mitigation strategies are provided to inform communities of additional ways to mitigate hazards.

Prevention

- Planning and Zoning
- Floodplain open space preservation
- Building construction regulation
- Regulation of other facilities (critical)
- Stormwater management

Property Protection

- Relocation
- Acquisition
- Building elevation
- Flood proofing
- Lifeline protection
- Flood Insurance

Natural Resource Protection

- Wetlands protection
- Erosion and sediment control

Emergency Services

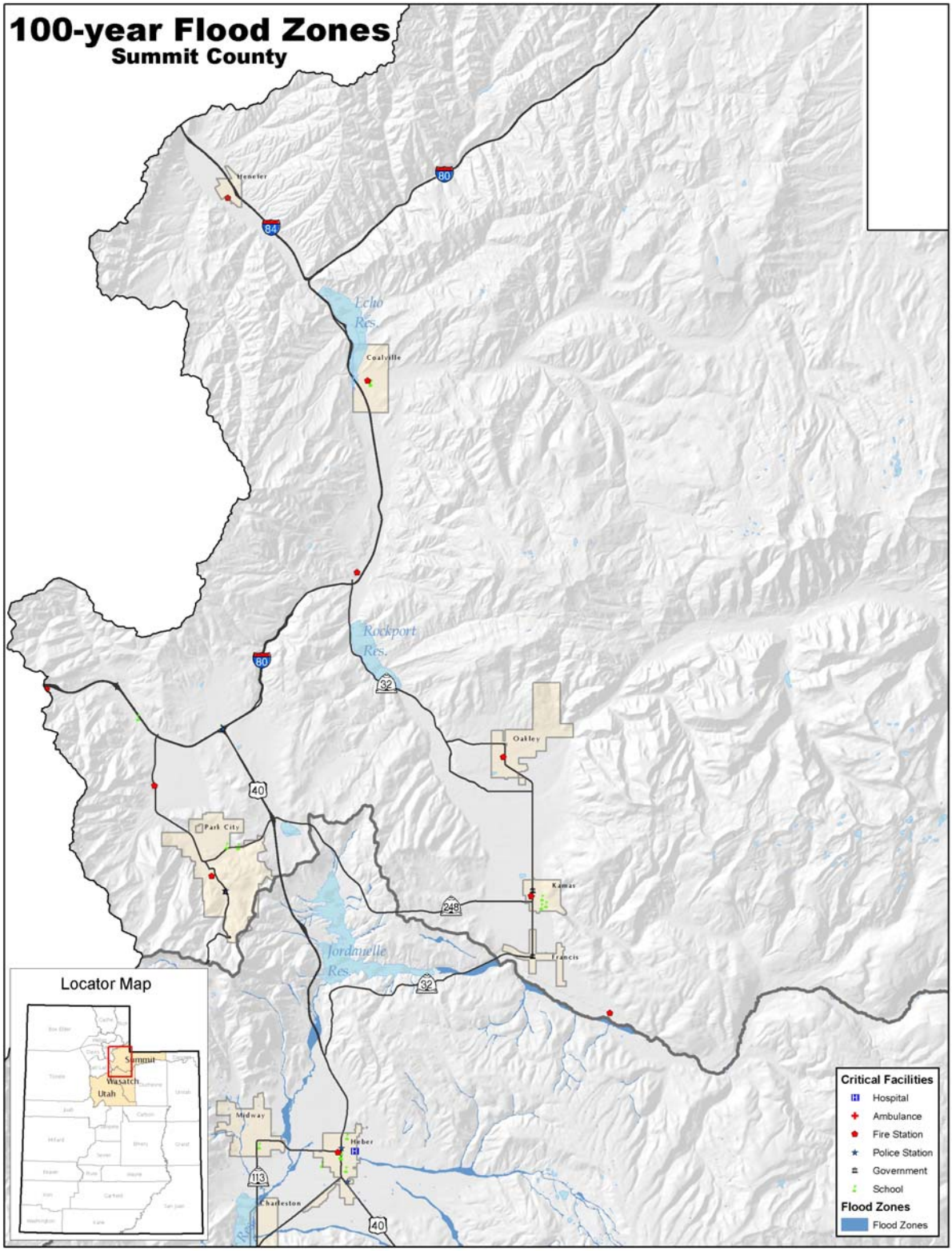
- Flood threat recognition
- Warning dissemination
- Flood response
- Critical Facilities Protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects

- Reservoirs/impounds
- Levees
- Diversions
- Channel and drainage modifications
- Channel and basin maintenance

Public information

- Flood Hazard maps
- Map Information
- Outreach projects
- Real estate disclosures
- Library
- Technical Assistance
- Environmental education


100-year Flood Zones
Summit County
Meneler
Echo Res.
Coalville
Rockport Res.
Oakley
Park City
Kamas
Jordanelle Res.
Francis
Midway
Heber
Charleston
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Flood Zones
Flood Zones

Wildland Fire

Assessing Vulnerability

The following tables are taken from GIS data to determine the vulnerability of properties to wildfire damage.

Table S-6

City	County	Population	Households	Value	Employment
Coalville	Summit	550	163	$24,450,000	18
Francis	Summit	45	14	$2,100,000	0
Kamas	Summit	75	23	$3,450,000	1
Park City	Summit	1,932	643	$96,450,000	2,289
Summit	Summit	7,298	2,517	$377,550,000	3

Table S-7

Roads				
CITY	COUNTY	Type of Road	Length in Miles	Value
	Summit		6.42	$12,840,000
	Summit	Cloverleaf or interchange	3.68	$7,360,000
	Summit	Connecting road	9.29	$18,580,000
	Summit	Jeep trail,	4.63	
	Summit	Neighborhood roads	106.98	$213,960,000
	Summit	Neighborhood roads	0.07	$140,000
	Summit	Primary road, interstate highway	5.91	$21,276,000
	Summit	Primary road, interstate	0.08	$288,000
	Summit	Primary road, interstate	9.89	$35,604,000
	Summit	Primary road, interstate	0.19	$684,000
	Summit	Secondary road, U.S. highway	5.43	$13,102,590
	Summit	Walkway	1.53	$80,784
Coalville	Summit	Neighborhood roads	2.89	$5,780,000
Coalville	Summit	Walkway	0.5	$26,400
Kamas	Summit	Connecting road	0.01	$20,000
Kamas	Summit	Neighborhood roads	0.14	$280,000
Park City	Summit	Jeep trail	0.75	
Park City	Summit	Neighborhood	7.72	$15,440,000
		Total	166.11	$345,461,774

Table S-8

Utilities				
County	City	Type of Line	Length in Miles	Value
Summit	Park City	KV-46	1	$48,280
Summit		KV-12.5 or less	9	$434,520
Summit		KV-138	1	$48,280
Summit		KV-46	10	$482,800
Summit		Owned by others	10	$482,800
Summit		SUB-CO	0	
Summit		SUB-PP	0	
		Total	31	$1,496,680

Historic Fires

The following table identifies historic Wildfires in Summit County

Table S-9

FIRE_ID	YEAR	NAME	SDATE	CAUSE	COUNTY	TYPE	SIZE
2045-1999	1999	EMORY	11/3/1999	SM	Summit	Wildland	160.00
3382-2000	2000	DRY FORK	9/6/2000	MC	Summit	Wildland	200.00
3126-2000	2000	DRY BREAD	8/4/2000	LT	Summit	Wildland	250.00
1820-1999	1999	HARRIS CANYON	8/19/1999	LT	Summit	Wildland	300.00
3056-2000	2000	EAGLE CANYON 2	7/3/2000	DB	Summit	Wildland	410.00
2048-1999	1999	HENEFER LEDGES	10/24/1999	IN	Summit	Interfac	490.00
2049-1999	1999	LAMBS MEADOW	10/13/1999	CF	Summit	Wildland	600.00
3313-2000	2000	ECHO	7/21/2000	EQ	Summit		600.00
3433-2000	2000	FRANKLIN RIDGE	8/14/2000	MC	Summit	Interfac	3100.00
1347-1999	1999	EAGLE CANYON	7/24/1999	EQ	Summit	Interfac	3744.00

Overview

Wildfire is the most frequently occurring natural hazard within the Summit County area.

Development Trends

Much of the development occurring in Summit County and the jurisdictions in the county is in urban-wildland interface areas. Growth will occur on the urban fringe as well as resort properties near the ski areas of Park City.

Multi-Jurisdictional Risk Assessment

Most of the communities in Summit County are separated, however, wildfires may cross jurisdictional boundaries between communities and the unincorporated areas of rural Summit County.

Problem Identification: Continuing non-compliance with Fire-wise development "Best Practices".

Goal 1 – Priority High

Objective 1.1 Increase compliance with existing building and fire codes.

Action: Develop and enforce current local, state and national codes
Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Problem Identification: Building continues to be of concern in Urban Wildfire Interface Areas (URWIN). Especially in the following areas: Pine Mountain – Oakley, Samak – Kamas, Sage Mountain – Echo, Mountainland and developed areas near Bear River Service on Mirror Lake Highway.

Goal 2 – Priority High

Objective 2.1 Educate homeowners on how to reduce risk of wildfire damage

Action 1: Conduct an education program (Firewise) on reducing wildfire risks
Time Frame: Ongoing
Funding: County
Estimated Cost: Minimal
Staff: Fire District(s), County Emergency Management, State FFSL
Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes

Action 2: Develop a firebreak road in Pine Mountain Subdivision in Oakley
Time Frame: 3 years
Funding: County, State and Federal
Estimated Cost: Unknown
Staff: Private land owners, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service
Background: Wildfires have the potential to threaten this area. This will assist in protecting the community by providing a firebreak

Action 3: Continue to work with current Firewise communities (Pinebrook, The Colony's, Summit Park) on their wildfire risks
Time Frame: Ongoing
Funding: County, State and Federal Grants
Estimated Cost: Minimal
Staff: County Emergency Management, State FFSL, US Forest Service
Background: It is essential we continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.

Mitigation Strategies–Wildland Fire

The following mitigation strategies are examples that could be used to limit the exposure to Wildland Fire related damage.

Prevention

- Zoning ordinances to reflect fire risk zones
- Regulate development areas near fire protection and water resources
- Planning to include: spacing of buildings, firebreaks, on-site water storage, wide roads, multiple access
- Code standards for roof materials and fire protection systems
- Maintenance programs to clear dead and dry brush
- Regulations on open fires
- Open space around structures

Property Protection

- Retrofitting roofs, add spark arrestors
- Create and maintain defensible space
- Insurance
- Eliminate ladder fuels
- Install sprinkler systems
- Develop fire resistant plans
- Have home addresses clearly displayed
- Clean out rain gutters

Natural Resource Protection

- Require mitigation of development in high-risk areas
- Understand impact of non-native vegetation
- Promote tread soft ATV use
- Develop watershed management plans
- Maintain watersheds
- Establish and promote fuel reduction

Emergency Services

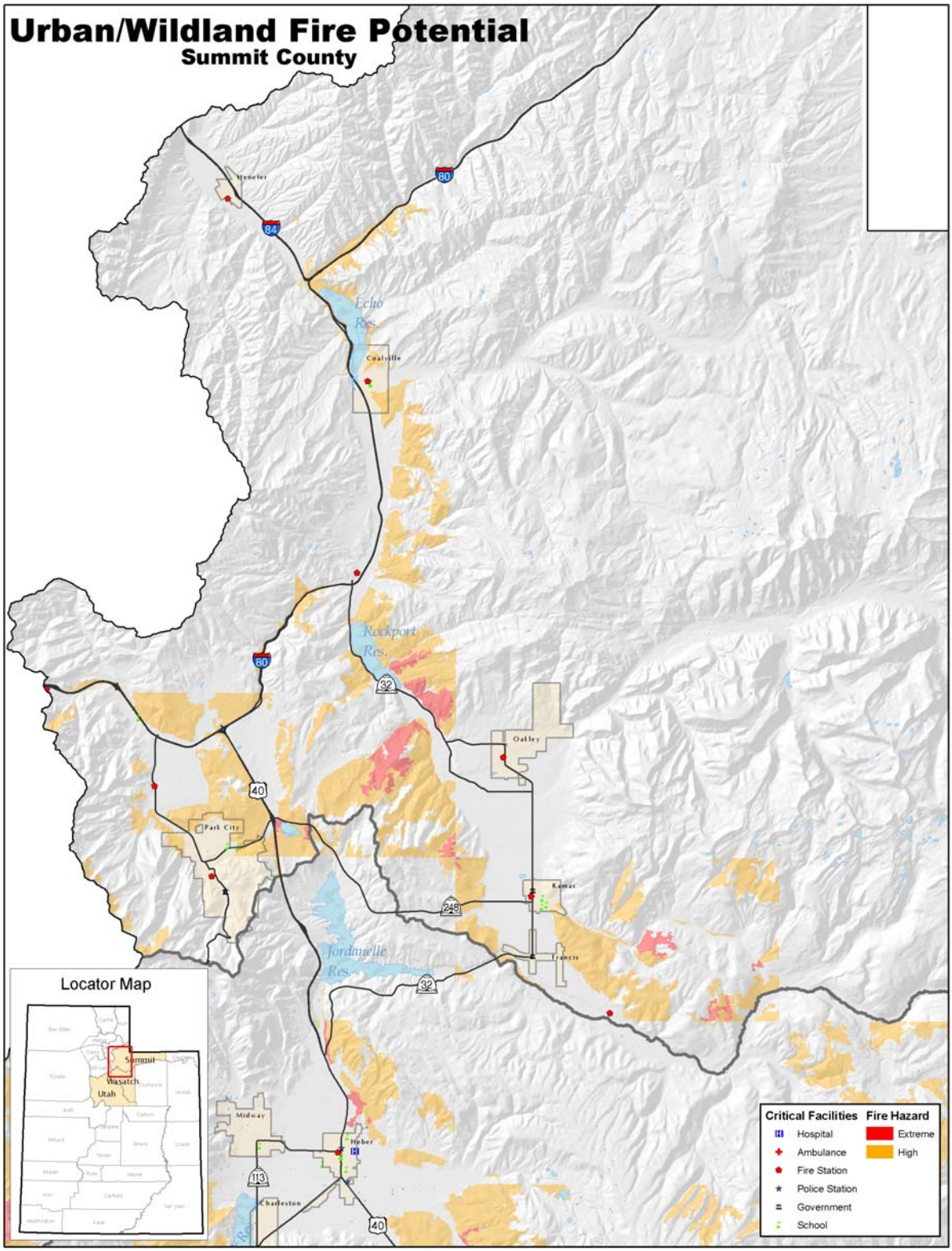
- Mutual aid agreement for fire fighting
- Participate in State Wildfire Suppression Fund
- Develop and exercise local wildfire response plan and evacuation plans

Structural Projects

- Construct wildfire fuel breaks
- Install Heliport water stations
- Tree and underbrush thinning in critical areas
- Increase the number of fire hydrants
- Install water tanks

Public information

- Develop maps for wildfire hazard areas
- Mail wildfire information to owners high-risk structures
- Develop urban wildfire “How to protect your home from Wildfires” book
- Publish newspaper articles on wildfires
- Presentations on wildfires at community meetings
- Develop displays for public buildings and events
- Real estate disclosure of high hazard wildland fire area


Urban/Wildland Fire Potential
Summit County
Meneier
Echo Res.
Coalville
Rockport Res.
Oakley
Park City
Kamas
Francis
Jordanelle Res.
Midway
Heber
Charleston
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Fire Hazard
Extreme
High

Landslide/Problem Soils

Assessing Vulnerability

No electronic data is currently available to determine the vulnerability for problem soils within the Summit County area based on a GIS analysis. It is assumed that the resort communities of Park City and the Snyderville basin will have potential problems with landslides. Due to the high value of much of the development occurring in the area, measures should be taken to reduce the potential for loss.

Development in areas suspected to have soils or landslide issues should be required to have geo-technical studies at the time of development review.

The following table was prepared from a GIS overlay to identify potential losses associated with landslides.

Table S-10
Active Landslides

County	City	Total population	Total houses	Description
Summit		1306	442	Deep Seated
Summit		719	230	LS and LS/talus/colluvial/etc
Summit	Coalville	0	0	Deep Seated
Summit	Coalville	0	0	LS and LS/talus/colluvial/etc
Summit	Oakley	61	17	Deep Seated
Summit	Park City	1092	466	Deep Seated

Development Trends

The area around Park City is known for its destination resort quality views. Much of the economy of the area is based on the snow ski industry. Future development will most assuredly be related to scenic views and resort development. Any areas of potential landslide or problem soils should be addressed in a site-specific geo-technical study.

Mitigation Strategies

Problem Identification: There is a potential risk to structures located in areas identified by the MAG GIS as landslide risk areas.

Goal 1 – Priority Medium

Objective 1.1 Reduce potential landslide risk on commercial, residential structures, and infrastructure (pipelines and utilities) in areas of known landslide potential.

Action 1: Assess the probability of landslides and identify specific structures and infrastructure at risk
Time Frame: Undetermined
Funding: County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Action 2: Include landslide data in County Information and Technology GIS system and include on County website.
Time Frame: Undetermined
Funding: County, possible grants
Estimated Cost: To be determined
Staff: County GIS Staff, UGS,
Background: General public and developers will have access to landslide data.

The following mitigation strategies are provided to inform communities of possible measures that could be used to limit the exposure to landslide/Problem Soils related damage.

Prevention

- Planning and zoning restrictions and regulations
- Open Space
- Building Codes
- Drainage system maintenance
- Monitor and evaluate areas after wildfire
- Install ground monitoring instruments on landslide-prone areas
- Establish codes (grading, construction, excavation) in landslide prone areas

Property Protection

- Insurance
- Remove soil
- Ensure rain gutters and sprinklers are directed away from structures
- Control and monitor surface and ground water drainage
- Control building in areas of landslides
- Evaluate property maintenance in areas of landslides (over watering)
- Plan proper valving of waterlines to ensure quick turn off in the event of a waterline break

Natural Resource Protection

- Leave area as open space
- Identify structures impacted by problem soils
- Complete a watershed management plan
- Limit use of ATVs in areas off landslides to manage erosion
- Evaluate impact of wildfire in areas of landslides
- Mitigate development in landslide-prone areas
- Maintain natural vegetation

Emergency Services

- Identify structures impacted by problem soils
- Monitor and warning systems
- Evacuation plans and exercises
- Critical Facilities Protection
- Equip emergency crews with water valve shut-off keys

Structural Projects

- Pre-soak and/or compact soils
- Install drain fields
- Bring in structural fill
- Build buttress, retaining walls and other engineered structures
- Install subsurface drainage materials
- Remove potential landslide debris

Public information

- Develop information on problem soils
- Outreach information on problem soil mitigation
- Map soils and landslide areas
- Real estate disclosure
- Notice to homeowners in landslide areas detailing hazard
- Library
- Technical Assistance
- Education

Earthquake

Assessing Vulnerability

Please see the HAZUS-MH Earthquake event report for Summit County 2500 year event, print date October 20, 2003 in the appendix of this document for full details of vulnerability. According to the HAZUS-MH run, about 42% or 6,284 will be damaged and that 516 will be completely destroyed. It must however be noted that Summit County lies outside of the Wasatch Fault and that there have only been 8 earthquakes in recorded history, none of which have caused any significant damage.

The geographical size of the region is 1,879.18 square miles and contains 5 census tracts. There are over 10 thousand households in the region and has a total population of 29,736 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 2,980 (millions of dollars). Approximately 99.00 % of the buildings (and 87.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,245 and 326 (millions of dollars) , respectively.

Critical Facility Inventory

HAZUS breaks critical facilites into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 16 schools, 2 fire stations, 2 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 46 dams identified within the region. Of these, 11 of the dams are classified as ‘high hazard’. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plant

Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,571.00 (millions of dollars). This inventory includes over 262 kilometers of highways, 156 bridges, 0 kilometers of pipes.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows:

Severity Level 1: Injuries will require medical attention, but hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization but are not considered life threatening.
Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum and 5:00 PM represents peak commute time.

The following table forecasts the number of casualties that might be expected if an earthquake occurred.
Table S-11

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	3	1	0	0
	Commuting	0	0	0	0
	Education	0	0	0	0
	Hotels	10	3	0	1
	Industrial	3	1	0	0
	Residential	31	7	1	2
	Single Family	108	26	4	7
	Total	156	38	5	10
2 PM	Commercial	198	57	9	18
	Commuting	0	0	0	0
	Education	42	12	2	4
	Hotels	2	1	0	0
	Industrial	25	7	1	2
	Residential	5	1	0	0
	Single Family	16	4	1	1
	Total	287	82	13	26
5 PM	Commercial	146	42	7	13
	Commuting	0	0	0	0
	Education	4	1	0	0
	Hotels	3	1	0	0
	Industrial	16	4	1	1
	Residential	12	3	0	1
	Single Family	42	10	1	3
	Total	223	62	10	19

Building Damage

HAZUS estimates that about 6,284 buildings will be at least moderately damaged. This is over 42% of the total number of buildings in the county. There are an estimated 516 buildings that will be completely destroyed. The following table summaries the expected damage by general occupancy for the buildings in the county.

Table S-12

Type	None	Slight	Moderate	Extensive	Complete
Agriculture	0	0	0	0	0
Commercial	17	24	46	32	16
Educational	0	0	0	0	0
Governmental	0	0	0	0	0
Industrial	1	2	4	3	1
Religion	1	1	1	1	0
Residential	126	234	339	237	91
Single Family	3,269	4,951	4,077	1,030	407
Total	3,413	5,212	4,467	1,302	516

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were $511,700,000; 11% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 73% of the total loss.

Critical Facilities

Table S-13

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	0	0	0	0
Schools	16	0	0	0
EOCs	0	0	0	0
Police Stations	2	0	0	0
Fire Stations	2	0	0	0

Development Trends

Due to Summit County being outside of the Wasatch Fault the potential for earthquakes is very low. Since there is a low potential for earthquakes, current development trends do not increase the vulnerability to earthquake damage.

The following table shows recorded earthquakes occurring in Summit County of Richter magnitude 3.0 or greater since 1950.

Table S-14

Date	Richter Magnitude	Epicenter
July 27, 1965	3.7	East of Park City
February 7, 1972	3.1	Near Kimball Junction

Problem Identification: Summit County will be impacted indirectly from an earthquake on the Wasatch Front. Transportation and utilities services to and from the County could be severely impacted.

Goal 1 – Priority Low

Objective 1.1 Provide for emergency response and relief

Action: Identify and maintain critical transportation and utility services
Time Frame: Ongoing
Funding: Grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: County
Background: Critical transportation systems need to be maintained.

Problem Identification: Lack of public awareness about earthquake damage prevention practices.

Goal 2 – Priority Medium

Objective 2.2 Through the CERT Program, educate community on earthquake damage prevention practices

Action: Educate the public on damage prevention practices for earthquakes
Time Frame: 2 years
Funding: State and Federal Grants from state and Federal governments
Estimated Cost: $50,000-$75,000
Staff: County Emergency Management and volunteers
Background: Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.

Mitigation Strategies

The following mitigation strategies are provided to suggest additional measures that communities could use to limit the exposure to earthquake related damage.

Prevention

- Planning and Zoning
- Building construction regulation

Property Protection

- Non-structural methods
- Retrofit upgrades
- Earthquake Insurance

Natural Resource Protection

- Identify Fault Rupture zones
- Identify secondary impact

Emergency Services

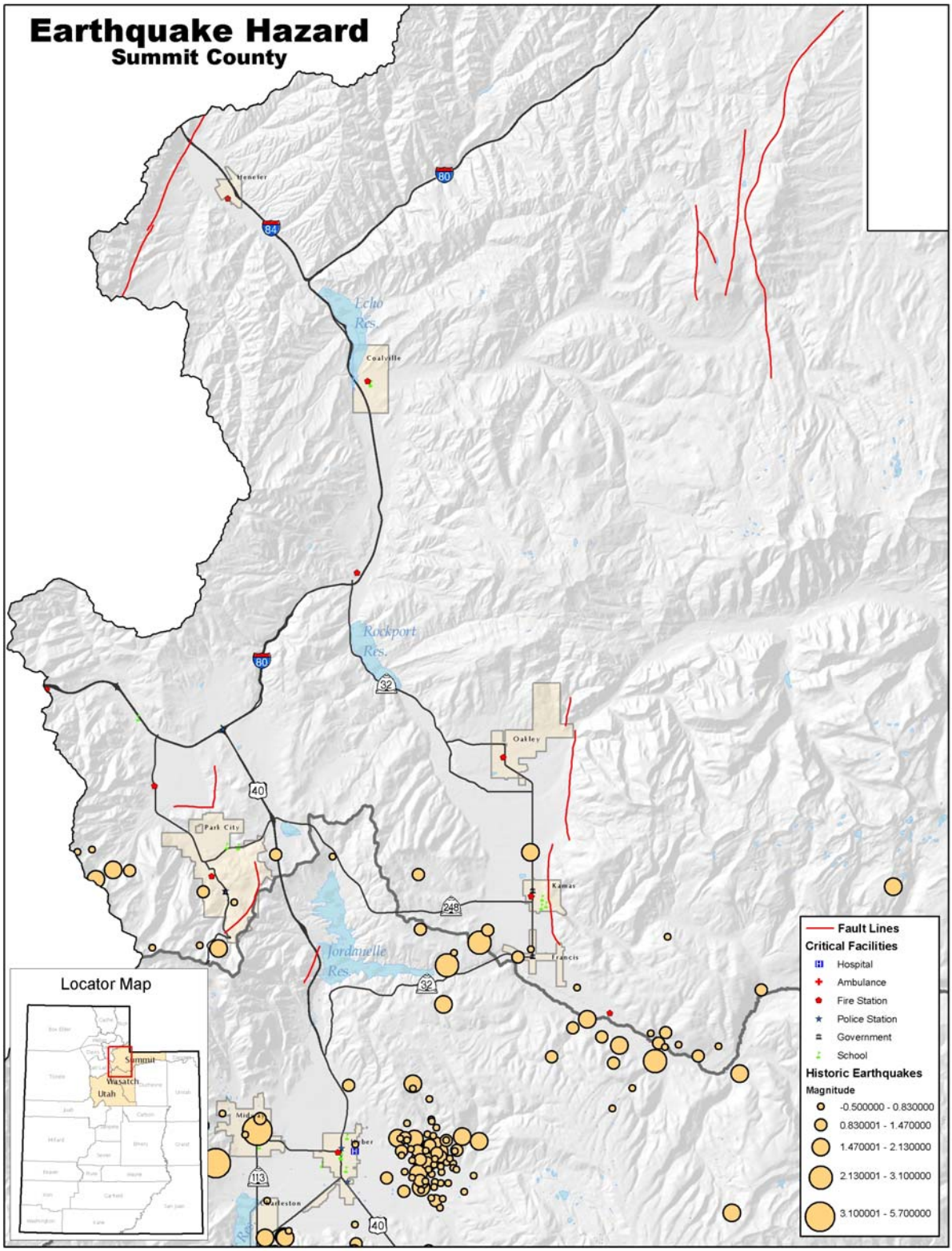
- Earthquake threat recognition
- Emergency Planning for Secondary Impact
- Emergency response (Mutual Aid, CERT)
- Critical Facilities Protection

Structural Projects

- Rebuild or retrofit critical facilities to higher seismic code
- Rebuild or retrofit infrastructure to higher seismic code

Public information

- Seismic maps; liquefaction, fault zones
- Map Information
- Outreach projects
- Real estate disclosures
- Technical Assistance
- Education


Earthquake Hazard
Summit County
Meneier
Echo Res.
Coalville
Rockport Res.
Oakley
Park City
Kamas
Francis
Jordanelle Res.
Charleston
Locator Map
Summit
Wasatch
Utah
Fault Lines
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Historic Earthquakes
Magnitude
-0.500000 - 0.830000
0.830001 - 1.470000
1.470001 - 2.130000
2.130001 - 3.100000
3.100001 - 5.700000

Drought

Assessing Vulnerability

Drought is a region-wide cyclical hazard that varies little among the three counties in the MAG area. The vulnerability will typically be related to agricultural production. A secondary affect of drought is the increase in vulnerability to wildfires. Many of the communities in the region have dealt with drought for a number of years. These communities have several sources for water and storage facilities. Many of the communities have secondary water systems to reduce the demand on culinary water resources. Many communities also have active water conservation programs in place.

County-wide

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority Low

Objective 1.1 Conserve culinary water by educating the public

Action 1: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State and Federal
Estimated Cost: Minimal
Staff: Water Districts
Background: Use a newsletter to educate the public

Action 2: Coordinate with current water systems and develop a secondary water systems plan for drought
Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

Mitigation Strategies

The following mitigation strategies are provided to illustrate measures communities could use to limit the exposure to drought related damage.

Prevention

- Establish economic incentives for water conservation
- Encourage water conservation
- Develop early warning system, monitoring programs
- Implement water metering and leak detection programs

Property Protection

- Identify potential for wildfire due to drought
- Identify secondary effects from drought
- Drought Insurance

Natural Resource Protection

- Legislation to protect stream flows
- Protect water aquifers
- Alert procedures for water quality issues
- Create inventory of pumps, filters and other equipment

Emergency Services

- Establish water hauling programs
- List livestock watering locations
- Establish hay hotline
- Fund water system improvements (wells, systems, reservoir)
- Lower well intakes
- Develop drought contingency plans
- Issue emergency permits for water use

Structural Projects

- Redesign or create new reservoir storage
- Provide pumps and piping for distribution

Public information

- Develop drought education material
- Water conservation outreach material
- Other outreach for awareness

Severe Weather/Avalanche

Assessing Vulnerability

Severe weather conditions and/or avalanche occur in Summit County on a regular basis, however most of the losses are limited. Most of the deaths occur to either backcountry skiers or to skiers skiing out-of-bounds. Search and rescue operations to find buried skiers costs tax payers significant dollars as well as put lives of emergency workers in harm's way. Education of skiers on the dangers of avalanches could go along way toward reducing avalanche deaths. Severe weather may cause closure of transportation routes and fatalities due to weather related vehicular accidents. The ski resorts count on winter storms to produce the snow pack needed to operate their businesses. Some of the ski runs are located in avalanche prone areas, the private ski resorts as well as county public works and state road crews are aware of the potential dangers and keep the avalanche danger to a minimum.

The following table shows recorded damaging snow avalanches that have occurred in Summit County since 1864:

Table S-16

Date	Location	Remarks
February 18, 1884	Park City	Three Deaths
January 21, 1886	Park City	Three Deaths
December 31, 1965	Park City Ski Area	One Death

The following table shows recorded deaths from lightning since 1954:

Table S-17

Date	Location	Remarks
August 2, 1991	Island Lake	Two deaths, standing under tree
July 18, 1997	Cliff Lake	One death, hiking back to camp
July 19, 2003	Crystal Lake Trailhead	Two deaths, sitting under tree
August 14, 2003	Near Dead Horse Lake	One death, hiking on trail

Problem: Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 1 – Priority High

Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participation in the StormReady program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action 2: Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Summit County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Proposed alternate EOC (Kamas), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.

Mitigation Strategies

The following mitigation strategies are provided inform communities of additional methods that could be used to limit the exposure to Severe Weather/Avalanche related damage.

Prevention

- Early warning and notification systems
- Building codes to address wind shear and snow load
- Properly ground structures for lightning
- Public education for severe weather conditions
- Restrict development in avalanche prone areas

Property Protection

- Structural tie downs of roofs in high wind areas
- Mitigate development in areas of avalanche potential
- Monitor NWS weather warnings and watches

Natural Resource Protection

- Evaluate the impacts of severe weather
- Mitigate development in areas of avalanche

Emergency Services

- Monitor NWS weather warnings and watches
- Develop plans and exercises for severe weather

Structural Projects

- Install sheds over roads below avalanche terrain
- Install drift fences along snow drift areas
- Install avalanche fencing along ridgelines for wind blown snow
- Promote Weatherization programs

Public information

- Develop outreach document on avalanche safety
- Become a NWS Storm Ready Community
- Promote Lighting Safety Week
- Develop cold weather safety materials
- Ensure that at risk groups, such as the elderly, are checked on during severe weather

Infestation

Assessing Vulnerability

The vulnerability for infestation damage to the Summit County area varies little from the regional assessment above.

The following table identifies the mitigation strategies that are the top priority for each community. The mitigation strategies where prioritized based on GIS data. The hazard identified with the highest number of household potentially affected was designated the highest priority.

Summit County Communities
PRIORITIZATION OF INDIVIDUAL COMMUNITY
MITIGATION STRATEGIES
Table S-18

Community	Hazard	Mitigation	Cost	Responsible party	Funding Source
Coalville	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunters
Francis	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Henefer	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Kamas	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Oakley	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Park City	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Summit County	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunters

Utah County

Area: 2,014 square miles; *population*:368,536 (in 2000); *county seat*: Provo; *origin of county name*: after the Ute Indians; *principal cities and towns*: Provo (105,166); Orem (84,324); Pleasant Grove (23,468); American Fork (21,941); Spanish Fork (20,246); Springville (20,424); Lehi (19,028); Payson (12,716); *economy*: steel industry, light manufacturing, agriculture; *points of interest*: Fairfield Stagecoach Inn, historic downtown Provo, Brigham Young University (Monte L. Bean Life Sciences Museum, Museum of People and Culture, Harris Fine Arts Center), Utah Lake, Timpanogos Cave National Monument, Springville Museum of Art, Hutchings Museum of Natural History in Lehi, McCurdy Historical Doll Museum in Provo, Bridal Veil Falls, Sundance ski resort.

The most striking geographical features of Utah County are the Wasatch Mountains along the eastern boundary, and Utah Lake, the state's largest fresh-water lake. The high mountains, rising over 11,000 feet, receive heavy snowfall which feeds the numerous rivers and creeks that flow into the lake. Though large in surface area, Utah Lake is very shallow--18 feet at its deepest point.

Before the valley was settled by Mormon pioneers in the 1840s and 1850s it was the home of the Ute Indians. They lived along the eastern shore of the lake and used fish from the lake as their main food source. The Spanish Catholic priests Dominguez and Escalante, who observed them in 1776, described these Indians as peaceful and kind. Dominguez and Escalante were trying to find a route between Santa Fe, New Mexico, and what is now southern California. When they came down Spanish Fork Canyon in the summer of 1776 they were the first non-Indians to enter Utah Valley.

Mormon pioneers began settling Utah Valley in 1849. Like the Indians before them, they chose to settle on the fertile, well-watered strip of land between the mountains and Utah Lake. More than a dozen towns were established between Lehi on the north and Santaquin on the south. Provo, named for the French fur trapper Etienne Provost, has always been the largest town and the county seat.

In March 1849 thirty-three families, composed of about 150 people, were called to go to Utah Valley under the leadership of John S. Higbee to fish, farm, and teach the Indians. During the next two years - 1850 and 1851 - communities were established at Lehi, Alpine, American Fork, Pleasant Grove, Springville, Spanish Fork, Salem, and Payson.

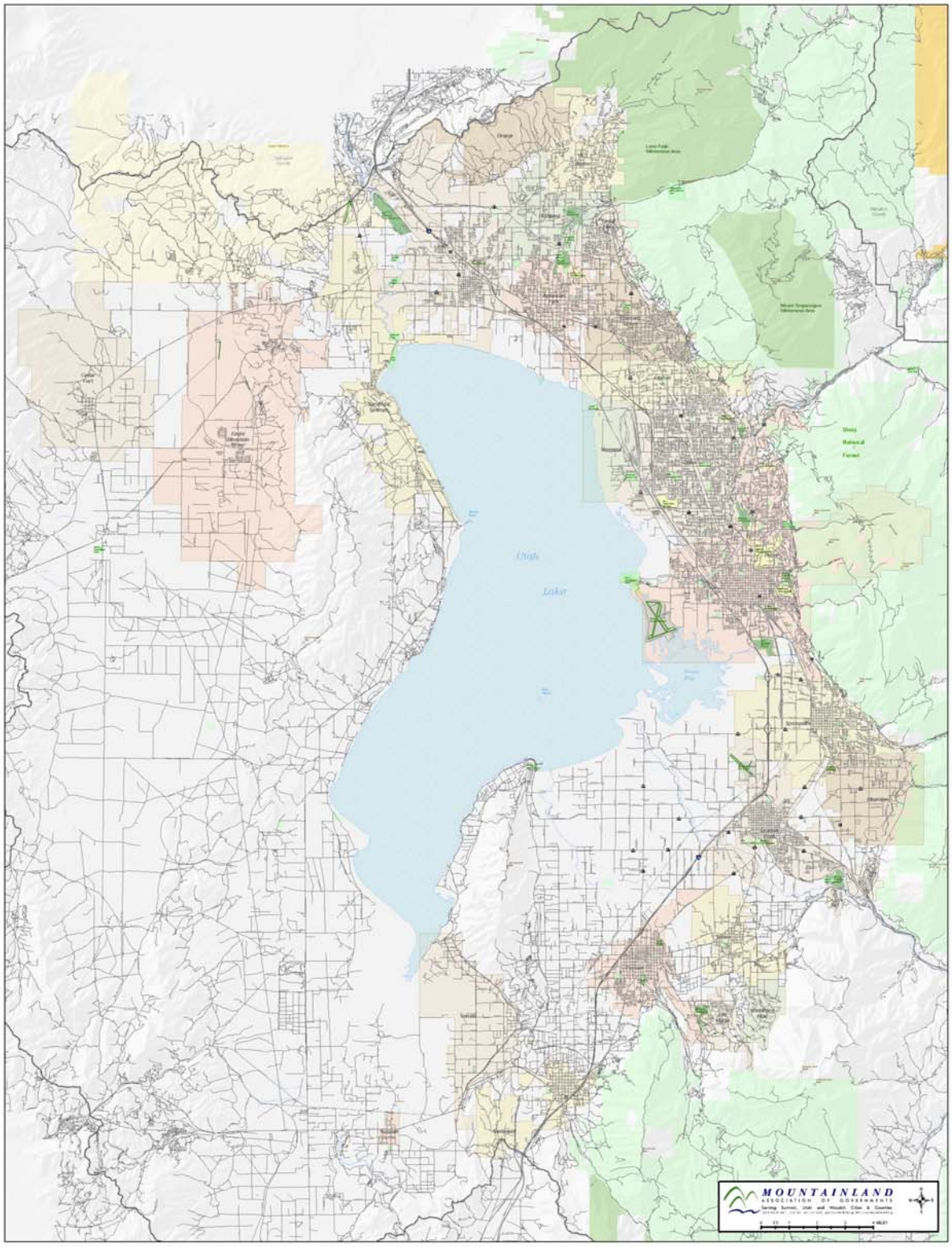
Farming was the most important early industry in the county, with fruit growing and the processing of sugar beets being especially important. The first large-scale sugar beet factory in Utah was built in Lehi in 1890. In recent years, the center of the fruit industry in the county has shifted from Orem to the south end of the valley, where orchards are not threatened by housing developments.

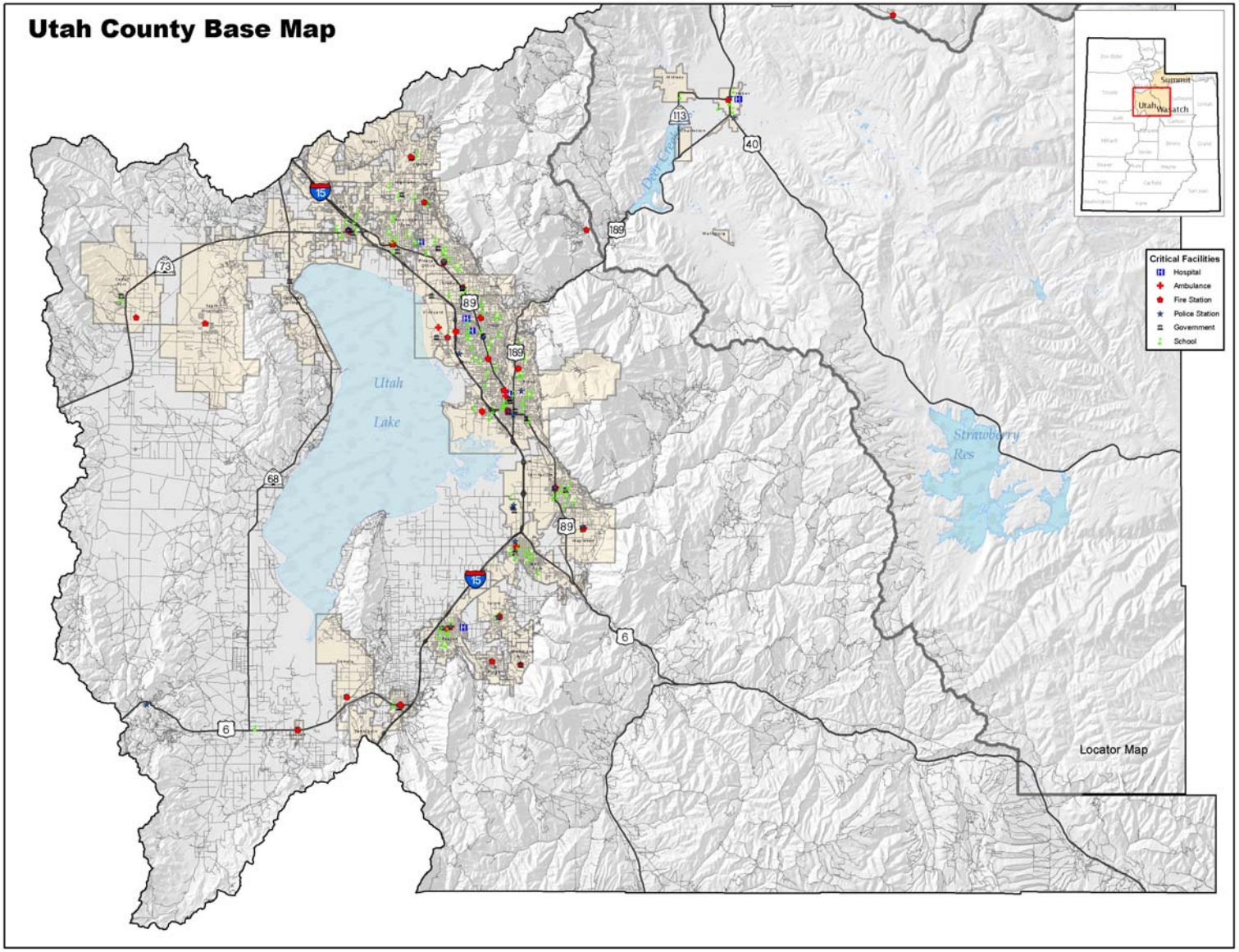
Mining was also an important industry in Utah County. In the late 1800s and early 1900s there were many successful mines in American Fork Canyon and in the Tintic mining district centered near Eureka, Juab County but included part of western Utah County. Many of the fine homes and business buildings in Provo were constructed with mining money.

Today, Utah County is best known as the home of the Geneva steel plant and Brigham Young University. Geneva was constructed at this inland location during World War II in case the steel plants near the coast were destroyed in the war. BYU was established in 1875 as a small high-school level "academy," but it has grown to become a major university with 27,000 students. The Utah Valley Community College at Orem has grown rapidly and plans are being developed to make the institution a four year college. Other

major Utah County employers include WordPerfect Corporation and Novell, two companies that began in Utah County and have become international leaders in the computer software industry.

Each of the major communities in the county have high schools and libraries. A culturally active area, the county has its own symphony--the Utah Valley Symphony, and one of the state's finest art museums: the Springville Art Museum. Provo's Fourth of July Celebration is the largest in the state and other special community celebrations include Pleasant Grove Strawberry Days, the Lehi Round-up, Steel Days in American Fork, Fiesta Days in Spanish Fork, Golden Onion Days in Payson, and the World Folkfest in Springville. (Source: Utah Historical Encyclopedia; Roger Roper, Author)


Utah
Lake
MOUNTAINLAND
ASSOCIATION OF GOVERNMENTS


Utah County Base Map
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Utah
Lake
Strawberry
Res
Locator Map
Summit
Utah
Wasatch
15
73
68
89
189
113
40
6

Population

The following table shows historic population data:

Table U-1

	1930	1940	1950	1960	1970	1980	1990	2000
Utah	49,021	57,382	81,912	106,991	137,776	218,106	263,590	368,536

Economy

Table U-2

Economic Indicators for Utah County 1997-2001						
Utah County	1997	1998	1999	2000	2001	% Change 00-01
Population	334,658	344,820	358,463	371,894	385,692	3.7
Employment						
-Ave civilian labor force	153,912	159,751	164,930	169,890	172,455	1.4
-Ave non-ag employment	135,148	141,691	146,724	152,747	154,058	.9
Income						
-Ave monthly non-ag wage	1,907	1,998	2,102	2,215	2,243	1.3
-Annual non-ag payroll ($Mil)	3,093	3,398	3,701	4,057	4,147	2.2
Total personal income ($Mil)	5,600	6,141	6,550	7,088	7,393	4.3
Per capita personal income	16,450	17,380	18,114	19,128	19,170	.2
Taxes						
-Total assessed value ($Mil)	11,229	11,825	11,460	12,811	14,357	12.1
-Prop taxes charged ($000)	127,708	129,646	126,218	137,956	153,870	11.5
-Gross taxable sales ($Mil)	3,264	3,670	3,939	4,171	4,327	3.8
-Net local sales tax ($000)	34,597	36,749	39,751	42,681	45,213	5.9
Construction (permitted)						
-New Dwelling Units (#)	3,291	4,146	4,111	3,898	4,272	9.6
-Value of new res. ($000)	327,293	422,156	481,103	503,210	576,294	14.5
-Value new non-res ($000)	229,722	139,423	160,099	154,361	167,323	8.4
-Value of total constr. ($000)	619,722	657,853	721,693	743,135	824,155	10.9
Miscellaneous						
-Fed mineral royalties ($000)	52,415	132,179	160,286	100,320	132,832	32.4
-Fed in lieu of taxes ($000)	458	478	488	519	761	46.7

Source: Bureau of Economic and Business Research, University of Utah.
www.business.utah.edu/bebr/Counties/utah.htm

Flood/Dam Failure

Assessing Vulnerability

Overview

Although Utah is considered a dry desert state, flooding does occur. Most floods are occur either from snow melt or severe thunderstorms. Often times flooding is increased by soils that are more impervious due to either wildfire or drying out. Floods occur on a regular basis in Utah County.

Development Trends

As development occurs on the bench areas of Utah Valley, along the shore of Utah Lake, or along river and stream corridors more homes will be in danger of floods. Communities need to make developers and homeowners aware of the danger. Cities should review every development that it is in compliance with NFIP guidelines.

The following table identifies the communities in Utah County with their NFIP Status.

Table U-3

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS*	THREAT (or NSFHA-eligible)
Utah	Unincorporated	17638		490517 - 12/15/94	Utah Lake & Tributaries
Utah	Alpine	7146	E5	490228 - 4/4/83	
Utah	American Fork	21941	E5	490152 - 11/25/80(M)	
Utah	Cedar Fort	341	E4	490153 - (NSFHA)	
Utah	Cedar Hills	3094	D5	Not Participating	Heisett's Hollow & Other drainages
Utah	Eagle Mountain	2157	D4	Not Participating	Tickville Gulch &Tributaries
Utah	Elk Ridge	1838	E5	Not Participating	Loafer Canyon & Others drainages
Utah	Genola	965	E5	490154 - (NSFHA)	
Utah	Goshen	874	F4	Not Participating	City Ditch (minor)
Utah	Highland	8172	D5	490254 - 2/4/02	
Utah	Lehi	19028	E5	490209 - 3/1/83	
Utah	Lindon	8363	E5	490210 - 2/19/86(M)	
Utah	Mapleton	5809	E5	490156 - 12/16/80(M)	
Utah	Orem	84324	E5	490216 - 9/24/84(M)	
Utah	Payson	12716	E5	490157 - 1/6/81	
Utah	Pleasant Grove	23468	E5	490235 -	

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS*	THREAT (or NSFHA-eligible)
				(NSFHA)	
Utah	Provo	105166	E5	490159 - 9/30/88	
Utah	Salem	4372	E5	490160 - 7/16/79	
Utah	Santaquin	4834	E5	490250 - **(NSFHA)**	Tributaries 4, 5, & 6
Utah	Saratoga Springs	1003	D4	490227 - **(NSFHA)**	
Utah	Spanish Fork	20246	E5	490241 - 2/19/86(M)	
Utah	Springville	13950	E5	490163 - 2/15/85	
Utah	Vineyard	150	E5	Not Participating	Utah Lake
Utah	Woodland Hills	941	E5	Not Participating	Broad and Snell Hollows

Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.
* D = Detailed Study Report and Map Prepared.

The following table is a vulnerability assessment for a 100 year flood in Utah County

Table U-4

City	County	Population	Households	Value	Employment
Alpine	Utah	2,970	693	$103,950,000	24
American Fork	Utah	1,407	354	$53,100,000	58
Cedar Hills	Utah	0	0	$0	
Genola	Utah	62	17	$2,550,000	
Highland	Utah	1,042	245	$36,750,000	
Lehi	Utah	3,020	821	$123,150,000	166
Lindon	Utah	1,737	398	$59,700,000	338
Mapleton	Utah	469	115	$17,250,000	
Orem	Utah	633	170	$25,500,000	473
Payson	Utah	1,649	441	$66,150,000	191
Pleasant Grove	Utah	173	40	$6,000,000	
Provo	Utah	8,438	2,409	$361,350,000	1388
Salem	Utah	604	186	$27,900,000	7
Saratoga Springs	Utah	451	123	$18,450,000	
Spanish Fork	Utah	1,157	298	$44,700,000	87
Springville	Utah	834	233	$34,950,000	51
Utah	Utah	1,795	492	$73,800,000	
Vineyard	Utah	48	16	$2,400,000	

Table U-5

Roads				
City	County	Type of Road	Length in Miles	Value
	Utah		0.9	$1,800,000
	Utah	Cloverleaf or interchange	0.35	$1,260,000
	Utah	Connecting road	0.08	
	Utah	Jeep trail	0.1	
	Utah	Neighborhood roads	28.71	$57,420,000
	Utah	Primary road	1.25	$2,500,000
	Utah	Secondary road, U.S. highway	1.41	$3,403,035
Alpine	Utah		0.04	
Alpine	Utah	Connecting road, county roads,	0.13	$260,000
Alpine	Utah	Neighborhood roads	2	$4,000,000
American Fork	Utah	Neighborhood roads	0.79	$1,580,000
American Fork	Utah	Primary road, interstate highway	0.11	$396,000
Cedar Hills	Utah	Connecting road, county roads,	0.14	$280,000
Highland	Utah	Connecting road, county roads,	0.26	$520,000
Highland	Utah	Neighborhood roads,	0.82	$1,640,000
Lehi	Utah	Connecting road, county roads	0.56	$1,120,000
Lehi	Utah	Neighborhood roads, city streets	5.04	$10,080,000

Lehi	Utah	Primary road, interstate highway	0.03	$108,000
Lehi	Utah	Secondary road, U.S. highway	0.07	$168,945
Lindon	Utah	Neighborhood roads, city streets	2.37	$4,740,000
Mapleton	Utah	Neighborhood roads, city streets	0.29	$580,000
Orem	Utah	Connecting road, county roads	0.01	$20,000
Orem	Utah	Neighborhood roads, city streets	0.22	$440,000
Orem	Utah	Secondary road, U.S. highway	0.42	$1,013,670
Payson	Utah	Neighborhood roads, city streets	3.16	$6,320,000
Pleasant Grove	Utah	Neighborhood roads, city streets	0.03	$60,000
Provo	Utah	Cloverleaf or interchange	1.16	$4,176,000
Provo	Utah	Connecting road, county roads,	0.07	$140,000
Provo	Utah	Neighborhood roads	5.94	$11,880,000
Provo	Utah	Primary road, interstate highway	0.67	$2,412,000
Provo	Utah	Secondary road	0.02	$40,000
Salem	Utah		0.02	
Salem	Utah	Neighborhood roads	0.72	$1,440,000
Saratoga Springs	Utah	Connecting road, county roads	0.05	$100,000
Saratoga Springs	Utah	Neighborhood	5.58	$11,160,000
Spanish Fork	Utah	Connecting road, county roads	0.36	$720,000
Spanish Fork	Utah	Neighborhood roads	0.49	$980,000
Spanish Fork	Utah	Secondary road, U.S. highway	0.67	$1,617,045
Springville	Utah	Cloverleaf or interchange	0.9	$3,240,000
Springville	Utah	Connecting road, county roads	0.54	$1,080,000
Springville	Utah	Neighborhood roads	1.36	$2,720,000
Springville	Utah	Primary road, interstate	0.61	$2,196,000
Vineyard	Utah	Neighborhood roads	0.9	$1,800,000
		Total	**69.35**	**$145,410,695**

Table U-6

Affected Facilities			
NAME	ADDRESS	CITY	DESC_
Lehi School	765 N Center, Lehi 84043	Lehi	SCHOOL
Sego Lily School	550 E 900 N, Lehi 84043	Lehi	SCHOOL
Lindon City Center	100 N State	Lindon	Government
Payson Fire Department	45 E 100 South	Payson	Fire Station
Parkview School	360 S 100 E, Payson 84651	Payson	SCHOOL
PLEASANT GROVE PD - LINDON STN			police station

Table U-7

Utilities				
City	County	Type of Line	Length in Miles	Value
Alpine	Utah	KV-138	0	$0
American Fork	Utah	KV-46	0	$0
Highland	Utah	KV-138	0	$0
Highland	Utah	KV-46	0	$0
Lehi	Utah	KV-138	1	$48,280
Lehi	Utah	KV-345	1	$48,280
Lehi	Utah	KV-46	0	$0
Lindon	Utah	KV-138	1	$48,280
Lindon	Utah	KV-46	0	$0
Mapleton	Utah	KV-138	0	$0
Orem	Utah	KV-138	0	$0
Orem	Utah	KV-46	0	$0
Provo	Utah	KV-138	0	$0
Provo	Utah	KV-345	1	$48,280
Provo	Utah	KV-46	0	$0
Salem	Utah	Owned by others	0	$0
Saratoga Springs	Utah	KV-46	2	$96,560
Saratoga Springs	Utah	SUB-CO	1	$10,000,000
Spanish Fork	Utah	KV-46	0	$0
Springville	Utah	KV-345	1	$48,280
Springville	Utah	KV-46	0	$0
Vineyard	Utah	KV-345	3	$144,840
	Utah	KV-138	3	$144,840
	Utah	KV-345	14	$675,920
	Utah	KV-46	2	$96,560
	Utah	Owned by others	1	$48,280
	Utah	SUB-CO	0	$0
		Total		$11,448,400

Utah County Flood and Dam failure History

Table U-8

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Utah	May 30, 1939	Thistle	Damage to homes, farmlands, and crops. Highways 50 and 89 received considerable damage	
Flood Utah	July 22, 1943	American Fork	Damage to crops and poultry	
Flood Utah	August 3, 1951	Lehi/Alpine/ American Fork	Damage to homes, farmlands, and crops. Utah Power generator plant damaged as well as 75 feet of	Source Box Elder and American Fork Canyons

			pipeline. Dam in upper American Fork Canyon washed out causing debris flow.	
Flood Utah	August 26, 1952	Lehi	City water lines flooded with mud, National Guard Headquarters flooded	
Flood Utah	July 30, 1953	American Fork	Bridges and roads damaged. Utah Power and Light stations and substations received $10,000 in damage.	Source American Fork Canyon
Flood Utah	September 27, 1962	Provo	Buildings and business establishments in downtown business district flooded	
Flood Utah	May 21, 1973	Payson	Payson Dam washed out causing several hundred thousand dollars in damage to city and roads	
Flood Utah Presidential	Spring 1983	County wide	Damage to county, state, and federal roads, rail lines, homes, and businesses. Damage by municipality below.	Creek Thistle landslide movement Utah Lake elevation reached 4,494.34 causing substantial flooding.
		Alpine	Alpine flooded,	Source Dry Creek Fort Creek
		American Fork	Extensive damage	Source American Fork Canyon
		Covered Bridge Property Owners Association	Bridge washed out forcing use of a swinging footbridge. Without phones for two weeks	
		Elk Ridge	Road damage	Source Loafer Creek
		Genola	Damage to state roads, and public right-of-ways.	
		Goshen	Several thousand dollars in damage.	Culinary water supply contaminated
		Highland	Public park and few road were damaged	Source American Fork Canyon
		Lehi	Damage to roads, bridges, channels, stream banks, and private property	Three families relocated.
		Lindon	Lindon roads damaged	
		Mapleton	$200,000 in damage to all sectors. Five culvert bridges washed out, loss of city culinary water supply.	Source Maple Canyon
		Orem	Minor damage to city other than along Provo River	
		Payson	Damage to water diversion structures in the canyon	Source Payson Canyon
		Pleasant Grove	Damage to streets and homes.	Source Battle Creek Grove Creek
		Provo	Damage to culverts, streets, public property, farmlands, and homes.	Minor landsliding along foothills.

				High groundwater
		Salem	Damage to streets, private yards, and city park	Not eligible for federal funding because damage occurred after the incident period was closed. Sinkholes appeared.
		Santaquin	Damage to roads and loss of culinary water source for six weeks.	
		Spanish Fork	Damage to all sectors	Source Spanish Fork River
		Springville	Damage to riverbanks, bridges, public property, private property, and farmland.	Source Hobble Creek $400,000 in damages
		Strawberry Water Users Association	$216, 777 in damage to improvements owned by the Water Assoc.	Rock diversion dam washed out 2,100 feet of canals, roads, and culverts damaged.
Flooding Utah Presidential	Spring 1984	County Wide	Estate of damage $5, 467,000	

(All dollar values for given are for year of disaster)
Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.

The following table illustrates the vulnerability assessment of the failure of both Deer Creek and Jordanelle Dams. A list of the critical facilities affected by the dam failures is listed in the appendix.

Table U-9

City - Depth of Water	Depth	Population	Households	Value	Employment
Orem – 2	2	36,717	10,683	$1,602,450,000	13983
Provo – 2	2	6,457	1,414	$212,100,000	487
Utah – 2	2	93	28	$4,200,000	
Vineyard - 2	2	36	13	$1,950,000	
Orem – 4	4	3,341	835	$125,250,000	194
Provo – 4	4	6,748	2,011	$301,650,000	386
Spanish Fork - 4	4	0	0	$0	1
Springville - 4	4	119	55	$8,250,000	165
Utah – 4	4	17	5	$750,000	
Orem – 6	6	1,012	252	$37,800,000	600
Provo – 6	6	12,229	3,473	$520,950,000	462
Springville - 6	6	0	0	$0	
Utah – 6	6	70	14	$2,100,000	
Orem – 10	10	272	81	$12,150,000	56
Provo – 10	10	5,123	1,531	$229,650,000	5276
Springville - 10	10	0	0	$0	747
Utah – 10	10	162	44	$6,600,000	
Orem – 15	15	350	92	$13,800,000	5
Provo – 15	15	20,547	6,466	$969,900,000	11343
Springville - 15	15	15	6	$900,000	760
Utah – 15	15	35	7	$1,050,000	
Orem – 20	20	72	14	$2,100,000	4
Provo – 20	20	6,321	1,893	$283,950,000	15737
Vineyard - 20	20	13	4	$600,000	
Orem – 25	25	137	29	$4,350,000	
Provo – 25	25	9,128	2,718	$407,700,000	2953
Orem – 50	50	4	1	$150,000	7
Provo – 50	50	2,253	643	$96,450,000	3851
Total		111,271	32,312	$4,846,800,000	

The following table indicates critical facilities that could be affected by a dam failure: Table U-10

Affected Facilities			
NAME	ADDRESS	CITY	DESC_
Orem Community Hospital	331 N 400 West	Orem	Hospital
Orem City Ambulance Office #2	911 N Main St.	Orem	Ambulance
Orem City Hall	56 N. State	Orem	Government
Orem City Fire Station #2	911 N Main St.	Orem	Fire Station
Cascade School	160 N 800 E, Orem 84057	Orem	SCHOOL
Geneva School	400 N 665 W, Orem 84057	Orem	SCHOOL
Orem School	450 W 400 S, Orem 84058	Orem	SCHOOL
Scera Park School	450 S 400 E, Orem 84058	Orem	SCHOOL
Sharon School	525 N 400 E, Orem 84057	Orem	SCHOOL
Suncrest School	668 W 150 N, Orem 84057	Orem	SCHOOL
Vineyard School	950 W 800 S, Orem 84058	Orem	SCHOOL
Canyon View Junior High	625 E 950 N, Orem 84057	Orem	SCHOOL
Lakeridge Junior High	951 S 400 W, Orem 84058	Orem	SCHOOL
Orem Junior High	765 N 600 W, Orem 84057	Orem	SCHOOL
Mountain View High	665 W Center, Orem 84058	Orem	SCHOOL
Orem High	175 S 400 E, Orem 84057	Orem	SCHOOL
Utah Valley Regional Medical Center	1034 N 500 West	Provo	Hospital
Utah County Offices	100 E Center	Provo	Government
Provo City Hall	351 W Center	Provo	Government
Provo City Electric Energy Department	251 W 800 North	Provo	Government
Provo Ambulance Office #3	601 W Columbia Ln	Provo	Ambulance
Provo Fire Station #4	2050 W 95 South	Provo	Fire Station
Provo City Ambulance Dept Station #4	2050 W 95 South	Provo	Ambulance
Provo Fire Station #3	601 W Columbia Ln	Provo	Fire Station
National Guard Armory	222 W 500 North	Provo	Government
Provo Fire Station #1	80 S 300 West	Provo	Fire Station
Provo City Ambulance Office #1	80 S 300 West	Provo	Ambulance
Valley Ambulance	925 N 500 West	Provo	Ambulance
Amelia Earhart School	2585 W 200 S, Provo 84601	Provo	SCHOOL
Franklin School	350 S 600 W, Provo 84601	Provo	SCHOOL
Sunset View School	525 S 1600 W, Provo 84601	Provo	SCHOOL
Timpanogos School	449 N 500 W, Provo 84601	Provo	SCHOOL
Dixon Middle	750 W 200 N, Provo 84601	Provo	SCHOOL
Farrer Middle	100 N 600 E, Provo 84606	Provo	SCHOOL
Provo High	1125 N University Ave, Provo 8	Provo	SCHOOL
Mt Brook/Eastwood	1300 E Center, Provo 84601	Provo	SCHOOL
Brockbank School	340 W 500 N, Spanish Fork 8466	Spanish Fork	SCHOOL
GENEVA STEEL FIRE DEPT		Vineyard	Fire Station
OREM POLICE DEPT			police station
PROVO POLICE DEPT			police station
UTAH COUNTY SHERIFFS OFC			police station

Utah County Flood Mitigation Goals -

Problem Identification: Flooding occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.

Goal 1 – Priority High

Objective 1.1 Support the National Flood Insurance Program (NFIP), Flood Map Modernization Program, to update flood risk and flood maps in the County

Action: Support State Floodplain Manager in the Flood Map Modernization Program
Time Frame: Next three years
Funding: Dependent on if cost share is required.
Estimated Cost: Dependent on scope of individual mapping projects.
Staff: City/County Emergency Management, County/City Engineer(s), State Floodplain Manager, Contractors.
Background: The State has designated Utah County as the number one priority community in the State for updated flood maps. County needs to support this designation.

Objective 1.2 Promote flood insurance throughout the County

Action: Create outreach document promoting flood insurance and include in local newspaper(s), libraries, and other public buildings. Especially after wildfires where post fire debris flows are of concern.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer/Floodplain Administrator, County Emergency Management, State Floodplain Manager, DES
Background: General public is usual not aware they can purchase flood insurance even if they are located outside of a Special Flood Hazard Area. This information is especially critical when post fire debris flow potential has been identified and homes are located on alluvial fans.

Objective 1.3 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.4 Ensure EOC(s) are equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.
Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Background: Support response from alternate EOC. Adequate communication capabilities are essential between all response agencies within the County.

Goal 1 Reduce Risk of Potential Flooding

Unincorporated Utah County

Problem Identification: Utah County is one of the smallest counties in the state terms of size and unincorporated population – with less than 5 percent of its residents live in the unincorporated county. The County does participate in the National Flood Insurance Program and the mapping is scheduled to be updated. No major rivers threaten large unincorporated urban developments. Therefore, no structural flood control projects are warranted at this time. One exception to this is the small development, south of Payson, known as Spring Lake, that is vulnerable to flooding and debris flows. A large debris flood event occurred here in 2002 (following the adjacent Mollie Wildfire in 2001 which made conditions "ripe" for this type of event). Post fire hillside stabilization measures should reduce the flood threat to Spring Lake. General flood threats in the unincorporated county include the Utah Lake tributaries, and other potential flood sources such as Utah Lake itself.

Objective: Minimize future flood damage in the unincorporated County

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to regulate development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as limiting development on alluvial fans. New development near canals should be mitigated to limit losses due to canal failures. The county should require developers in these potential hazard areas to submit site specific mitigation plans to minimize potential losses. Costs associated with mitigating the potential hazard should be borne by the developer.

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Cedar Hills

Problem Identification: Cedar Hills is developing rapidly – mostly with large single-family homes. It faces a significant flood threat, especially on the east side of town, from Heisett's Hollow and adjacent, fairly large unnamed drainages to the north and south. Although not currently participating in the NFIP, this community should definitely be considered at rather high risk of flooding and should be included in any Utah County map updates or revisions.

Objective: Minimize future flood damage in Cedar Hills.

Action: A potentially viable alternative would be to construct a detention/debris basin at the mouth of Heisett's Hollow.
Time Frame:
Funding:
Estimated Cost: approximately $1million
Staff:

Action: As with similar communities, the relatively moderate threat of flooding in many parts of the community indicates that nonstructural zoning is preferable to structural measures unless a historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Eagle Mountain

Problem Identification: Eagle Mountain is located about 6 miles southwest of Lehi just south of Highway 73. Also one of the state's newer communities, it is growing very rapidly. As of 2003, Eagle Mountain now has a population of about 8,000 residents compared to the 2,000 identified in the 2000 Census. Channel modifications have been made to Tickville Gulch and its tributary West Canyon Wash that flow through the north part of the community. There are also numerous unnamed drainages along the east side of Eagle Mountain that drain Lake Mountain. These drainages range in size from about 1 to 3 square miles and therefore would pose a moderate level of threat during an infrequent flood event.

Objective: Minimize future flood damage in Eagle Mountain.

Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding near Tickville Gulch and West Canyon Wash.
Time Frame:
Funding:
Estimated Cost: $10k-$30k per structure
Staff:

Action: As with similar, growing communities, the relatively low to moderate threat of flooding to most of the homes indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Elk Ridge

Problem Identification: Also a relatively new community, Elk Ridge is situated just southeast of Payson. Elk Ridge is flanked by Loafer Canyon on the east and other unnamed drainages through the rest of the community. Development for the most part, appears to be sited up and away from the channels. However if the channels/culverts were to become blocked by debris or if wildfire were to occur in the surrounding mountain, devastating flood, mud, and debris flows are possible. (A wildfire was experienced in the area during the summer of 2003.)
Objective: Minimize future flood damage in Elk Ridge.

Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.
Time Frame:
Funding:
Estimated Cost: $10k-$30k per structure
Staff:

Action: As with similar, growing communities, the moderate threat of flooding indicates zoning would be less costly than structural measures (unless an historic flood problem is known to exist -see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Goshen

Problem Identification: Although not participating, this community appears to have little flood threat - unless Goshen Reservoir has problems in the future (earthquake or slope stability issues).

Objective: Minimize future flood damage in Goshen.

Action: As with similar small communities, the relatively low threat of flooding indicates that nonstructural zoning is preferable to structural measures unless a historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Santaquin

Problem Identification: Although Santaquin has a NSFHA designation based on its old town boundaries, it clearly has a very high flood, mud, and debris flow threat in the newer part of town – east of Interstate 15 – that needs to be addressed. It appears that virtually all development east of I-15 is at risk due to its location right on top of major alluvial fans. They are known as Tributaries 4, 5, and 6 (north to south). Although development for the most part, appears to be sited up and away from the channels, during the 2002 debris flow event (preceded by the 2001 Mollie Wildfire), the channels became blocked by debris and a devastating flood, with mud and debris flows occurred – putting the lives of many in community at very high risk. (Amazingly no one was injured or killed in the disaster.) Debris flow boundaries delineated by the Utah Geological Survey (attached) should be used as a minimum to approximate the flood threat until detailed analyses can be made.

Objective: Minimize future flood damage in Santaquin.

Action: Detention/debris basins are urgently needed if the town is going to continue to allow development "in harms way".

Timeframe:
Funding:
Estimated Cost: Approximately $500k - $1 million each – Total $2.5 million
Staff:

Action: As with similar growing communities, nonstructural zoning is less costly than structural measures to prevent future damages (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Saratoga Springs

Problem Identification: Like Santaquin, this community has also grown very rapidly and is also designated as a NSFHA. It appears to face a moderate flood threat from Tickville Gulch on the north and at least a dozen other drainages along the east side of town (in addition to the threat from Utah Lake).
Objective: Minimize future flood damage in Saratoga Springs.

Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.
Time Frame:
Funding:
Estimated Cost: $10k-$30k per structure
Staff:

Action: As with similar, growing communities, the low to moderate threat of flooding indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Vineyard

Problem Identification: Although there is no flood threat from any rivers, creeks, or streams, Utah Lake is within the corporate boundary-leaving Vineyard at some risk. A 1997 COE reconnaissance study (Provo River and Tributaries) determined that the 100-yr elevation of Utah Lake would be approximately 4494.5 MSL. Most of Vineyard is well above this elevation so the relative risk is minimal.

Objective: Minimize future flood damage in Vineyard

Action: As with similar communities, the relatively low threat of flooding indicates that nonstructural zoning is preferable to structural measures unless an historic flood problem is known to exist (see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Woodland Hills

Problem Identification: Also a relatively new community, Woodland Hills is situated southeast of Payson, in the southeast corner of Utah County. Woodland Hills is flanked by Maple Canyon on the east and is threatened by Broad and Snell Hollows, as well as another unnamed drainage through the rest of the community. Development for the most part, appears to be sited up and away from the channels. However if the channels/culverts were to become blocked by debris or if wildfire were to occur in the surrounding mountain, devastating flood, mud, and debris flows are possible – putting the community at very high risk.

Objective: Minimize future flood damage in Woodland Hills.

Action: A potentially viable alternative would be to flood proof those relatively few existing low-lying structures that are subject to flooding.
Time Frame:
Funding:
Estimated Cost: $10k-$30k per structure
Staff:

Action: As with similar, growing communities, the moderate threat of flooding indicates that nonstructural zoning would be preferable to structural measures (and less costly - unless an historic flood problem is known to exist - see discussion on zoning in the County's mitigation section above).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Dam Failure Mitigation Goals

Problem: National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means. Deer Creek and Jordanelle Dams are of specific concern in the County.

Goal 1 – Priority Medium

Objective 1.1 Obtain most up to date and accurate information on dams in County to protect lives and property from dam failure.

Action 1: Include dam inundation maps in current County EOP.
Time Frame: 3-5 Years
Funding: Undetermined
Estimated Cost: $ 10,000.00
Staff: County Emergency Management, BOR and State Dam Safety
Background: Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section is currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Utah County in future emergency management planning.

Objective. 1.2 Early warning systems (sirens) are critical to protecting lives from Jordanelle/Deer Creek dam failure.

Action 2: Continue to test warning sirens along Provo River
Time Frame: Ongoing
Funding: BOR and County, Provo and Orem City
Estimated Cost: Unknown
Staff: County/City Emergency Management and Public Works, UDOT, BOR, Sheriff and local Police.
Background: Current siren system needs to be tested on a regular basis and allow local responders to participate in the testing. This will create better planning and awareness at the local level.

Mitigation Strategies

The following mitigation strategies are provided so that communities may be aware of additional measures that could be used to limit the exposure to flood related damage.

Prevention

- Planning and Zoning
- Floodplain open space preservation
- Building construction regulation
- Regulation of other facilities (critical)
- Stormwater management

Property Protection

- Relocation
- Acquisition
- Building elevation
- Flood proofing
- Lifeline protection
- Flood Insurance

Natural Resource Protection

- Wetlands protection
- Erosion and sediment control

Emergency Services

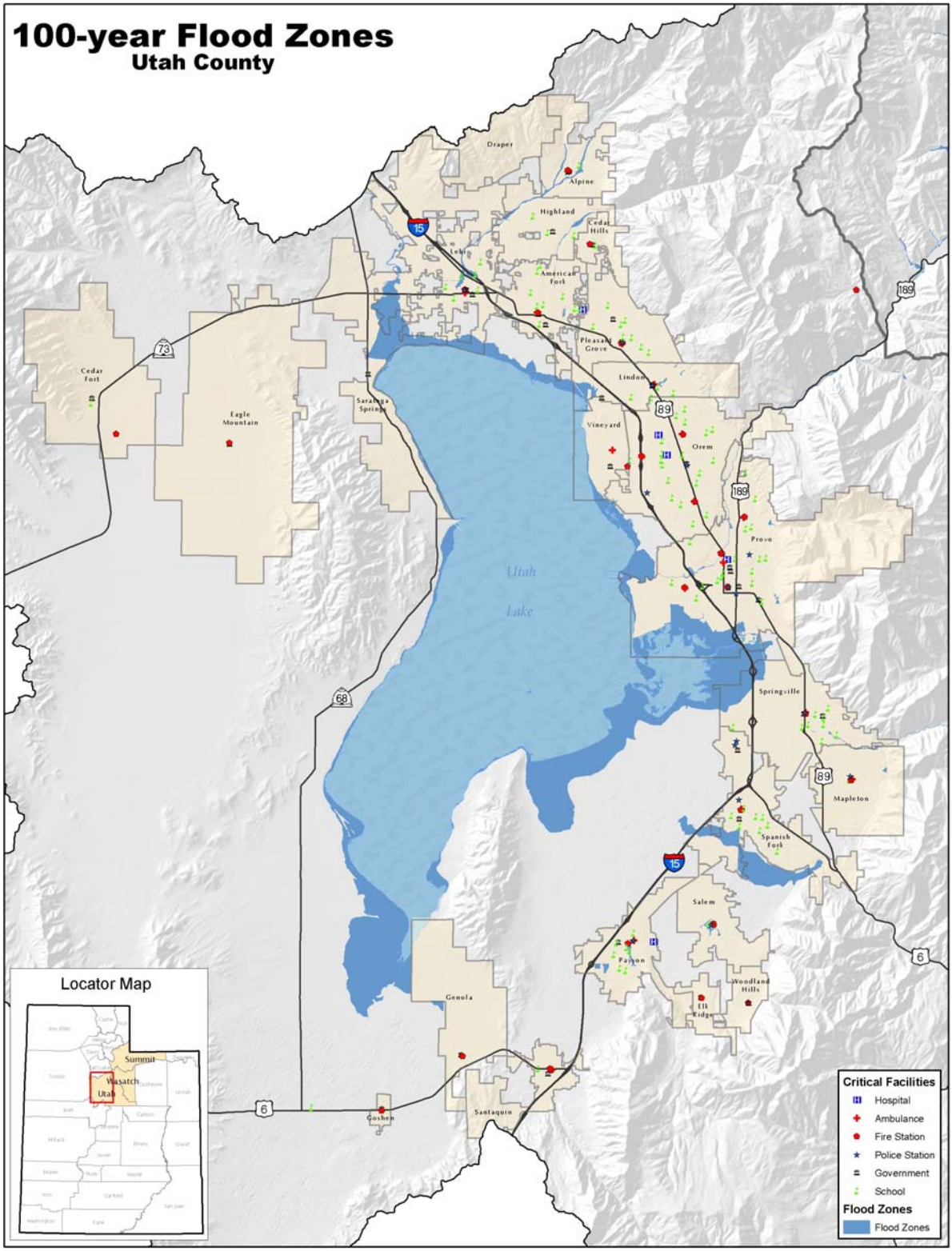
- Flood threat recognition
- Warning dissemination
- Flood response
- Critical Facilities Protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

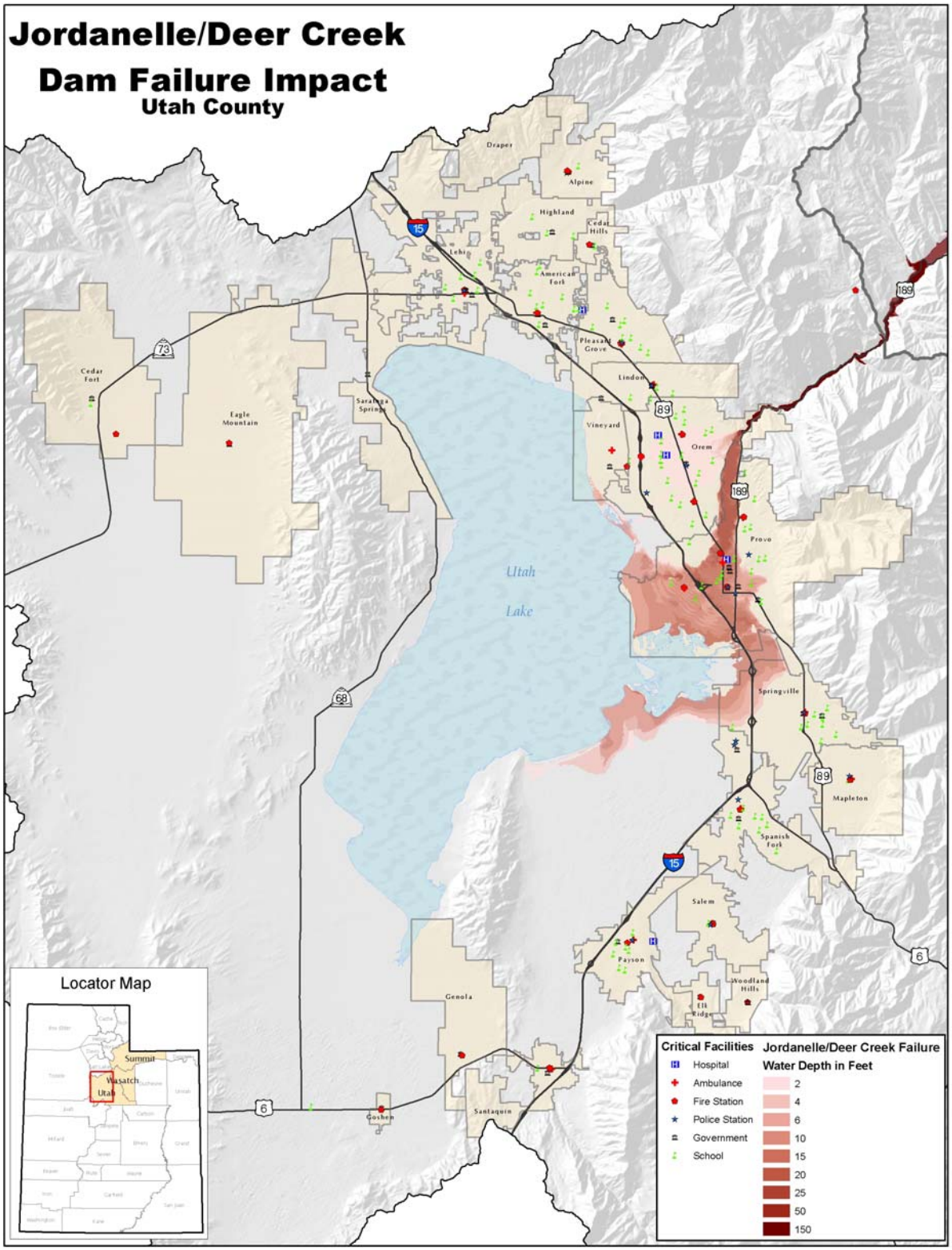
Structural Projects

- Reservoirs/impounds
- Levees
- Diversions
- Channel and drainage modifications
- Channel and basin maintenance

Public information

- Flood Hazard maps
- Map Information
- Outreach projects
- Real estate disclosures
- Library
- Technical Assistance
- Environmental education


100-year Flood Zones
Utah County
Draper
Alpine
Highland
Cedar Hills
Lehi
American Fork
Pleasant Grove
Lindon
Vineyard
Orem
Provo
Cedar Fort
Eagle Mountain
Saratoga Springs
Utah Lake
Springville
Mapleton
Spanish Fork
Salem
Payson
Woodland Hills
Elk Ridge
Genola
Santaquin
Goshen
15
73
68
89
189
6
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Flood Zones
Flood Zones


Jordanelle/Deer Creek
Dam Failure Impact
Utah County
Draper
Alpine
Highland
Cedar Hills
Lehi
American Fork
Pleasant Grove
Lindon
Cedar Fort
Eagle Mountain
Saratoga Springs
Vineyard
Orem
Provo
Utah Lake
Springville
Mapleton
Spanish Fork
Salem
Payson
Woodland Hills
Elk Ridge
Genola
Santaquin
Goshen
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Jordanelle/Deer Creek Failure
Water Depth in Feet
2
4
6
10
15
20
25
50
150

Wildland Fire

Assessing Vulnerability

The following table illustrates the vulnerability assessment for wildfire in Utah County.

Table U-11

NAME	County	Population	Households	Value	Employment
Alpine	Utah	3,284	735	$110,250,000	141
Cedar Fort	Utah	65	17	$2,550,000	0
Cedar Hills	Utah	99	26	$3,900,000	0
Draper	Utah	139	36	$5,400,000	0
Eagle Mountain	Utah	14	3	$450,000	0
Elk Ridge	Utah	1,027	234	$35,100,000	0
Goshen	Utah	109	30	$4,500,000	0
Lehi	Utah	4	1	$150,000	0
Lindon	Utah	2,631	573	$85,950,000	209
Mapleton	Utah	256	57	$8,550,000	122
Orem	Utah	1,415	281	$42,150,000	1
Payson	Utah	830	227	$34,050,000	26
Pleasant Grove	Utah	850	192	$28,800,000	71
Provo	Utah	4,487	1,171	$175,650,000	4996
Santaquin	Utah	892	233	$34,950,000	115
Spanish Fork	Utah	855	217	$32,550,000	131
Springville	Utah	2,301	582	$87,300,000	197
Utah	Utah	2,360	649	$97,350,000	1
Woodland Hills	Utah	112	28	$4,200,000	0

The following table is a historical list of fires over 100 acres in Utah County.

Table U-12

FIRE_ID	YEAR	NAME	SDATE	CAUSE	COUNTY	TYPE	SIZE
3141-2000	2000	GENOLA CITY	8/10/2000	MC	Utah	Rural	120.00
2999-2000	2000	NEBO CREEK	8/1/2000	LT	Utah	Wildland	120.00
2073-1999	1999	CLAY PIT 2	8/29/1999	MC	Utah	Wildland	400.00
2065-1999	1999	JENSEN	11/6/1999	DB	Utah	Wildland	475.00
3905-2001	2001	MILE MARKER 12	7/2/2001	LT	Utah	Wildland	655.00
2072-1999	1999	LONG RIDGE	7/24/1999	CF	Utah	Wildland	1049.00
3043-2000	2000	DIVIDEND	7/4/2000	LT	Utah	Wildland	1154.00
3001-2000	2000	BISMARK	7/26/2000	LT	Utah	Wildland	2930.00
2075-1999	1999	CEDAR VALLEY	6/25/1999	MC	Utah	Wildland	3200.00
2074-1999	1999	CLAY PIT	8/14/1999	MC	Utah	Interfac	4407.00

3000-2000	2000	TEN MILE	8/6/2000	IN	Utah	Wildland	5500.00
4409-2001	2001	MOLLIE	8/18/2001	IN	Utah	Interfac	8021.00

Overview

Wildfires occur on a regular basis in Utah County. Most fires occur in the late summer to early fall. Although many fires occur from natural causes such as lightning, humans cause most fires. Sparks from trains traveling on the railroad cause many small fires in south Utah County. People riding ATV's, using fireworks and campfires also start a number of fires in the area.

Development Trends

As development occurs on the bench areas of Utah Valley more homes will be in danger of wildfire. Communities need to make developers and homeowners aware of the danger. Cities should also require firebreaks and access roads along urban/wildland interfaces. Although development brings homes closer to areas of potential wildfire, it also brings water and access for firefighters closer to the urban fringe. Firewise community development principles, such as not storing firewood near homes, installing fire resistant roofing and cleaning debris from rain gutters will reduce potential loses.

Mitigation Strategies–Wildland Fire

Problem Identification: Non-compliance with Firewise development practices.

Goal 1 – Priority High

Objective 1.1 Increase and ensure compliance with existing building and fire codes, especially in the rural areas of the County where secondary residences are upgraded or new construction.

Action 1: Develop and enforce current local, state and national codes
Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Problem Identification: Building continues to be of concern in Urban Wildfire Interface Areas (URWIN). Especially in the following areas: Identified high hazard areas along foothills adjacent to Wasatch Front, eastern Utah County adjacent to Highway 6 to include Solider Summit, and areas along Highway 89 South into Sanpete County

Goal 2 – Priority High

Objective 1.1 Educate homeowners on how to reduce risk of wildfire damage

Action 1 : Conduct an education program (Firewise) on reducing wildfire risks
Time Frame: Ongoing
Funding: County
Estimated Cost: Minimal
Staff: Fire District(s), County Emergency Management, State FFSL

Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes. Currently, Sundance is the only recognized Firewise Community in the County.

Action 2: Work with State Forestry Fire and State Lands and US Forest Service to identify areas where fire breaks and be designed, implemented and maintained.
Time Frame: 3 years
Funding: County, State and Federal
Estimated Cost: Unknown
Staff: Private land owners, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service
Background: Wildfires have the potential to threaten high density population communities along the Wasatch Front.

Action 3: Using Sundance as a model Firewise community, promote the Firewise Program in the County.
Time Frame: Ongoing
Funding: County, State and Federal Grants
Estimated Cost: Minimal
Staff: County Emergency Management, State FFSL, US Forest Service
Background: It is essential to continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.

The following mitigation strategies are provided so that communities may be aware of additional measures that could be used to limit the exposure to Wildland Fire related damage.

Prevention

- Zoning ordinances to reflect fire risk zones
- Regulate development areas near fire protection and water resources
- Planning to include: spacing of buildings, firebreaks, on-site water storage, wide roads, multiple access
- Code standards for roof materials and fire protection systems
- Maintenance programs to clear dead and dry brush
- Regulations on open fires
- Open space around structures

Property Protection

- Retrofitting roofs, add spark arrestors
- Create and maintain defensible space
- Insurance
- Eliminate ladder fuels
- Install sprinkler systems
- Develop fire resistant plans
- Have home addresses clearly displayed
- Clean out rain gutters

Natural Resource Protection

- Require mitigation of development in high-risk areas
- Understand impact of non-native vegetation
- Promote tread soft ATV use
- Develop watershed management plans
- Maintain watersheds
- Establish and promote fuel reduction

Emergency Services

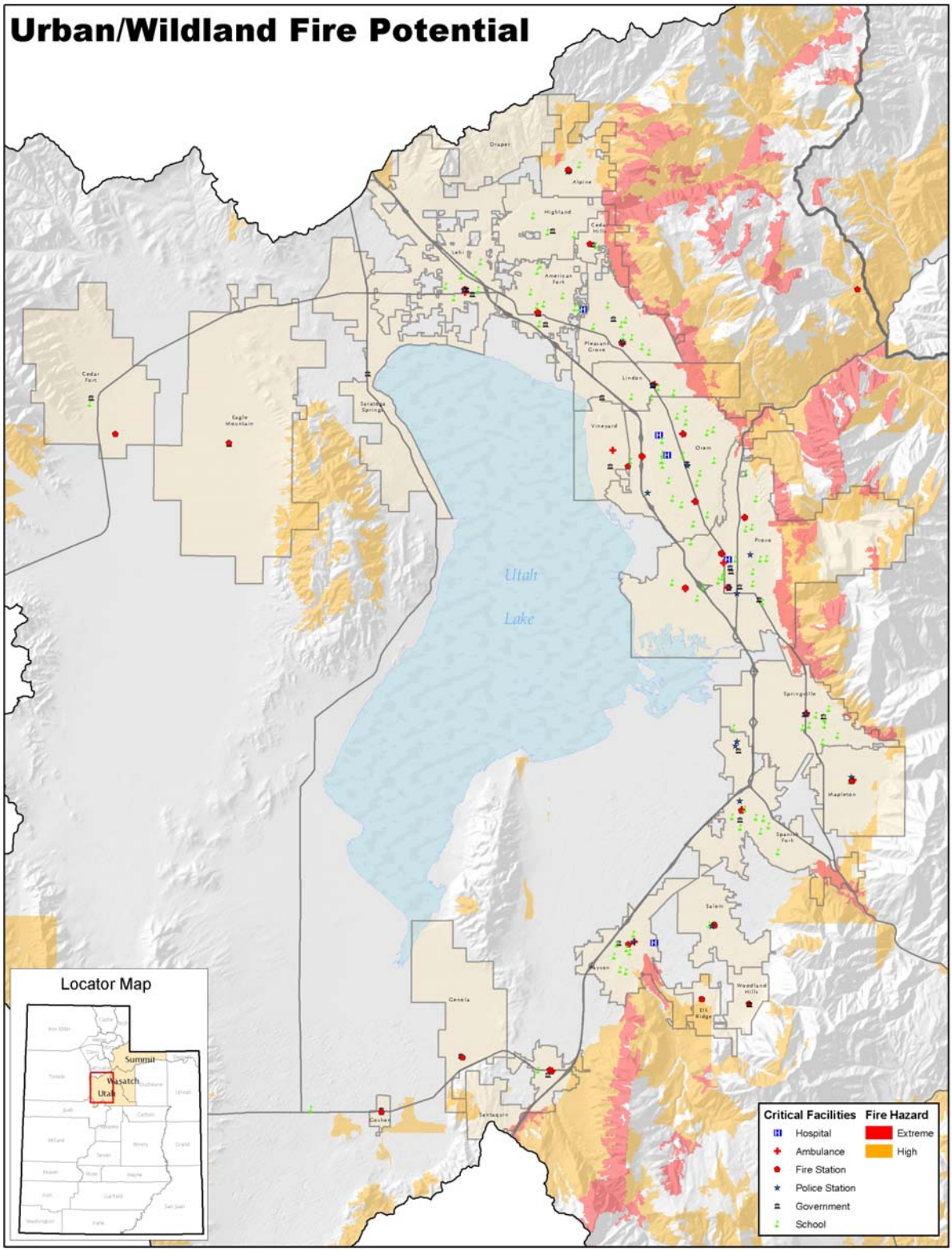
- Mutual aid agreement for fire fighting
- Participate in State Wildfire Suppression Fund
- Develop and exercise local wildfire response plan and evacuation plans

Structural Projects

- Construct wildfire fuel breaks
- Install Heliport water stations
- Tree and underbrush thinning in critical areas
- Increase the number of fire hydrants
- Install water tanks

Public information

- Develop maps for wildfire hazard areas
- Mail wildfire information to owners high-risk structures
- Develop urban wildfire “How to protect your home from Wildfires” book
- Publish newspaper articles on wildfires
- Presentations on wildfires at community meetings
- Develop displays for public buildings and events
- Real estate disclosure of high hazard wildland fire area


Urban/Wildland Fire Potential
Draper
Alpine
Highland
Cedar Hills
Lehi
American Fork
Pleasant Grove
Lindon
Cedar Fort
Eagle Mountain
Saratoga Springs
Vineyard
Orem
Provo
Utah
Lake
Springville
Mapleton
Spanish Fork
Salem
Payson
Woodland Hills
Elk Ridge
Genola
Santaquin
Goshen
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Fire Hazard
Extreme
High

Landslide/Problem Soils

Assessing Vulnerability

Due to the topography of Utah County, landslides are an issue. The foothills and alluvial fans on the bench areas are desirable for home locations. Landslides and debris flows often occur after a wildfire event. The following table illustrates the vulnerability assessment for landslides in Utah County.

Table U-13

Name	Households	Value	Population	Employment
Alpine	604	$90,600,000	2,617	2
American Fork	17	$2,550,000	71	
Cedar Hills	156	$23,400,000	705	
Draper	36	$5,400,000	139	
Elk Ridge	202	$30,300,000	871	
Genola	91	$13,650,000	394	
Highland	74	$11,100,000	301	
Lehi	360	$54,000,000	1,408	
Lindon	768	$115,200,000	3,500	160
Mapleton	74	$11,100,000	322	6
Orem	970	$145,500,000	4,020	536
Payson	169	$25,350,000	613	24
Pleasant Grove	1,629	$244,350,000	6,900	103
Provo	3,854	$578,100,000	13,320	5106
Salem	281	$42,150,000	1,147	182
Santaquin	59	$8,850,000	208	78
Spanish Fork	503	$75,450,000	2,101	6
Springville	993	$148,950,000	3,813	180
Utah	704	$105,600,000	2,737	
Vineyard	1	$150,000	1	
Woodland Hills	208	$31,200,000	885	
Total	11,753	$1,762,950,000	46,073	
Data source: Utah County Public Works				

Table U-14

Affected Facilities			
NAME	ADDRESS	CITY	DESC_
Canyon Crest School	4664 N Canyon Rd	Provo	School
Woodland Hills Fire Department	Woodland Hills Dr	Woodland Hills	Fire Station
Woodland Hills City Offices	125 E Lakeview Wy	Woodland Hills	Government

Problem soils are also an issue in the county. Most of the problem soils deal with expansive and collapsible soils. Damage is usually caused by homeowners directing either sprinklers or gutter down pipes toward the foundations of homes or water main breaks. Cities should require site-specific soils reports when the community approves subdivisions.

Thistle Slide

In 1983 the town of Thistle, Utah, known to many highway travelers as the small community where both the Spanish Fork River and nearby U.S. highways branch, was eliminated by the most costly landslide on record in the United States.

Thistle was located at the triple junction of transportation systems leading south to Sanpete County, east to the coal counties of Carbon and Emery and points beyond, and northwest to the Wasatch Front and Salt Lake City. Two major highways converged at Thistle (U.S. Highways 89 and 6). Until the landslide, two rail lines also converged at Thistle--the main line of the Denver and Rio Grande Western Railroad (D&RGW) joining Denver and Salt Lake City, and a branch line to Marysvale.

Ironically, the main line of the D&RGW railway from Denver to Salt Lake City follows the Soldier Creek and Spanish Fork drainages because of, rather than in spite of, landslides. Few corridors through the Rocky Mountains accommodate the gentle gradients required by railroads. Less stable landforms susceptible to landslides have eroded and formed the gentler terrain that allows modern rail passage. The advantages of this route had long been known. Undoubtedly the local Native Americans who guided the Spanish explorers traveled this route. Later trappers and pioneers used this natural corridor for their trade and transportation needs. The name "Spanish Fork" refers to the early exploration of the area by the Spanish, specifically Dominguez and Escalante in 1776 as they sought a trading route from Mexico to California. Soldier Creek is named for the route taken by federal troops as they moved through the area in the mid-1800s.

Storms heralding the 1982 to 1986 wet cycle kicked off the wettest month ever recorded at the Salt Lake City International Airport in September 1982, and saturated the ground before the winter snows. The winter was neither exceptionally wet nor cold. However, snows and cold nights continued late into April and May 1983, and resulted in an unusually late and sudden snowmelt when temperatures did warm up. May snowpacks of northern Utah averaged two to three times their normal. Utah's landslide problems correlate with precipitation and snowmelt. Two large landslides in the early spring alerted geologic experts to the situation. The National Weather Service briefed local and national officials about the unusual conditions. Yet even with the geologic and climatic indicators, the events of April, May, and June caught the state by surprise.

Starting in January, the D&RGW watched the Thistle area as well as several other landslide-prone areas near Soldier Summit. Their geotechnical experts visited the area on April 12. Days later, when the Thistle landslide began to move visibly, no one recognized it as a major hazard. The railroad tracks went out of alignment on Wednesday, 13 April. The highway became bumpy, fractured, and became impassible on Friday, 15 April. The streambed and deposits on the canyon floor rose approximately one foot an hour as a huge tongue of earth piled up against the bedrock buttress of Billies Mountain, filled the canyon, and dammed the river. The waters of the Spanish Fork River rapidly created Thistle Lake upstream of the landslide dam.

The railroad company and the Utah Department of Transportation (UDOT) initially tried to keep the railroad tracks, highway, and river open. Sunday, 17 April the landslide defeated efforts to cut down through the rising toe of the landslide and allow passage of the river water. Efforts to siphon waters rising behind the landslide dam also failed. Rising lake waters drowned the community of Thistle. That very day, the president of the D&RGW announced at Thistle that the railroad would tunnel a new railroad course through Billies Mountain. To be successful, the tunnel had to be above Thistle Lake's eventual highest water line. Railroad experts in consultation with the state decided to form the landslide into a dam and to construct an overflow spillway tunnel to control the uppermost rise of the lake. Having calculated

how fast an overflow tunnel could be constructed, and how fast the lake would rise, they began drilling. The state took charge of public safety priorities. Armies of workers and heavy equipment shaped the landslide dam while it moved by transferring 500,000 cubic yards of earth from the middle area of the landslide onto its toe. This also provided a platform from which to construct the tunnels. The state constructed a third tunnel to drain the impounded water. UDOT decided to relocate the highway over Billies Mountain. The Army Corps of Engineers constructed a pumping system to keep Thistle Lake from rising to dangerously high levels.

The impounded water rose at approximately the rate predicted and the D&RGW contractors completed the overflow tunnel system with two days to spare. Trains passed through the new tunnel on 4 July, eighty-one days after the initiation of the project and eleven days before the contracted completion date. The new tunnel provided a permanent bypass for the Spanish Fork River around the landslide. The relocated highway encountered difficult geotechnical problems. The highway opened at the end of the year but was often closed due to major rockfalls and slope stability problems.

The town of Thistle was destroyed. The Marysvale branch line of the railroad was never reopened, leaving a large area of central Utah without rail service. Thistle resulted in Utah's first presidential disaster declaration and became the most costly landslide the United States had experienced. The Utah Business and Economic and Research Bureau reported the following dramatic impacts of the landslide. The D&RGW and Utah Railway embargoed all shipment that normally went through Thistle. The rerouting surcharge of $10 per ton virtually stopped coal shipments. Two trucking companies laid off workers, cancelled contracts, and even suspended operations. Most of the area's coal mines laid off miners, cancelled contracts, and experienced shut downs. Some miners' commutes suddenly exceeded 100 miles. Some coal haulage commutes trebled. Due to market conditions and the Thistle landslide, coal production dropped nearly 30 percent in 1983. Uranium producers paid substantially more for supplies in an already soft market. At least one oil company became non-competitive due to increased travel costs. Tourism in the area, particularly in-state tourism, sagged in response to negative publicity and difficult access. To the south, the blockage of route 89 and the Marysvale line hurt coal companies, turkey and feed operations, and gypsum, cement, and clay shipments.

The Thistle landslide caused total estimated capital losses of $48 million and revenue losses of $87 million, plus associated losses in tax revenues. Direct costs of Thistle tally over $200 million, including relocating the railroad at a cost of $45 million, relocating the highway at a cost of $75 million, and lost revenue to the railroad of $1 million per day (which totaled $80 million, including $19 million in charges that the D&RGW paid the Union Pacific to use their rail lines).
See: O.B. Sumsion, Thistle . . . Focus on Disaster (1983).

Santaquin Mollie Fire Debris Flow

In August of 2001, the 8,000+ acre Mollie Fire burned Dry Mountain above Santaquin. The bench development area of Santaquin City is located not more than 50 yards from the edge of the fire perimeter. This enormous wild fire left a devastated hillside, and the city below, vulnerable to the slipping of loosened earth with the onset of late summer monsoon rains.

At approximately 6:45 p.m. on Thursday, September 12, 2002, after nearly a week of steady rain, the charred earth of the ironically named Dry Mountain gave way and mud flowed out of five separate canyons. Of the five flows, two caused extensive property damage, one to residents of Santaquin and one to the residents of unincorporated Spring Lake. Furthermore, one flow of nearly equal volume flowed through a principally undeveloped area of Santaquin. According to USGS statistics, the highest possibility of ground slippage will occur within the first year after the fire. Although chronologically the mudslide occurred more than 365 days from the wild fire, it was still in the first monsoon season following the fire.

Following the fire, Santaquin City and the US Forest Service participated in a massive re-seeding effort on the mountain in an attempt to prevent or minimize the potential for a mudslide. Furthermore, the City took steps to prevent the potential mudslide from impacting the citizens of the community. Jersey barriers were placed along the upper boundaries of the developed community. In addition, walls of straw bails were constructed in areas analyzed to be the highest possibility of water flows. Both the City and the Forest Service, with the help of the National Weather Service, maintain constant monitoring of the mountainside.

Over the course of the 12+ months that followed the Mollie fire, the City collaborate with numerous governmental divisions, private firms and private property owners to develop and design a plan to handle whatever may come out of the canyons. Even before the mudslide event, the City initiated efforts to record easements for the construction of debris flow channels. Although they found it hard skating, the mudslide event showed that the efforts of the parties involved was in fact necessary.

In the time since September 2002, a formal diversion channel has been constructed to lead any further debris that comes out of the canyons into a natural ravine. Within the ravine, silt fencing and flow breaks have been installed to slow the flow of debris in the ravine and thereby minimizing its potential impact. This ravine travels between developed areas and down the hill to the location of US highway 198. Here UDOT has approved and is constructing culverts under the highway that will allow the debris pass under the highway and be disposed of without endangering private property.

The developed area within Santaquin City, which was hardest hit by the mudslide is as yet to be protected from future slide events. Due to the unwillingness of private property owners, no effort other than re-seeding the mountainside, have taken place to protect those residences.

Recommendations related to the Mollie Flow

- Coordinate with the Uinta National Forest Burned Area Emergency Rehabilitation (BAER) Team on post-wildfire watershed improvements.
- Consult with the USDA's Natural Resources Conservation Service (NRCS) concerning eligibility for the Emergency Watershed Protection (EWP) program.
- Note: This program is still available to the City of Santaquin.

- Promote purchasing of flood insurance through the National Flood Insurance Program (NFIP) for those individuals building or purchasing homes on alluvial fans.
- Construction of detention basins, deflectors, or other engineered structures.
- Note: Detention basins at the mouths of canyons catch all incoming debris flows, thus there is less chance for failure.
- Note: Possible funding mechanisms include special projects fees as part of a storm water collection fee, for homeowners living on alluvial fans.
- Adopt and enforce ordinances requiring geotechnical reports addressing debris flow, flooding, earthquakes, rock falls, and landslides for all proposed developments in areas susceptible to natural hazards. Maps illustrating the location of most of the above mentioned natural hazards are available through Utah County.
- Note: Utah Geological Survey (UGS) provides no cost independent review and recommendations of geotechnical reports to determine their accuracy and completeness. In addition, the Division of Emergency Services and UGS will aid in the design and implementation of ordinances concerning natural hazards.
- Register any structure pertaining to water impoundment with Division of Water Rights, Dam Safety Section.
- Note: The retention basin located within the impacted subdivision was not registered with Dam Safety.

Buckley Draw—Springville Fire

The Springville fire started on June 30, 2002 at 7:19 p.m. The fire burned a total of 2,207 acres above dozens of homes. The immediate post fire impacts for Provo City were: loose surface rock, silty and sandy soils, and blackened steep (40% grade) hillsides. Steep terrain and impervious soils cause rapid run off with rocks. Post fire conditions increased sediment expectations to 13 tons per acre. Brian McInerney of the NWS stated our risk level was the highest in the state.

Recommendations for mitigation offered to Provo City included the Uinta National Forest rehabilitating the burn area with vegetation (seed and mulch) and installing wire fences in the upper channel. The Natural Resource Conservation Service (NRCS) and the Emergency Watershed Program (EWP) implemented temporary measures to reduce the transport of sediment. Additionally, a Rain Activated Weather Station (RAWS) unit was relocated to the Buckley Draw area (elevation of 9,143 feet) to monitor site conditions on Sunday, July 13, 2002.

Provo City held public meetings on Sunday, July 13, and Monday, July 14, 2002 to present information and resources for the residents. National Flood Insurance Program (NFIP) information distributed. Sandbags and sand drops were scheduled and delivered.

On July 15, 2002, information was distributed to the Neighborhood regarding the increase in risk of post fire debris flow, with information about the NFIP program. Communication links to relay current hazard information to the residents were established. The evacuation plan was updated.

On July 16, 2002 a helicopter overview of the burn area was taken. Provo Public Safety responders had a Post Fire Debris Flow Risks in Utah class on July 31, 2002. NRCS and the EWP engineered of a trench to redirect potential debris flow. Provo City obtained the necessary property agreements. Two debris flow events just to the north and just to the south of Provo in September, 2002 provided motivation to secure agreements and build the trench.

A SNOTEL was installed above the Little Rock Canyon drainage to monitor soil moisture and snow pack conditions on 22 October, 2002.

At the April 29, 2003 neighborhood meeting, the debris flow in Santaquin was contrasted with the conditions at the Buckley Draw. Plans for trench construction were discussed. A flag notification system and evacuation plan for the residents for the risk level was proposed and accepted. A web link with updated hazard information, a phone 'hot line' with an updated message, and a notification procedure alerting the Neighborhood Chair of any changes in the hazard level were implemented. A practice evacuation drill was held on Saturday, May 10, 2003.

The 1500 feet long trench was essentially complete on July 28, 2003. Weather conditions continued to be monitored on a daily basis.

At approximately 3:00 a.m. on September 10, 2003, four separate debris flows were triggered. The second largest flow came down the newly finished trench. There was little or no warning. This flow would have been life threatening and would have caused significant property damage without the debris trench in place. The spreader fences in the debris field distributed the runoff materials and completely contained this debris flow.

Development Trends

Development along the foothills and bench areas is very desirable as more development occurs, more homes will be at risk for landslide damage. As more of the county land is developed, more marginal areas with problems soils will be developed.

Mitigation Strategies

The following mitigation strategies are provided so communities may be aware of additional methods that could be used to limit the exposure to Landslide/Problem Soils related damage.

Prevention

- Planning and zoning restrictions and regulations
- Open Space
- Building Codes
- Drainage system maintenance
- Monitor and evaluate areas after wildfire
- Install ground monitoring instruments on landslide-prone areas
- Establish codes (grading, construction, excavation) in landslide prone areas

Property Protection

- Insurance
- Remove soil
- Ensure rain gutters and sprinklers are directed away from structures
- Control and monitor surface and ground water drainage
- Control building in areas of landslides
- Evaluate property maintenance in areas of landslides (over watering)

- Plan proper valving of waterlines to ensure quick turn off in the event of a waterline break

Natural Resource Protection

- Leave area as open space
- Identify structures impacted by problem soils
- Complete a watershed management plan
- Limit use of ATVs in areas off landslides to manage erosion
- Evaluate impact of wildfire in areas of landslides
- Mitigate development in landslide-prone areas
- Maintain natural vegetation

Emergency Services

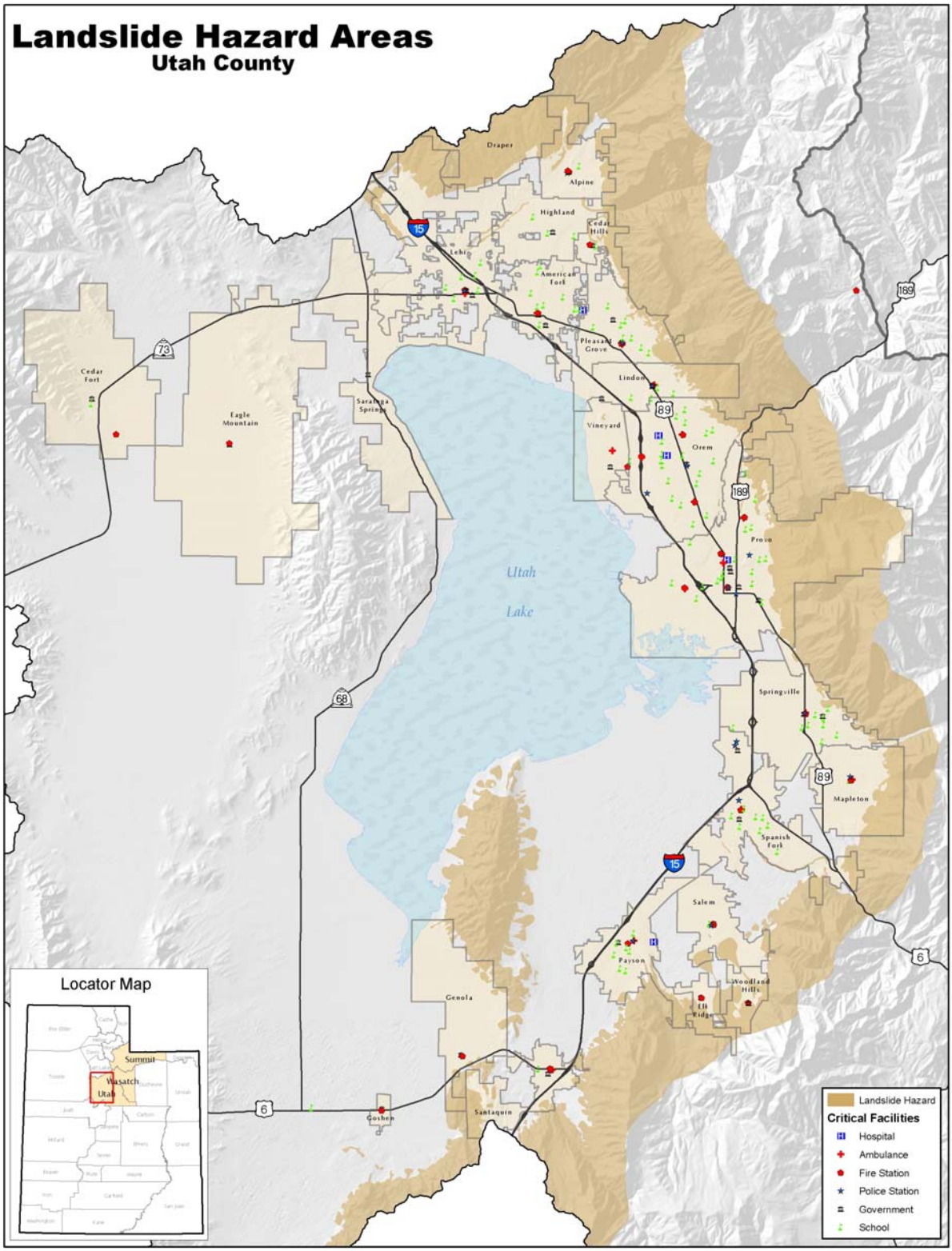
- Identify structures impacted by problem soils
- Monitor and warning systems
- Evacuation plans and exercises
- Critical Facilities Protection
- Equip emergency crews with water valve shut-off keys

Structural Projects

- Pre-soak and/or compact soils
- Install drain fields
- Bring in structural fill
- Build buttress, retaining walls and other engineered structures
- Install subsurface drainage materials
- Remove potential landslide debris

Public information

- Develop information on problem soils
- Outreach information on problem soil mitigation
- Map soils and landslide areas
- Real estate disclosure
- Notice to homeowners in landslide areas detailing hazard
- Library
- Technical Assistance
- Education


Landslide Hazard Areas
Utah County
Draper
Alpine
Highland
Cedar Hills
Lehi
American Fork
Pleasant Grove
Lindon
Cedar Fort
Eagle Mountain
Saratoga Springs
Vineyard
Orem
Provo
Utah Lake
Springville
Mapleton
Spanish Fork
Salem
Payson
Woodland Hills
Elk Ridge
Genola
Santaquin
Goshen
15
73
68
89
189
6
Locator Map
Summit
Wasatch
Utah
Landslide Hazard
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School

Earthquake/Liquefaction

Please see the HAZUS-MH Earthquake event report for Utah County 2500 year event, print date October 20, 2003 in the appendix of this document for full details of vulnerability. According to the HAZUS-MH run, about 63% or 51,171 buildings will be damaged and that 6,812 buildings will be completely destroyed. Liquefaction has a greater potential for damage than the earthquake itself in Utah County.

The geographical size of the region is 2,138.07 square miles and contains 85 census tracts. There are over 99 thousand households in the region and has a total population of 368,536 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 81 thousand buildings in the region with a total building replacement value (excluding contents) of 16,313 (millions of dollars). Approximately 99.00 % of the buildings (and 83.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,997 and 846 (millions of dollars), respectively.

The following table shows recorded earthquakes occurring in Utah County of Richter magnitude 3.0 or greater since 1950:

Table U-15

Date	Richter Magnitude	Epicenter
February 20, 1950	3.7	Payson
May 8, 1950	4.3	Payson
August 12, 1951	4.3	Provo
July 21, 1952	3.7	Santaquin
September 28, 1952	4.3	Lehi
July 10, 1963	4.2	Southwest of Strawberry Reservoir
March 9, 1965	3.5	20 miles south of Strawberry Reservoir
July 27, 1971	3.0	Near Lehi
August 5, 1973	3.2	Northeast of Orem
May 24, 1980	4.4	Elberta

Development Trends

As development occurs in Utah County, more buildings and people will be in danger from earthquakes. However, newer buildings will be built to better standards, which will actually decrease the risk of damage. It is interesting to note that when most residential structures are engineered, out the three categories of design criteria; seismic zone, wind shear and snow load; the design criteria for wind shear over-rules the other criteria.

Assessing Vulnerability

Please see the HAZUS-MH run in the appendix of this document for a detailed vulnerability assessment related to earthquakes.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites

For essential facilities, there are 6 hospitals in the region with a total bed capacity of 1,044 beds. There are 124 schools, 11 fire stations, 16 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 33 dams identified within the region. Of these, 22 of the dams are classified as 'high hazard'. The inventory also includes 85 hazardous material sites, 0 military installations and 0 nuclear power plants.

Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 3,843.00 (millions of dollars). This inventory includes over 560 kilometers of highways, 314 bridges, 0 kilometers of pipes.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

The following table forecasts the number of casualties that might be expected if an earthquake occurred.

Table U-16

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	40	12	2	4
	Commuting	0	0	0	0
	Education	0	0	0	0
	Hotels	16	5	1	1
	Industrial	60	18	3	6
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	116	35	6	11
2 PM	Commercial	2,356	733	124	245
	Commuting	2	3	4	1
	Education	948	294	50	98
	Hotels	3	1	0	0
	Industrial	439	136	23	45
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	3,755	1,167	201	389
5 PM	Commercial	2,054	634	108	209
	Commuting	0	0	1	0
	Education	194	60	10	20
	Hotels	5	1	0	0
	Industrial	275	85	14	28
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	2,528	780	133	257

Building Damage

HAZUS estimates that about 51,171 buildings will be at least moderately damaged. This is over 63% of the total number of buildings in the county. There are an estimated 6,812 buildings that will be completely destroyed. The following table summaries the expected damage by general occupancy for the buildings in the county.

Table U-17

Type	None	Slight	Moderate	Extensive	Complete
Agriculture	0	0	0	0	0
Commercial	39	95	258	251	202
Educational	1	1	4	3	3
Governmental	1	3	9	9	7
Industrial	6	14	42	44	38
Religion	1	2	5	4	3
Residential	454	1,431	2,541	1,877	1,368
Single Family	7,311	21,068	29,316	9,996	5,193
Total	7,813	22,614	32,175	12,184	6,813

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Critical Facilities

Table U-18

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	6	6	0	0
Schools	124	122	0	0
EOCs	1	0	0	1
Police Stations	16	16	0	0
Fire Stations	11	11	0	0

Fire and Debris Generation

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 13 ignitions that will burn about 0.11 sq. mi 0.01 % of the region's total area.) The model also estimates that the fires will displace about 203 people and burn about 8 (millions of dollars) of building value.

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris

The model estimates that a total of 2 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 33.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 80,000 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

The following table indicates the potential vulnerability assessment for liquefaction in Utah County based on GIS mapping.

Table U-19

Name	Households	Value	Population	Employment
American Fork	1,938	$290,700,000	6,467	4898
Eagle Mountain	1	$150,000	2	30
Genola	217	$32,550,000	931	
Goshen	272	$40,800,000	874	19
Lehi	2,559	$383,850,000	8,969	2598
Lindon	401	$60,150,000	1,689	3447
Mapleton	1,415	$212,250,000	5,704	957
Orem	2,423	$363,450,000	8,247	10377
Payson	2,011	$301,650,000	6,955	1901
Pleasant Grove	2,021	$303,150,000	7,145	2214
Provo	23,961	$3,594,150,000	82,056	46278
Salem	425	$63,750,000	1,516	154
Santaquin	2	$300,000	5	67
Saratoga Springs	305	$45,750,000	1,115	
Spanish Fork	3,775	$566,250,000	12,651	8020
Springville	5,743	$861,450,000	19,485	7045
Vineyard	45	$6,750,000	159	
Utah	1,942	$291,300,000	7,316	
Total	**49,456**	**$7,418,400,000**	**171,286**	

The following table lists the critical facilities that would be affected by liquefaction:

Table U-20

Affected Facilities			
NAME	ADDRESS	CITY	DESC_
National Guard Armory	251 S 200 East	American Fork	Government
Greenwood School	50 E 200 S, American Fork 8400	American Fork	School
Genola City Offices	74 W. 800 South	Genola	Government
GENOLA FIRE DEPT		Genola	Fire Station
Goshen City Offices	12 W Main	Goshen	Government
Goshen School	PO Box B, 60 N Center, Goshen	Goshen	School
GOSHEN FIRE DEPT		Goshen	Fire Station
Lehi School	765 N Center, Lehi 84043	Lehi	School
Lehi City Fire Department	176 N Center	Lehi	Fire Station
Lehi City Hall	153 N 100 East	Lehi	Government
National Guard Armory	348 E Main	Lehi	Government

Eaglecrest School	2760 N 300 W, Lehi 84043	Lehi	School
Meadow School	176 S 500 W, Lehi 84043	Lehi	School
Lehi High	180 N 500 E, Lehi 84043	Lehi	School
U. S. B. O. R. Field Materials Control Lab	3979 W 5600 North	Lindon	Government
Oak Canyon Junior High	750 E 200 S, Lindon 84042	Lindon	School
Mapleton Fire Department	35 E Maple	Mapleton	Fire Station
Mapleton City Offices	35 E Maple	Mapleton	Government
Mapleton Ambulance Office	35 E Maple	Mapleton	Ambulance
Mapleton School	120 W Maple, Mapleton 84664	Mapleton	School
MAPLETON FIRE DEPT		Mapleton	Fire Station
Vineyard School	950 W 800 S, Orem 84058	Orem	School
Payson City Offices	425 W Utah Ave	Payson	Government
Taylor School	40 S 500 W, Payson 84651	Payson	School
Wilson School	590 W 500 S, Payson 84651	Payson	School
Elementary School	600 N 1300 W, Pleasant View	Pleasant View	School
Utah Valley Regional Medical Center	1034 N 500 West	Provo	Hospital
Utah County Offices	100 E Center	Provo	Government
Provo City Hall	351 W Center	Provo	Government
Provo City Electric Energy Department	251 W 800 North	Provo	Government
Provo Ambulance Office #3	601 W Columbia Ln	Provo	Ambulance
Provo Fire Station #4	2050 W 95 South	Provo	Fire Station
Provo City Ambulance Dept #4	2050 W 95 South	Provo	Ambulance
Provo Fire Station #3	601 W Columbia Ln	Provo	Fire Station
National Guard Armory	222 W 500 North	Provo	Government
Provo Fire Station #1	80 S 300 West	Provo	Fire Station
Provo City Ambulance Office #1	80 S 300 West	Provo	Ambulance
Valley Ambulance	925 N 500 West	Provo	Ambulance
Amelia Earhart School	2585 W 200 S, Provo 84601	Provo	School
Franklin School	350 S 600 W, Provo 84601	Provo	School
Sunset View School	525 S 1600 W, Provo 84601	Provo	School
Timpanogos School	449 N 500 W, Provo 84601	Provo	School
Dixon Middle	750 W 200 N, Provo 84601	Provo	School
Farrer Middle	100 N 600 E, Provo 84606	Provo	School
Provo High	1125 N University Ave, Provo 8	Provo	School
Mt Brook/Eastwood	1300 E Center, Provo 84601	Provo	School
Utah County Health Department	589 S State	Provo	Government
Provo City Ambulance Office #2	2737 N Canyon Rd	Provo	Ambulance
Provo Fire Station #2	2737 N Canyon Rd	Provo	Fire Station
Joaquin School	550 N 600 E, Provo 84606	Provo	School
Provost School	629 S 1000 E, Provo 84606	Provo	School
Westridge School	1720 W 1460 N, Provo 84604	Provo	School
Centennial Middle	305 E 2320 N, Provo 84604	Provo	School

Salem School	140 W 100 S, Salem 84653	Salem	School
Saratoga Springs City Offices	6394 S Redwood Rd	Saratoga Springs	Government
Brockbank School	340 W 500 N, Spanish Fork	Spanish Fork	School
Spanish Fork City Offices	40 S Main	Spanish Fork	Government
Utah County Security Center	3075 N Main St.	Spanish Fork	Police Station
Spanish Fork Ambulance Station	360 N Main St.	Spanish Fork	Ambulance
Spanish Fork Fire Station	360 N Main St.	Spanish Fork	Fire Station
National Guard Armory	2801 N Main	Spanish Fork	Government
Park School	90 N 600 E, Spanish Fork 84660	Spanish Fork	School
Rees School	185 E 400 N, Spanish Fork 8466	Spanish Fork	School
Spanish Fork Middle	50 N 900 E, Spanish Fork 84660	Spanish Fork	School
Spanish Fork High	99 N 300 W, Spanish Fork 84660	Spanish Fork	School
Landmark High (Alt HS)	320 S Main, Spanish Fork 84660	Spanish Fork	School
Springville City Hall	50 S Main	Springville	Government
Springville Ambulance Office	45 S Main	Springville	Ambulance
Springville Fire Department	45 S Main	Springville	Fire Station
National Guard Armory	125 S 700 East	Springville	Government
Art City School	121 N 900 E, Springville 84663	Springville	School
Brookside School	750 E 400 S, Springville 84663	Springville	School
Grant School	105 S 400 E, Springville 84663	Springville	School
Sage Creek School	1050 S 700 E, Springville 8466	Springville	School
Westside School	570 S Main, Springville 84663	Springville	School
Springville Middle	485 S 100 E, Springville 84663	Springville	School
Springville Junior High	165 S 700 E, Springville 84663	Springville	School
Springville High	1205 E 900 S, Springville 8466	Springville	School
GENEVA STEEL FIRE DEPT		Vineyard	Fire Station
Geneva Steel Ambulance Office	10 S Geneva Rd	Vineyard	Ambulance
Vineyard City Offices	240 E Gammon	Vineyard	Government
Provo Police Dept			Police Station
Utah County Sheriffs Ofc			Police Station
Lehi City Ambulance Office	54 N Center		Ambulance
Lehi Police Dept			Police Station
Mapleton Police Dept			Police Station
Spanish Fork Police Department			Police Station
Springville Police Dept			Police Station
Utah County Justice Center			Police Station
Utah Valley State College Pd			Police Station

Mitigation Strategies

Problem Identification: Utah County will be impacted directly from an earthquake on the Wasatch Fault. There are also other smaller faults that could generate significant damage. Transportation and utilities services within County could be severely impacted.

Goal 1 – Priority High

Objective 1.1 Reduce loss of life and limit damage to property. Provide education on seismic hazards and mitigation to Utah County residents and homeowners.

Action: Develop and promote earthquake public education program.
Time Frame: Immediate
Funding: County/State
Estimated Cost: $2500.00
Staff: County Emergency Management, State Earthquake Program
Jurisdictions: Countywide
Background: Provide information to residents and business owners to encourage them to take appropriate measures to make homes and businesses less susceptible to damage from ground shaking. Education pertaining to earthquakes will be part of a holistic natural hazards education program, including wildfires, flooding, sever weather, and landslides.

Goal 2 – Priority Medium

Objective 2.1 Through the CERT Program, educate community on earthquake damage prevention practices

Action: Educate the public on damage prevention practices for earthquakes
Time Frame: 2 years
Funding: State and Federal Grants from state and Federal governments
Estimated Cost: $50,000-$75,000
Staff: County Emergency Management and volunteers
Background: Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.

Goal 3 – Priority Medium

Objective 3.1 Increase quality and quantity of available natural hazards data to facilitate better decision-making.

Action 1: Update fault zone and liquefaction maps for the county to a better scale
Time Frame: Two years
Funding: Undetermined, potentially USGS or UGS
Estimated Cost: Minimal
Staff: USGS Staff
Background: Provide updated, detailed maps to city and county planning groups, emergency managers, and public to assist them in making educated decisions by understanding earthquake danger zones.

Action 2: Develop better ground acceleration maps for building officials
Time Frame: Three years
Funding: UGS, USGS, State Earthquake Program, Utah Seismic Safety Commission
Estimated Cost: Unknown, some cost share for printing.
Staff: UGS

Background: Current ground accelerations maps are too small and difficult to read. Better maps create better decision-making.

The following mitigation strategies are provided so that communities may be aware of additional mitigation measures that could be used to limit the exposure to earthquake related damage.

Prevention
- Planning and Zoning
- Building construction regulation
- Regulation of other facilities (critical)

Property Protection

- Non-structural methods
- Retrofit upgrades
- Earthquake Insurance

Natural Resource Protection

- Identify Fault Rupture zones
- Identify secondary impact

Emergency Services

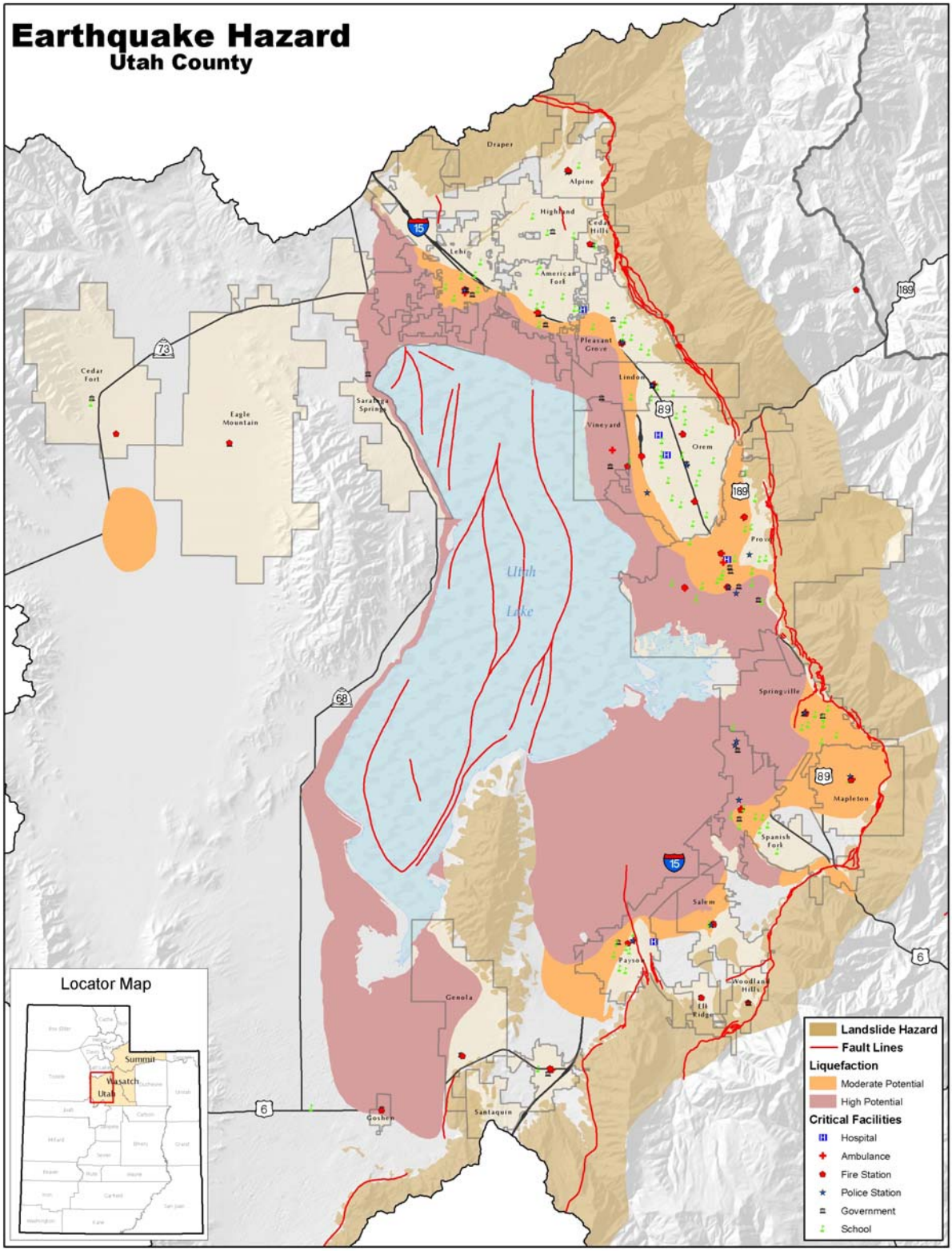
- Earthquake threat recognition
- Emergency Planning for Secondary Impact
- Emergency response (Mutual Aid, CERT)
- Critical Facilities Protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects

- Rebuild or retrofit critical facilities to higher seismic code
- Rebuild or retrofit infrastructure to higher seismic code

Public information

- Seismic maps; liquefaction, fault zones
- Map Information
- Outreach projects
- Real estate disclosures
- Library
- Technical Assistance
- Education


Earthquake Hazard
Utah County
Draper
Alpine
Highland
Cedar Hills
Lehi
American Fork
Pleasant Grove
Lindon
Vineyard
Orem
Provo
Cedar Fort
Eagle Mountain
Saratoga Springs
Utah Lake
Springville
Mapleton
Spanish Fork
Salem
Payson
Woodland Hills
Elk Ridge
Genola
Goshen
Santaquin
Locator Map
Summit
Wasatch
Utah
Landslide Hazard
Fault Lines
Liquefaction
Moderate Potential
High Potential
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School

Drought

Assessing Vulnerability

Drought is a region-wide hazard that varies little between the three counties in the MAG area. The vulnerability will typically be related to agricultural production. A secondary affect of drought is the increase in vulnerability to wildfires. Many of the communities in the region have dealt with drought for a number of years. These communities have several sources for water and storage facilities. Many of the communities have secondary water systems to reduce the demand on culinary water resources. Many communities also have active water conservation programs in place.

Mitigation Strategies

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority Low

Objective 1.1 Conserve culinary water by educating the public

Action 1: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State and Federal
Estimated Cost: Minimal
Staff: Water Districts
Background: Use a newsletter to educate the public

Action 2: Coordinate with current water systems and develop a secondary water systems plan for drought
Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

The following mitigation strategies are provided so that communities may be aware of additional mitigation measures that could be used to limit the exposure to drought related damage.

Prevention

- Establish economic incentives for water conservation
- Encourage water conservation
- Develop early warning system, monitoring programs
- Implement water metering and leak detection programs

Property Protection

- Identify potential for wildfire due to drought
- Identify secondary effects from drought
- Drought Insurance

Natural Resource Protection

- Legislation to protect stream flows
- Protect water aquifers
- Alert procedures for water quality issues
- Create inventory of pumps, filters and other equipment

Emergency Services

- Establish water hauling programs
- List livestock watering locations
- Establish hay hotline
- Fund water system improvements (wells, systems, reservoir)
- Lower well intakes
- Develop drought contingency plans
- Issue emergency permits for water use

Structural Projects

- Redesign or create new reservoir storage
- Provide pumps and piping for distribution

Public information

- Develop drought education material
- Water conservation outreach material
- Other outreach for awareness

Severe Weather/Avalanche

Assessing Vulnerability

No data is readily available for potential losses related to severe weather or avalanche, however most of the losses are limited. Severe weather may cause closure of transportation routes and fatalities due to weather related vehicular accidents. The ski resorts count on winter storms to produce the snow pack needed to operate their business. Some of the ski runs are located in avalanche prone areas, the private ski resorts as well as county public works and state road crews are aware of the potential dangers and keep the avalanche danger to a minimum. Backcountry skiers, snowboarders and snowshoe enthusiasts have the most severe threat to life related to avalanche danger. As recently as December 27, 2003 there were three snowboarder deaths in one avalanche above Sundance Ski Resort. Avalanche danger warnings are issued, however it is the individual's responsibility to assure that the warnings are heeded

The following table shows recorded snow avalanches that have occurred in Utah County:

Table U-21

Date	Location	Remarks
January 16, 1875	Summit Canyon	One Death, Property Damage
February 8, 1899	Provo Canyon	Property Damage
January 30, 1911	Provo Canyon	Property Damage
February 16, 1962	Provo Canyon	Property Damage
February 19, 1968	Rock Canyon	One Death
February 1998	Bridal Veil Falls	Property Damage
December 27, 2003	Aspen Grove	Three Deaths

The following table shows recorded lightning deaths in Utah County since 1950

Table U-22

Date	Location	Remarks
July 21, 1977	Moraine State Park	One Death, On camping trip
May 31, 1984	Mapleton	One Death, Outside during storm

The following table lists the recorded tornado for Utah County since 1950

Table U-23

Date	Location	Remarks
July 9, 1965	Provo Canyon	Two small funnel clouds
April 17, 1966	Springville	$10,000 Property Damage
December 2, 1970	Below Timpanogos Divide	Picked up snow above 8,000 ft
September 2, 1971	West shore of Utah Lake	Brief No Damage
August 13, 1984	South of Provo	No Damage
April 5, 1997	Near Allen's Ranch (Cedar Fort)	No Damage

Development Trends

Most new development is not in avalanche areas. A limited number of recreational cabins are being built in the canyon areas. Any new development should be built to withstand avalanche forces.

Mitigation Strategies

Problem: Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 1 – Priority High

Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participate in the StormReady program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service StormReady program.

Action 2: Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Utah County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from severe weather events including lightning.

The following mitigation strategies are provided so that communities may be aware of additional mitigation measures that could be used to limit the exposure to Severe Weather/Avalanche related damage.

Prevention

- Early warning and notification systems
- Building codes to address wind shear and snow load
- Properly ground structures for lightning
- Public education for severe weather conditions
- Restrict development in avalanche prone areas

Property Protection

- Structural tie downs of roofs in high wind areas
- Mitigate development in areas of avalanche potential
- Monitor NWS weather warnings and watches

Natural Resource Protection

- Evaluate the impacts of severe weather
- Mitigate development in areas of avalanche

Emergency Services

- Monitor NWS weather warnings and watches
- Develop plans and exercises for severe weather

Structural Projects

- Install sheds over roads below avalanche terrain
- Install drift fences along snow drift areas
- Install avalanche fencing along ridgelines for wind blown snow
- Promote Weatherization programs

Public information

- Develop outreach document on avalanche safety
- Become a NWS Storm Ready Community
- Promote Lighting Safety Week
- Develop cold weather safety materials
- Ensure that at risk groups, such as the elderly, are checked on during severe weather

Infestation

The vulnerability assessment of Insect Infestation varies little across the county. The western area of the county has an increased vulnerability for cricket invasions, while communities around Utah Lake have an increased chance of West Nile Virus infections. For the most part, the above referenced region-wide analysis covers infestations in sufficient detail for Utah County.

The following table identifies the mitigation strategies that are the top priority for each community. The mitigation strategies where prioritized based on GIS data. The hazard identified with the highest number of household potentially affected was designated the highest priority.

Utah County Communities
PRIORITIZATION OF INDIVIDUAL COMMUNITY
MITIGATION STRATEGIES
Table U-24

Community	Hazard	Mitigation	Cost	Responsible party	Funding Source
Alpine	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
American Fork	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Cedar Fort	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Cedar Hills	Landslides/ Flood	Participate in the NFIP/Require site-specific soils reports	$1,000	Local Gov	Local cash, grants, volunteers
Eagle Mountain	Wildfire	Educate Homeowners on Firewise practices	$1,000	Local Gov	Local cash, grants, volunteers
Elk Ridge	Wildfire/ Flood	Educate Homeowners on Firewise practices Join NFIP Flood Map Community	$1,000	Local Gov	Local cash, grants, volunteers
Genola	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Goshen	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Highland	Flood	Encourage Homeowner Participation in NFIP	N/A	Local Gov	Local cash, grants, volunteers
Lehi	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Lindon	Landslide	Prohibit development in Landslide areas	$1,000	Local Gov	Local cash, grants, volunteers
Mapleton	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Orem	Dam Failure	Establish Early Warning System	In Process	Local Gov	Local cash, grants, volunteers
Payson	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Pleasant Grove	Flood	Encourage Homeowner Participation in NFIP	N/A	Local Gov	Local cash, grants, volunteers
Provo	Dam Failure	Establish Early Warning System	In Process	Local Gov	Local cash, grants, volunteers

Salem	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Santaquin	Flood	Map flood and debris flow areas in newly annexed areas	$1,000	Local Gov	Local cash, grants, volunteers
Saratoga Springs	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Spanish Fork	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Springville	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Utah County	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Vineyard	Liquefaction	Educate Homeowners/Require mitigation on new development	$1,000	Local Gov	Local cash, grants, volunteers
Woodland Hills	Landslide	Prohibit development in Landslide areas	N/A	Local Gov	Local cash, grants, volunteers

Wasatch County

Area: 1,191 square miles; *population*: 15,215 (in 2000); *county seat*: Heber City; *origin of county name*: from the Wasatch Mountains; *principal cities/towns*: Heber City (7,291), Midway (2,121), Charleston (378), Wallsburg (274); *economy:* hay, livestock, recreation; *points of interest*: Strawberry, Deer Creek, and Jordanelle reservoirs, Wasatch Mountain State Park, Wasatch LDS Tabernacle in Heber City, Heber Creeper, historic homes in Midway.

Heber Valley, one of several back valleys in the Wasatch Mountains, is often called Utah's Switzerland because of the rugged beauty of Mount Timpanogos located to the west, its climate, and a large population of Swiss that settled in Midway. The county's highest peaks top 10,000 feet, and over half of the land is 7,500 feet above sea level. The climate zone, classified as undifferentiated highlands, offers cool summers and very cold winters. The average annual precipitation is about sixteen inches.

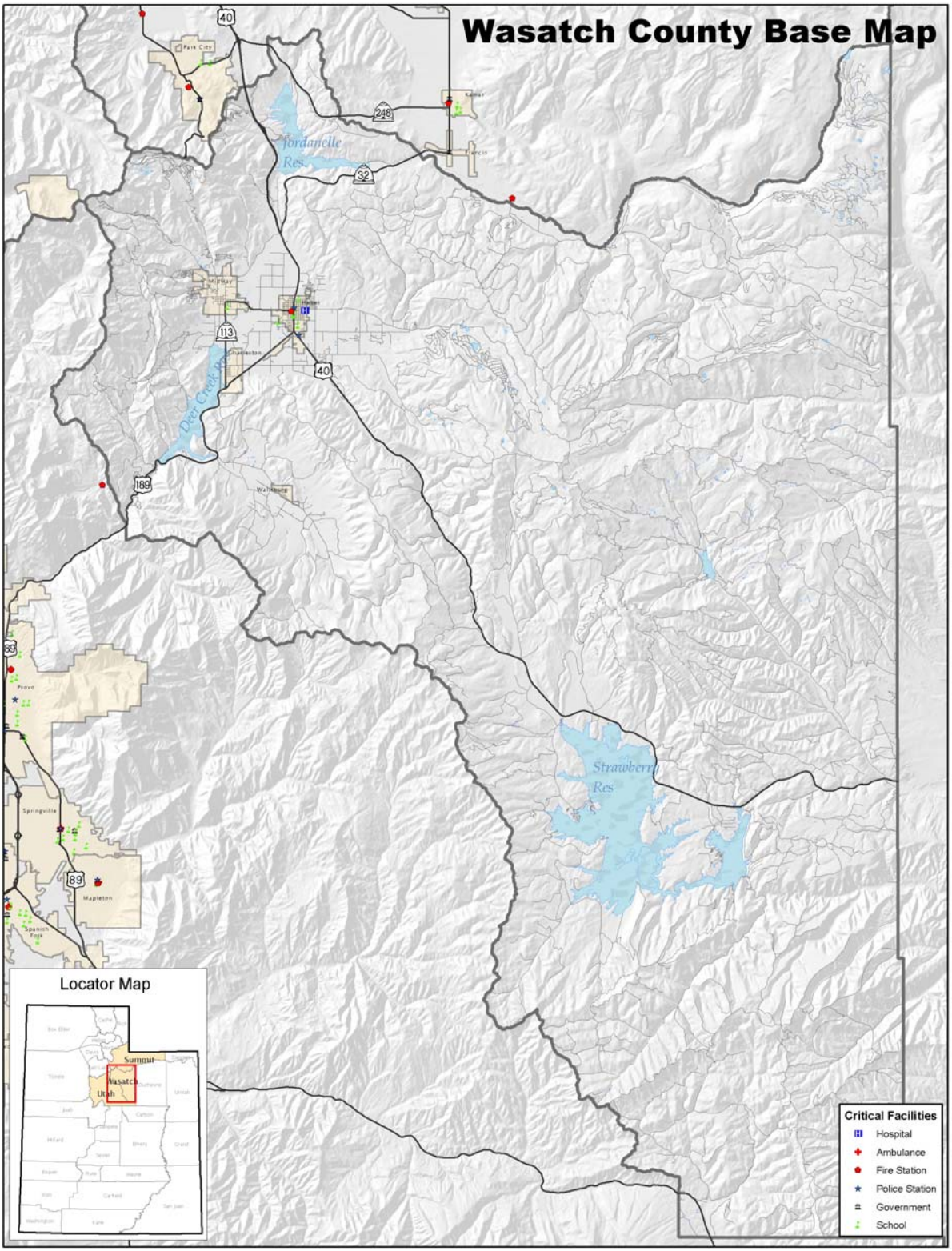
The county is divided into two watersheds--the Colorado and the Great Basin drainage systems. Because of its annual precipitation and its location between the Uinta and Wasatch mountains, Heber Valley is well endowed with water. Flowing from the east are Daniels, Lake Fork, and Center creeks. From the north and northeast is the Provo River. From the west Snake Creek drains a central portion of the Wasatch Mountains. Two additional sources of water are man-made: the Ontario Drain Tunnel west of Keetley drains many of the Park City mines, and the Weber/Provo diversion canal diverts water from the Weber across the Kamas prairie in Summit County to the Provo River in Wasatch County.

Prior to the 1850s, Heber Valley was an important summer hunting ground for the Timpanogos Utes living around Utah Lake. The first white men to visit the county were members of the Dominguez-Escalante expedition in 1776. They skirted Heber Valley, traveling down Diamond Fork to Spanish Fork Canyon and then into Utah Valley. Fifty years later fur trappers entered the county. In 1824 and 1825 Etienne Provost from Taos, New Mexico, trapped beaver in the Uinta and Wasatch mountains. About the same time, William Henry Ashley and members of his fur company from St. Louis also hunted and trapped for beaver in the county.

The first settlers came into Wasatch County from Utah Valley in the spring of 1859 and located a short distance north of present Heber City at the London or John McDonald Spring. That same year, Midway and Charleston were also settled. In 1862 the territorial legislature created Wasatch County, which then included all of the Uinta Basin. Wasatch in Ute means "mountain pass" or "low pass over high range." Heber City, named for Mormon Apostle Heber C. Kimball, was selected as the county seat.

The county produces hay, dairy products, sheep and cattle. During the early 1900s, after the Denver and Rio Grande Railroad completed a line into the county from Provo, Heber City became an important shipping terminal for wool and sheep. In 1922 the Union Pacific Railroad constructed a spur from Park City to the mines west of Keetley. Lead, zinc, and silver ore were shipped from these mines on this railroad spur. Today neither railroad line is in full operation, and other economic activities are more important to the county than transportation and mining.

Strawberry Reservoir (completed in the 1910s), Deer Creek Reservoir (completed in the 1940s), and Jordanelle Reservoir (completed in the 1990s), together with sparkling streams and beautiful mountain scenery, have made Wasatch a popular recreation area. (Source: Utah Historical Encyclopedia. Craig Fuller, Author)


Wasatch County Base Map
Jordanelle Res
Deer Creek Res
Strawberry Res
Park City
Kamas
Francis
Heber
Midway
Charleston
Wallsburg
Provo
Springville
Mapleton
Spanish Fork
40
248
32
113
189
89
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School

Population

The following table shows historic population data:

Table W-1

	1930	1940	1950	1960	1970	1980	1990	2000
Wasatch	5,636	5,754	5,574	5,308	5,863	8,523	10,089	15,215

Economy

Wasatch County, though still largely rural in nature, has seen its economy show greater signs of life than ever before. Heber City and Midway, the two largest cities in the county, have both seen a number of new developments add some vitality and tax base to their communities. New economic development and housing plans currently being completed will no doubt add to Wasatch County's ability to focus and channel resources into the most beneficial sectors and activities.

Table W-2

Economic Indicators for Wasatch County
1997-2001

Wasatch County	1997	1998	1999	2000	2001	% Change 1999-00
Population	13,307	14,132	14,560	15,433	15,947	3.3
Employment						
-Ave civilian labor force	5,759	5,991	6,239	6,369	6,577	3.0
-Ave non-ag employment	3,817	4,097	4,686	4,698	4,727	.07
Income						
-Ave monthly non-ag wage	1,454	1,582	1,689	1,834	1,898	3.4
-Annual non-ag payroll ($000)	66,570	78,062	94,971	103,408	107,700	4.2
Total personal income ($Mil)	256	281	305	332	357	7.7
Per capita personal income	19,193	20,144	20,991	21,547	22,424	4.1
Taxes						
-Total assessed value ($Mil)	941	1,111	1,211	1,359	1,493	9.9
-Prop taxes charged ($000)	9,232	10,958	11,998	12,979	13,811	7.6
-Gross taxable sales ($000)	118,483	136,583	155,799	171,693	173,996	1.3
-Net local sales tax ($000)	1,265	1,351	1,506	1,685	1,809	7.4
Construction (permitted)						
-New Dwelling Units (#)	183	239	504	370	279	-24.6
-Value of new res. ($000)	22,586	26,514	67,744	74,751	54,062	-27.7
-Value new non-res ($000)	10,421	14,202	4,705	25,706	8,869	-65.7
-Value of total constr. ($000)	35,480	42,819	75,162	102,913	65,965	-35.9
Miscellaneous						
-Fed mineral royalties ($000)	826	434	451	73		
-Fed in lieu of taxes ($000)	291	306	318	337	503	49.3

Source: Bureau of Economic and Business Research, University of Utah.
www.business.utah.edu/bebr/Counties/wasatch.htm

Flood
Risk Assessment

Wasatch County

Table W-3

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Wasatch	Unincorporated	5718		490164A - 10/1/86(L)	Provo River & Tributaries
Wasatch	Charleston	378	E5	490165 - 8/5/80(M)	
Wasatch	Heber City	7291	D5	490166 - 3/18/87	
Wasatch	Midway	1554	D5	490167 - 8/19/80(M)	
Wasatch	Wallsburg	274	E5	Not Participating	Spring & Main Creeks

Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.

Wasatch County Flood and Dam failure History

Table W-4

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Wasatch Presidential	Spring 1983	Wasatch County	Uncontrolled flooding washed out culverts, bridges, public and private roads. Irrigation systems along with livestock holding fences, corrals were destroyed. 2.5 miles of the Heber Creep track was destroyed.	
		Heber City	Clogged culverts, and flooding damage to residential, commercial and public property.	
Flood Wasatch Presidential	Spring 1984	County wide	Damage to stream banks, culverts, bridges, structures, and roadways near or along streams.	County damage was estimated at $646,526.

(All dollar values for given are for year of disaster)
Source: Flood Hazard Identification Study: Mountainland Association of Governments, US Army Corps of Engineers, September 3, 2003.

Assessing Vulnerability

Table W-5

Roads				
City	County	Type of Road	Length in Miles	Value
	Wasatch		1.28	$2,560,000
	Wasatch	Connecting road, county roads	1.98	$3,960,000
	Wasatch	Jeep trail,	0.5	$1,000,000
	Wasatch	Neighborhood roads	29.07	$58,140,000
	Wasatch	Secondary road, U.S. highway	2.55	$6,154,425
Charleston	Wasatch		0.04	$80,000
Charleston	Wasatch	Connecting road, county roads	0.07	$140,000

Charleston	Wasatch	Neighborhood roads	0.38	$760,000
Charleston	Wasatch	Secondary road, U.S. highway	0.19	$458,565
Midway	Wasatch		0.25	$500,000
Midway	Wasatch	Neighborhood roads	0.53	$1,060,000
Wallsburg	Wasatch	Connecting road, county roads	0.14	$280,000
Wallsburg	Wasatch	Neighborhood roads	0.22	$440,000
		Total	37.2	$75,532,990

Table W-6

Utilities				
City	County	Type of Line	Length in Miles	Value
Charleston	Wasatch	KV-12.5 or less	0	$0
	Wasatch	KV-12.5 or less	2	$96,560
	Wasatch	KV-138	0	$0
	Wasatch	KV-46	1	$48,280
	Wasatch	Owned by others	0	$0
		Total	**3**	**$144,840**

Wasatch County Flood Mitigation Goals

Problem Identification: Flood occurs primarily from spring snow-melt and occasionally from localized summer thunderstorms. Identifying and then controlling flooding will assist in responding to flood events. Protection of life and property before, during, and after a flooding event is essential.

Goal 1 – Priority High

Objective 1.1 Encourage 100% participation in the National Flood Insurance Program (NFIP).

Action: Assist the Town of Wallsburg in joining NFIP
Time Frame: 1 year
Funding: None required
Estimated Cost: None
Staff: County Emergency Management, County Engineer, State Floodplain Manager
Jurisdictions: Wallsburg
Background: FEMA has yet to map the Town of Wallsburg with Special Flood Hazards (SFHA). The community does not participate in the NFIP therefore flood insurance is not available.

Objective 1.2 Promote flood insurance throughout the County

Action: Create outreach documents promoting flood insurance for inclusion in local newspaper(s), libraries, and other public buildings.
Time Frame: 1 year
Funding: Minimal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager, DES
Jurisdictions: Countywide
Background: General public is usual not aware they can purchase flood insurance.

Objective 1.3 Reduce threat of unstable canals throughout the County. Identify County-wide canal systems

Action: Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County Engineer, County Public Works, County Information and Technology, County Emergency Management
Jurisdictions: Countywide
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control.

Objective 1.4 Reduce flooding threat in Midway, Heber, Charleston, and Wallsburg.

Action: Clear debris and other material from streams prior to spring snow melt.
Time Frame: Ongoing
Funding: None
Estimated Cost: Unknown
Staff: County Public Works
Jurisdictions: Countywide
Background: Most flooding is attributed to debris-laden streams.

Objective 1.5 Ensure EOC(s) is equipped to respond to flooding.

Action: Obtain communication equipment that will allow for timely response to flooding.
Time Frame: 1 year
Funding: Federal Grants
Estimated Cost: $30,000
Staff: County Sheriff, County Emergency Management
Jurisdictions: Wasatch County
Background: An alternate EOC is being considered in Kamas. An adequate communication capability is essential between all response agencies within the County.

Objective 1.6 Support updating of flood hazard data

Action: Support and encourage participation in the NFIP Flood Map Mod Program.
Time Frame: Ongoing
Funding: Federal
Estimated Cost: Unknown
Staff: County Engineer, State Floodplain Manager
Jurisdictions: Countywide
Background: Accurate flood maps assist the County in the administration of the NFIP and better reflects flood risk within the County.

Mitigation Strategies

The following mitigation strategies are provided so that communities may be aware of additional measure that could be used to limit the exposure to flood related damage.

Prevention

- Planning and Zoning
- Floodplain open space preservation
- Building construction regulation
- Regulation of other facilities (critical)
- Stormwater management

Property Protection

- Relocation
- Acquisition
- Building elevation
- Flood proofing
- Lifeline protection
- Flood Insurance

Natural Resource Protection

- Wetlands protection
- Erosion and sediment control

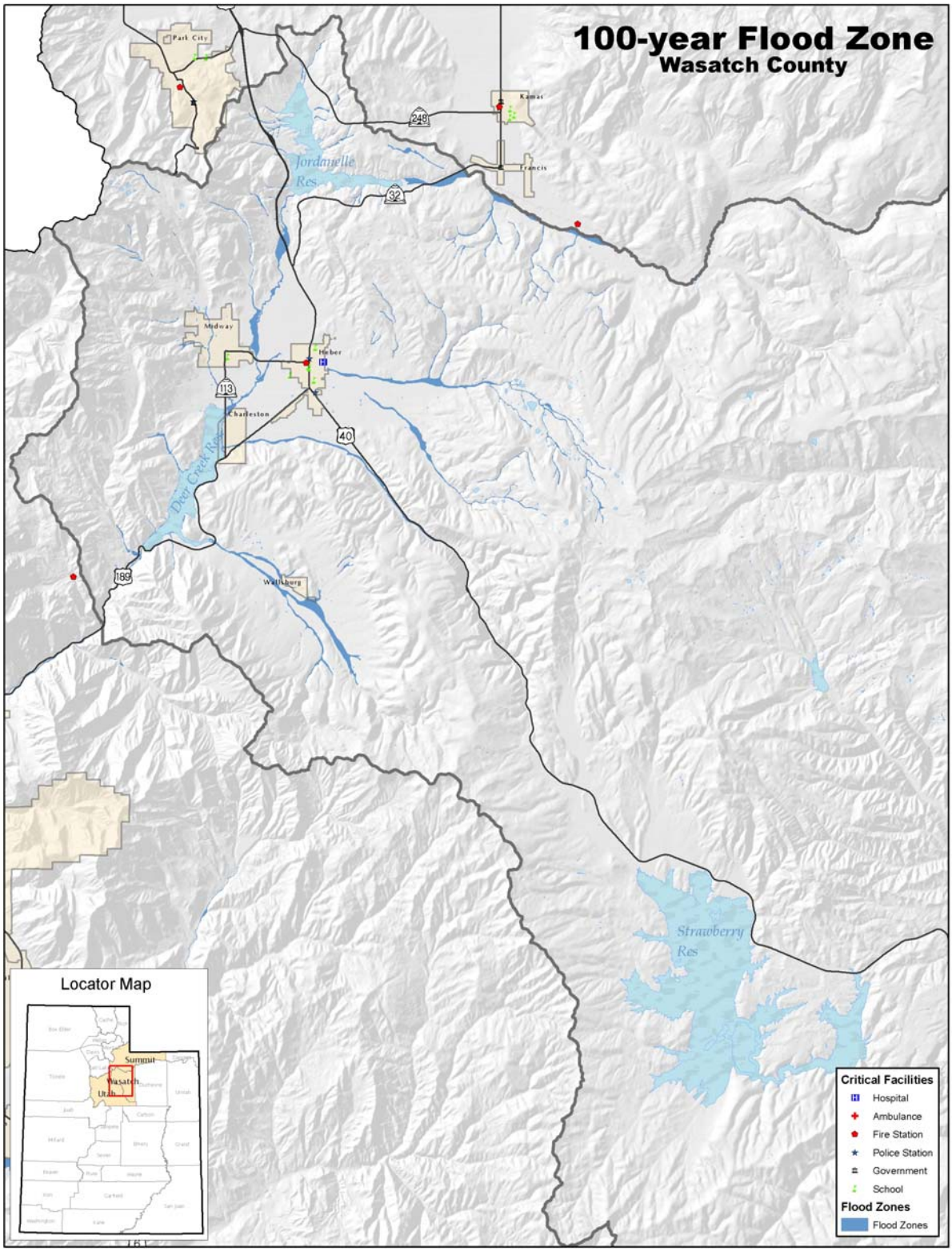
Emergency Services

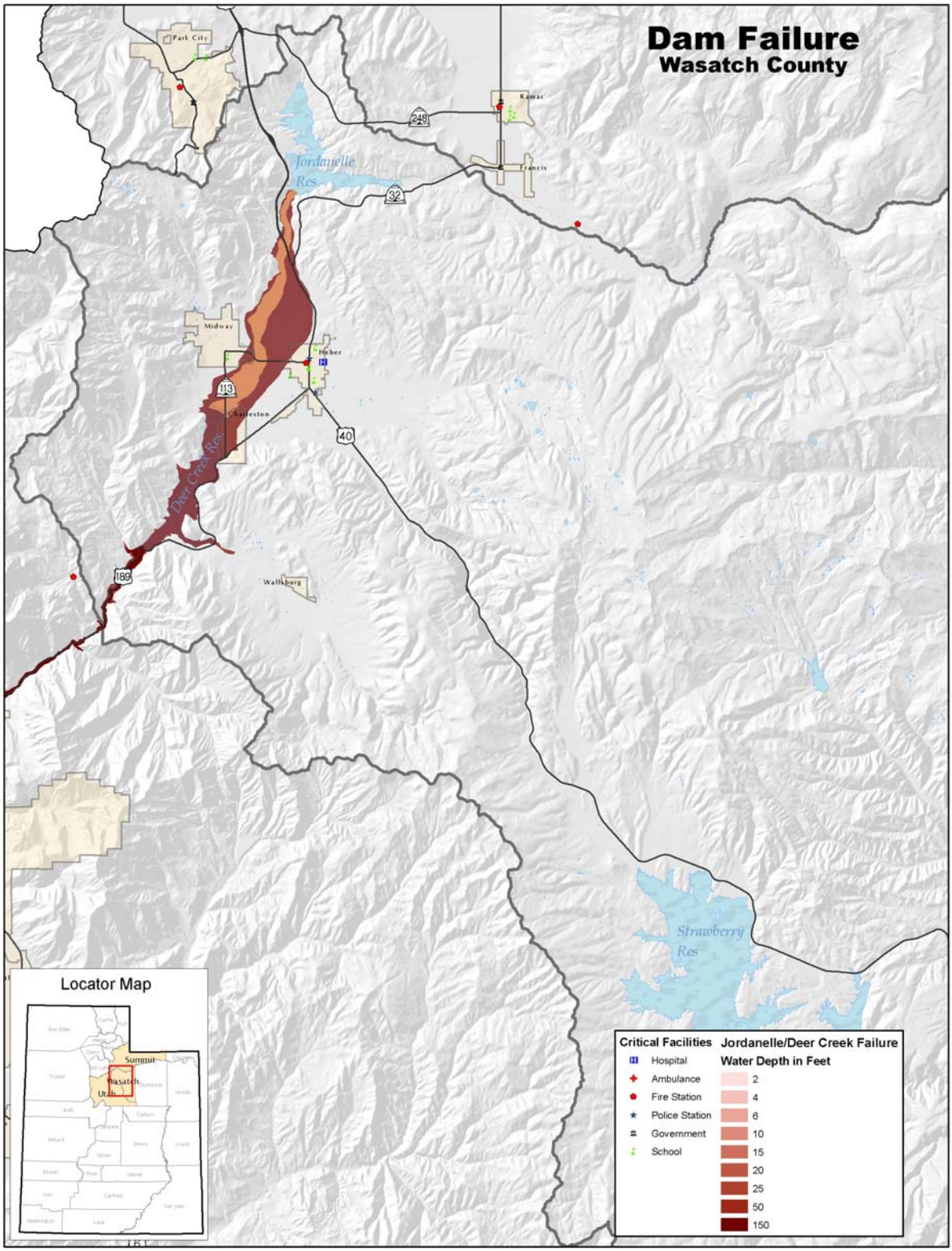
- Flood threat recognition
- Warning dissemination
- Flood response
- Critical Facilities Protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects
- Reservoirs/impounds
- Levees
- Diversions
- Channel and drainage modifications
- Channel and basin maintenance

Public information

- Flood Hazard maps
- Map Information
- Outreach projects
- Real estate disclosures
- Library
- Technical Assistance
- Environmental education


100-year Flood Zone
Wasatch County
Park City
Kamas
Francis
Jordanelle Res
Midway
Heber
Charleston
Wallsburg
Deer Creek Res
Strawberry Res
248
32
113
40
189
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Flood Zones
Flood Zones


Dam Failure
Wasatch County
Park City
Kamas
Francis
Jordanelle Res
Midway
Heber
Charleston
Deer Creek Res
Wallsburg
Strawberry Res
248
32
113
40
189
Locator Map
Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Jordanelle/Deer Creek Failure
Water Depth in Feet
2
4
6
10
15
20
25
50
150

Wildland Fire

Assessing Vulnerability

Wildland fire is a big concern in the Wasatch County area. On August 24, 1990, the most devastating urban wildland interface wildfire (URWIN) to have occurred in Utah began just west of the Heber Valley and lasted for six days, burning nearly 3,000 acres until it was officially contained. The Wasatch Mountain Fire, as it is referred to now, killed two firefighter, destroyed 18 homes and cost the state approximately $1.42 million in fire suppression. The overall loses were estimated to be about $2 million. Following this wildfire, precautions were taken in Midway for flash flooding and the NRCS Emergency Watershed Protection Program (EWP) was implemented with emergency flash flood mitigation measures.

Due to this fire a grant was received to implement a Children's Wildfire Mitigation Awareness Program. In the summer of 2003, a second wildfire, also started by the Forest Service, this time in the Cascade Springs area of Utah County, got out of control and burned into Wasatch County. The original "Prescribed" Burn was to be about 600 acres. The wildfire consumed more than 8,000 acres and threatened homes in the Midway area. Mudflows from the burned areas may have a negative effect on water quality in the Deer Creek Reservoir. There was considerable concern on the part of Wasatch County Officials that Forest Service Officials would not let the County aid in fighting the fire.

The following GIS based analysis indicates the vulnerability analysis for Wildland Fire in Wasatch County

Table W-6

NAME	County	Population	Households	Value
Charleston	Wasatch	84	27	$4,050,000
Wasatch	Wasatch	2,462	748	$112,200,000
Total		2,546	775	$116,250,000

The following Table lists the Wildfires over 100 acres

Table W-7

FIRE_ID	YEAR	NAME	SDATE	CAUSE	COUNTY	TYPE	SIZE
3436-2000	2000	East Vivian	7/26/2000	LT	Wasatch	Wildland	328
	1990	Wasatch Mtn	8/24/1990	FS	Wasatch	Wildland	>3,000
	2003	Cascade Springs	9/22/2003	FS	Wasatch	Wildland	>8,000

Timberlakes Project Report

Due to increasing Wildland fire activity in the western US and in particular, the terrible Wildland fire season of 2000, the National Fire Plan was developed. In 2001, the Timberlakes community, a Wildland Urban/Interface community, was listed as the #2 Wildland Hazard Risk in the State of Utah. This community is a mixture of permanent and seasonal residents with over 500 homes and 3,000 people located in the Lake Creek region approximately five (5) miles east of Heber City.

The State of Utah, Division of Forestry, Fire and State Lands, in collaboration with the Timberlakes Homeowners Association Board, Timberlakes residents, The Church of Jesus Christ of Latter-Day Saints. Wasatch County, and the US Forest Service, applied for a hazardous fuel reduction grant. This grant was approved for $20,400. The grant objectives were to primarily educate and undertake an assessment of the severity of the wildfire hazard faced by the individual homeowners. The remaining objective of the grant was to demonstrate how these hazards could be mitigated through the use of a demonstration of defensible space around the homes and a perimeter fuel break. The project was not intended to "mitigate all of the wildfire hazards" faced by the community.

The risk in the Timberlakes community was evaluated using the Division of Forestry, Fire, and State Lands wildfire hazard rating criteria. Risk factors included poor road access, lack of a reliable water system, fuel loading within the subdivision, and fire history. Following this evaluation, an action plan was developed for further action. This consisted of providing information and education to Timberlakes residents, homeowner and community action, and hazardous fuel reduction. Lot assessments were completed for 342 lots of which 300 were rated high, 16 were rated extreme, and 26 were rated as moderate, with an overall rating of high. As a response to the lot assessment program and education efforts significant interest in creating defensible space resulted with 107 lots doing some kind of fuel reduction and approximately 1,000 tons of slash removed.

As a result of these activities, the Timberlakes community has taken the first step and the initial response by the partners to continue. So it is very important that the initial work completed is maintained and the creation of defensible space and proactive community involvement continues in the future.

Mitigation Strategies–Wildland Fire

Problem Identification: Non-compliance with best firewise practices.

Goal 1 – Priority High

Objective 1.1 Increase compliance with existing building and fire codes.

Action: Develop and enforce current local, state and national codes
Time Frame: Ongoing
Funding: Local budgets
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Jurisdictions: Countywide
Background: Implement and enforce rules, regulations and codes

Problem Identification: Building continues to be of concern in Urban Wildfire Interface Areas (URWIN).

Goal 2 – Priority High

Objective 1.1 Educate homeowners on how to reduce risk of wildfire damage

Action 1: Conduct an education program (Firewise) on reducing wildfire risks
Time Frame: Ongoing
Funding: County
Estimated Cost: Minimal

Staff: Fire District(s), County Emergency Management, and State FFSL
Jurisdictions: Countywide
Background: Educate homeowners using newsletters and personal contacts of the importance of clearing combustibles from perimeters of their homes and defensible space. The Utah Living With Fire Committee has created a Utah specific wildfire education-training package. GIS analysis conducted by Mountainland Association of Government indicates the county has 775 structures costing $116,250,000 vulnerable to wildfire in Wasatch County.

Action 2: Complete mitigation detailed in the wildfire plan prepared for the community of Interlaken Estates.
Time Frame: 3 years
Funding: County, State and Federal
Estimated Cost: Unknown
Staff: Private land owners, Interlaken Community Fire Council, County Public Works, County Emergency Management, Fire District, State Forestry Fire and State Lands, US Forest Service
Jurisdictions: Interlaken Estates
Background: Wildfires have the potential to threaten this area. These community specific mitigation strategies will assist in protecting the community.

Action 3: Continue to coordinate with current Firewise communities.
Time Frame: Ongoing
Funding: County, State and Federal Grants
Estimated Cost: Minimal
Staff: County Emergency Management, State FFSL, US Forest Service
Jurisdictions:
Background: It is essential we continue to promote wildfire mitigation actions and educate homeowners on wildfire risks.

The following mitigation strategies have been provided so that communities may be aware of additional measures that could be used to limit the exposure to Wildland Fire related damage.

Prevention

- Zoning ordinances to reflect fire risk zones
- Regulate development areas near fire protection and water resources
- Planning to include: spacing of buildings, firebreaks, on-site water storage, wide roads, multiple access
- Code standards for roof materials and fire protection systems
- Maintenance programs to clear dead and dry brush
- Regulations on open fires
- Open space around structures

Property Protection

- Retrofitting roofs, add spark arrestors
- Create and maintain defensible space
- Insurance
- Eliminate ladder fuels
- Install sprinkler systems

- Develop fire resistant plans
- Have home addresses clearly displayed
- Clean out rain gutters

Natural Resource Protection

- Require mitigation of development in high-risk areas
- Understand impact of non-native vegetation
- Promote tread soft ATV use
- Develop watershed management plans
- Maintain watersheds
- Establish and promote fuel reduction

Emergency Services

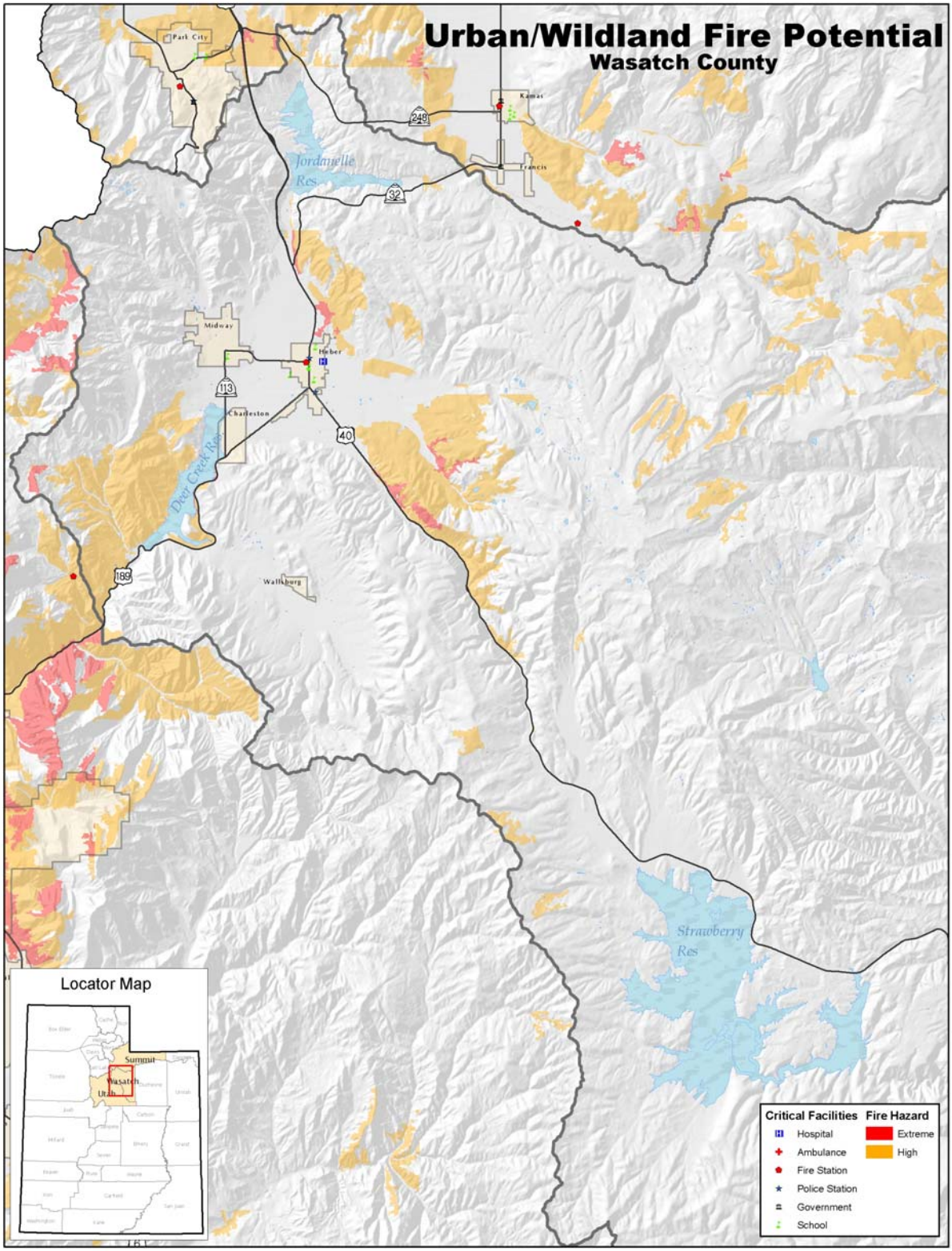
- Mutual aid agreement for fire fighting
- Participate in State Wildfire Suppression Fund
- Develop and exercise local wildfire response plan and evacuation plans

Structural Projects

- Construct wildfire fuel breaks
- Install Heliport water stations
- Tree and underbrush thinning in critical areas
- Increase the number of fire hydrants
- Install water tanks

Public information

- Develop maps for wildfire hazard areas
- Mail wildfire information to owners high-risk structures
- Develop urban wildfire “How to protect your home from Wildfires” book
- Publish newspaper articles on wildfires
- Presentations on wildfires at community meetings
- Develop displays for public buildings and events
- Real estate disclosure of high hazard wildland fire area


Urban/Wildland Fire Potential
Wasatch County
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Summit
Wasatch
Utah
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Fire Hazard
Extreme
High

Landslide/Problem Soils

Assessing Vulnerability

The Utah Interagency Technical Team (IAT) has worked with Wasatch County in 1999 due to extensive landslide complexes identified by the Utah Geological Survey in the Timber Lakes area and also in several mountain communities on the west side of the Heber Valley. In one such area of Timber Lakes, more than 200 homes are in a Landslide Study Area of the UGS. Thus, the UGS has completed, and is still conducting, Landslide Hazard and Risk Analysis for Timber Lake and other communities. These reports can be obtained from the UGS.

The following table is from a GIS analysis of active landslides in Wasatch County than the data being produced for the Timber Lakes area.

Table W-8

County	City	Population	Households	Type
Wasatch		371	138	Deep Seated
Wasatch		1066	338	LS and LS/talus/colluvial/etc
Wasatch	Midway	20	9	LS and LS/talus/colluvial/etc

Development Trends

As development continues on the foothills of the Heber Valley, more houses may be in danger of landslides. Wasatch County is currently restricting development in the Timber Lakes area.

Mitigation Strategies

Problem Identification: There is a potential risk to structures located in areas identified by the MAG GIS analysis and UGS study as landslide risk areas. Several areas in Wasatch County are particularly vulnerable they include the Provo river area down stream from Deer Creek Reservoir, Timber Lakes area, and several communities on the west side of Heber Valley.

Goal 1 – Priority Medium

Objective 1.1 Reduce potential landslide risk on commercial, residential structures, and infrastructure (pipelines and utilities) in areas of known landslide potential.

Action 1: Assess the probability of landslides and identify specific structures and infrastructure at risk
Time Frame: Undetermined
Funding: County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners
Estimated Cost: Unknown
Staff: Unknown
Jurisdictions: Countywide
Background: Soil surveys and other engineering surveys are needed.

Action 2: Include landslide data in County Information and Technology GIS system and include on County website.
Time Frame: Undetermined
Funding: County, possible grants
Estimated Cost: To be determined
Staff: County GIS Staff, UGS,
Jurisdictions: Countywide
Background: General public and developers will have access to landslide data.

Action 3: Map landslide risk areas for inclusion in site development ordinances. These ordinances should include at a minimum a natural hazards disclosure clause.
Time Frame: Undetermined
Funding: County Engineer, County Emergency Management, County Public Works, Utilities, Developers and Property Owners
Estimated Cost: Unknown
Staff: Unknown
Jurisdictions: Countywide
Background: Soil surveys and other engineering surveys are needed.

The following mitigation strategies are provided so that communities may be aware of additional methods that could be used to limit the exposure to landslide/Problem Soils related damage.

Prevention

- Planning and zoning restrictions and regulations
- Open Space
- Building Codes
- Drainage system maintenance
- Monitor and evaluate areas after wildfire
- Install ground monitoring instruments on landslide-prone areas
- Establish codes (grading, construction, excavation) in landslide prone areas

Property Protection

- Insurance
- Remove soil
- Ensure rain gutters and sprinklers are directed away from structures
- Control and monitor surface and ground water drainage
- Control building in areas of landslides
- Evaluate property maintenance in areas of landslides (over watering)
- Plan proper valving of waterlines to ensure quick turn off in the event of a waterline break

Natural Resource Protection

- Leave area as open space
- Identify structures impacted by problem soils
- Complete a watershed management plan
- Limit use of ATVs in areas off landslides to manage erosion
- Evaluate impact of wildfire in areas of landslides
- Mitigate development in landslide-prone areas
- Maintain natural vegetation

Emergency Services

- Identify structures impacted by problem soils
- Monitor and warning systems
- Evacuation plans and exercises
- Critical Facilities Protection
- Equip emergency crews with water valve shut-off keys

Structural Projects

- Pre-soak and/or compact soils
- Install drain fields
- Bring in structural fill
- Build buttress, retaining walls and other engineered structures
- Install subsurface drainage materials
- Remove potential landslide debris

Public information

- Develop information on problem soils
- Outreach information on problem soil mitigation
- Map soils and landslide areas
- Real estate disclosure
- Notice to homeowners in landslide areas detailing hazard
- Library
- Technical Assistance
- Education

Earthquake

Assessing Vulnerability

The following table shows recorded earthquakes occurring in Wasatch County since 1950

Table W-9

Date	Richter Magnitude	Epicenter
August 17, 1963	3.9	12 miles northeast of Strawberry Reservoir
October 1, 1972	3.8	Near Heber
October 2, 1972	3.2	Near Heber
December 24, 1972	3.0	Near Heber
August 5, 1973	3.4	Deer Creek Reservoir
August 19, 1973	3.4	South of Heber

Please see the HAZUS-MH Earthquake event report for Utah County 2500 year event, print date October 20, 2003 in the appendix of this document for full details of vulnerability. According to the HAZUS-MH run, about 35% or 2,093 buildings will be damaged and that 138 buildings will be completely destroyed

The geographical size of the region is 2,138.07 square miles and contains 85 census tracts. There are over 99 thousand households in the region and has a total population of 368,536 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 81 thousand buildings in the region with a total building replacement value (excluding contents) of 16,313 (millions of dollars). Approximately 99.00 % of the buildings (and 83.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,997 and 846 (millions of dollars), respectively.

Development Trends

As development occurs in Wasatch County, more buildings and people will be in danger from earthquakes. However, newer buildings will be built to better standards, which will actually decrease the risk of damage. It is interesting to note that when most residential structures are engineered, out the three categories of design criteria; seismic zone, wind shear and snow load; the design criteria for wind shear over-rules the other criteria.

Assessing Vulnerability

Please see the HAZUS-MH run in the appendix of this document for a detailed vulnerability assessment related to earthquakes.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites

For essential facilities, there is 1 hospital in the region with a total bed capacity of 16 beds. There are 6 schools, 1 fire station, 2 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 26 dams identified within the region. Of these, 13 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 949.00 (millions of dollars). This inventory includes over 165 kilometers of highways, 24 bridges, 0 kilometers of pipes.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

The following table forecasts the number of casualties that might be expected if an earthquake occurred.

Table W-10

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Education	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Residential	9	2	0	0
	Single Family	46	11	1	3
	Total	57	13	2	3
2 PM	Commercial	38	11	2	3
	Commuting	0	0	0	0
	Education	9	3	0	1
	Hotels	0	0	0	0
	Industrial	7	2		1
	Residential	2	0	0	0
	Single Family	8	2	0	0
	Total	65	18	3	5
5 PM	Commercial	35	10	2	3
	Commuting	0	0	0	0
	Education	0	0	0	0
	Hotels	0	0	0	0
	Industrial	4	1	0	0
	Residential	4	1	0	0
	Single Family	18	4	1	1
	Total	61	16	2	5

Building Damage

HAZUS estimates that about 2,093 buildings will be at least moderately damaged. This is over 35% of the total number of buildings in the county. There are an estimated 138 buildings that will be completely destroyed. The following table summaries the expected damage by general occupancy for the buildings in the county.

Table W-11

Type	None	Slight	Moderate	Extensive	Complete
Agriculture	0	0	0	0	0
Commercial	5	6	10	6	3
Educational	0	0	0	0	0
Governmental	0	1	1	1	0
Industrial	0	0	0	0	0
Religion	0	0	0	0	0
Residential	22	49	98	78	24
Single Family	1,674	2,067	1,436	324	111
Total	1,702	2,123	1,545	410	139

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Critical Facilities

Table W-12

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	1	0	0	0
Schools	6	0	0	0
EOCs	0	0	0	0
Police Stations	2	0	0	0
Fire Stations	1	0	0	1

Fire and Debris Generation

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 2 ignitions that will burn about 0.03 sq. mi 0.0 % of the region's total area.) The model also estimates that the fires will displace about 22 people and burn about 1 (millions of dollars) of building value.

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris

The model estimates that a total of 0 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Mitigation Strategies

Problem Identification: Wasatch County will be impacted indirectly from an earthquake on the Wasatch Front. Transportation and utilities services to and from the County could be severely impacted.

Goal 1 – Priority Low

Objective 1.1 Provide for emergency response and relief.

Action: Identify and maintain critical transportation and utility services
Time Frame: Ongoing
Funding: Grants
Estimated Cost: Unknown Determined by the extent of anticipated damage.
Staff: County
Jurisdictions: Countywide
Background: Critical transportation systems need to be maintained.

Problem Identification: Lack of public awareness about earthquake damage prevention practices.

Goal 2 – Priority Medium

Objective 2.2 Through the CERT Program, educate community on earthquake damage prevention practices

Action: Educate the public on damage prevention practices for earthquakes
Time Frame: 2 years
Funding: State and Federal Grants from state and Federal governments
Estimated Cost: $50,000-$75,000
Staff: County Emergency Management and volunteers
Jurisdictions: Countywide
Background: Continue to support C.E.R.T. program in the County. Earthquakes preparedness techniques and guidelines can be utilized in an all-hazard approach to personal and individual preparedness.

The following mitigation strategies are provided so that communities may be aware of additional measures that could be used to limit the exposure to earthquake related damage.

Prevention

- Planning and Zoning
- Building construction regulation
- Regulation of other facilities (critical)

Property Protection

- Non-structural methods
- Retrofit upgrades
- Earthquake Insurance

Natural Resource Protection

- Identify Fault Rupture zones
- Identify secondary impact

Emergency Services

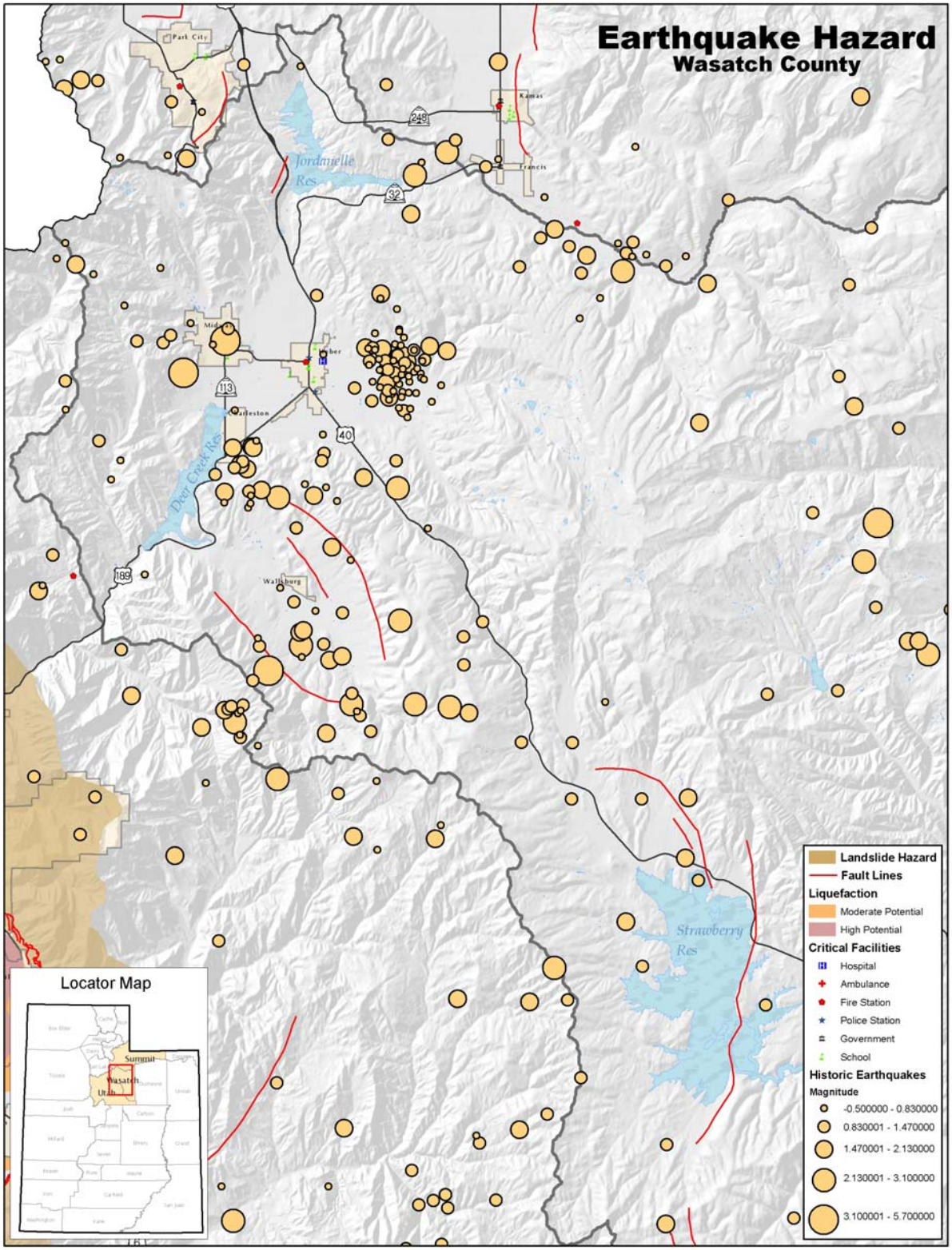
- Earthquake threat recognition
- Emergency Planning for Secondary Impact
- Emergency response (Mutual Aid, CERT)
- Critical Facilities Protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects

- Rebuild or retrofit critical facilities to higher seismic code
- Rebuild or retrofit infrastructure to higher seismic code

Public information

- Seismic maps; liquefaction, fault zones
- Map Information
- Outreach projects
- Real estate disclosures
- Library
- Technical Assistance
- Education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Fault Lines
Liquefaction
Moderate Potential
High Potential
Critical Facilities
Hospital
Ambulance
Fire Station
Police Station
Government
School
Historic Earthquakes
Magnitude
-0.500000 - 0.830000
0.830001 - 1.470000
1.470001 - 2.130000
2.130001 - 3.100000
3.100001 - 5.700000
Locator Map
Summit
Wasatch
Utah

Drought

Assessing Vulnerability

Drought is a region-wide hazard that varies little between the three counties in the MAG area. The vulnerability will typically be related to agricultural production. A secondary affect of drought is the increase in vulnerability to wildfires. Many of the communities in the region have dealt with drought for a number of years. These communities have several sources for water and storage facilities. Many of the communities have secondary water systems to reduce the demand on culinary water resources. Many communities also have active water conservation programs in place.

Mitigation Strategies

Problem Identification: Cyclical periods of drought place a strain on community culinary water resources.

Goal 1 – Priority Low

Objective 1.1 Conserve culinary water by educating the public

Action 1: Educate the public on the need to be water wise
Time Frame: Ongoing
Funding: State and Federal
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: Use a newsletter to educate the public

Action 2: Coordinate with current water systems and develop a secondary water systems plan for drought
Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

The following mitigation strategies are provided so that communities may be aware of additional measures that could be used to limit the exposure to drought related damage.

Prevention

- Establish economic incentives for water conservation
- Encourage water conservation
- Develop early warning system, monitoring programs
- Implement water metering and leak detection programs

Property Protection

- Identify potential for wildfire due to drought
- Identify secondary effects from drought
- Drought Insurance

Natural Resource Protection

- Legislation to protect stream flows
- Protect water aquifers
- Alert procedures for water quality issues
- Create inventory of pumps, filters and other equipment

Emergency Services

- Establish water hauling programs
- List livestock watering locations
- Establish hay hotline
- Fund water system improvements (wells, systems, reservoir)
- Lower well intakes
- Develop drought contingency plans
- Issue emergency permits for water use

Structural Projects

- Redesign or create new reservoir storage
- Provide pumps and piping for distribution

Public information

- Develop drought education material
- Water conservation outreach material
- Other outreach for awareness

Severe Weather/Avalanche

Assessing Vulnerability

No data is readily available for potential losses related to severe weather or avalanche, however most of the losses are limited. Severe weather may cause closure of transportation routes and fatalities due to weather related vehicular accidents. The ski resorts count on winter storms to produce the snow pack needed to operate their business. Some of the ski runs are located in avalanche prone areas, the private ski resorts as well as county public works and state road crews are aware of the potential dangers and keep the avalanche danger to a minimum. Backcountry skiers, snowboarders and snowshoe enthusiasts have the most severe threat to life related to avalanche danger. Avalanche danger warnings are issued, however it is the individual's responsibility to assure that the warnings are heeded

The following table shows recorded lightning deaths in Wasatch County since 1950

Table W-13

Date	Location	Remarks
July 1, 1990	Strawberry Reservoir	One Death, Sitting at picnic table
October 1, 2003	Strawberry Reservoir	One Death, loading boat on trailer

Development Trends

Most new development is not in avalanche areas. A limited number of recreational cabins are being built in the canyon areas. Any new development should be built to withstand avalanche forces.

Mitigation Strategies

Problem: Snowstorms, summer thunderstorms, hail, and high winds over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists.

Goal 1 – Priority High

Objective 1.1 Protect County from adverse affects of severe weather

Action 1: County participation in the Storm Ready program.
Time Frame: 2 Year
Funding: State and Federal
Estimated Cost: Unknown
Staff: City and County Emergency Management
Jurisdictions: Countywide
Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Action 2: Encourage avalanche preparedness and education for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal

Staff: County Emergency Management State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry, these figures when taken cumulatively result in avalanches be Utah's most deadly natural disaster. While the avalanche terrain is mainly on US Forest Service land the search and rescue efforts are conduct by City and County staff for the lost individual. Introductory avalanche awareness training could lessen search and rescue costs to Wasatch County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Action 3: Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide
Background: Alternate EOC(s), Sheriff's Dispatch, Command Vehicle(s)and associated equipment need to be protected from sever weather events including lightning.

The following mitigation strategies are provided so that communities may be aware of additional methods that could be used to limit the exposure to Severe Weather/Avalanche related damage.

Prevention

- Early warning and notification systems
- Building codes to address wind shear and snow load
- Properly ground structures for lightning
- Public education for severe weather conditions
- Restrict development in avalanche prone areas

Property Protection

- Structural tie downs of roofs in high wind areas
- Mitigate development in areas of avalanche potential
- Monitor NWS weather warnings and watches

Natural Resource Protection

- Evaluate the impacts of severe weather
- Mitigate development in areas of avalanche

Emergency Services

- Monitor NWS weather warnings and watches
- Develop plans and exercises for severe weather

Structural Projects

- Install sheds over roads below avalanche terrain
- Install drift fences along snow drift areas
- Install avalanche fencing along ridgelines for wind blown snow
- Promote Weatherization programs

Public information

- Develop outreach document on avalanche safety
- Become a NWS Storm Ready Community
- Promote Lighting Safety Week
- Develop cold weather safety materials
- Ensure that at risk groups, such as the elderly, are checked on during severe weather

Dam Failure

Assessing Vulnerability

This issue is a multi-county problem. For more information please see the detailed data in the Risk Assessment in this document.

Based on a GIS Analysis the following roads could be impacted by the failure of Jordanelle Dam.

Table W-14

County	Description	City	Length
Wasatch	Other		1.2
Wasatch	Connecting road, county roads, and roads not classified as A10 or A20, undivided		4.01
Wasatch	Neighborhood roads, city streets and unimproved roads, undivided		33.06
Wasatch	Secondary road, U.S. highway not classified A10, and state roads, undivided		9.46
Wasatch	Other	Charleston	0.07
Wasatch	Connecting road, county roads, and roads not classified as A10 or A20, undivided	Charleston	1.13
Wasatch	Neighborhood roads, city streets and unimproved roads, undivided	Charleston	5.28
Wasatch	Secondary road, U.S. highway not classified A10, and state roads, undivided	Charleston	0.96
Wasatch	Connecting road, county roads, and roads not classified as A10 or A20, undivided	Heber City	0.28
Wasatch	Neighborhood roads, city streets and unimproved roads, undivided	Heber City	1.09
Wasatch	Connecting road, county roads, and roads not classified as A10 or A20, undivided	Midway	0.37
Wasatch	Neighborhood roads, city streets and unimproved roads, undivided	Midway	2.56

Also based on a GIS Analysis the following power lines could be impacted by the failure of Jordanelle Dam.

Table W-15

County	Type	City	Length
Wasatch	KV-12.5 or less	Charleston	0
Wasatch	KV-12.5 or less		4
Wasatch	KV-138		0

Mitigation

Problem: National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means. The towns of Charleston, Midway, and Heber are down stream from the Jordanelle Reservoir. Dam failure inundation study show significant flooding to all three towns.

Goal 1 – Priority Medium

Objective 1.1 Obtain most up to date and accurate information on dams in County to protect lives and property from dam failure.

Action 1: Include dam inundation maps in current County EOP.
Time Frame: 3-5 Years
Funding: Undetermined
Estimated Cost: $ 10,000.00
Staff: County Emergency Management, BOR and State Dam Safety
Jurisdictions: Charleston, Midway, Heber.
Background: Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section in currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Wasatch County in future emergency management planning.

Action 2: Evaluate need and associated cost to have dam failure early warning sirens for communities of Charleston, Heber, and Midway.
Time Frame: 3- 5 years
Funding: Undetermined
Cost: Unknown
Staff: County Emergency Management, County Public Works, and BOR
Jurisdictions: Charleston, Heber, and Midway
Background: Charleston, Heber, and Midway could be directly impacted by a dam failure.

Action 3: Maintain rigorous dam safety inspections.
Time Frame: Ongoing
Funding: Operating budgets of inspecting agencies.
Cost: Unknown
Staff: County Emergency Management, County Public Works, and BOR
Jurisdictions: Charleston, Heber, and Midway
Background: Charleston, Heber, and Midway could be directly impacted by a dam failure.

Infestation

Infestation is a region-wide issue. Please see the information on this topic in the risk assessment section of this document.

The following table identifies the mitigation strategies that are the top priority for each community. The mitigation strategies where prioritized based on GIS data. The hazard identified with the highest number of households potentially affected was designated the highest priority.

Wasatch County Communities
PRIORITIZATION OF INDIVIDUAL COMMUNITY
MITIGATION STRATEGIES
Table W-16

Community	Hazard	Mitigation	Cost	Responsible party	Funding Source
Charleston	Dam Failure	Establish an early warning system	Unknown	BOR	Federal Government, grants
Heber	Dam Failure	Establish an early warning system	Unknown	BOR	Federal Government, grants
Midway	Wildfire	Distribute Information on Firewise Communities	$1,000	Local Gov	Local cash, grants, volunteers
Wallsburg	Wildfire	Distribute Information on Firewise Communities	$1,000	Local Gov	Local cash, grants, volunteers
Wasatach County	Wildfire	Distribute Information on Firewise Communities	$1,000	Local Gov	Local cash, grants, volunteers

Part V Plan Maintenance

Plan Maintenance Procedures

Monitoring, Evaluating and Updating the Plan

Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for the Mountainland Region are kept current and that local mitigation efforts are being carried out. The Plan has therefore been designed to be user-friendly in terms of monitoring implementation and preparing regular progress reports.

Annual Reporting Procedures

The Plan shall be reviewed annually, as required by the Executive Council, or as situations dictate such as following a disaster declaration. Each year the MAG Community Development Department Staff will review the plan and ensure the following:

1. The Executive Director and the Executive Council will receive an annual report and/or presentation on the implementation status of the Plan at the January Executive Council Meeting.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan.

If the MAG Executive Council determines that a modification of the Plan is warranted, the Council may initiate a Plan amendment.

Revisions and Updates

Periodic revisions and updates of the Plan are required to ensure that the goals and objectives for the Mountainland Region are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review

The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the Mountainland Region that would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the Plan.
The Pre-Disaster Hazard Mitigation Plan Ad-Hoc Committee, with a potential membership representing every jurisdiction in the MAG area, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the Plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review should become summarized in the annual report prepared for this Plan under the direction of the Community Development Director. The annual report will include an

evaluation of the effectiveness and appropriateness of the Plan, and will recommend, as appropriate, any required changes or amendments to the Plan.

If the Executive Council determines that the recommendations warrant modification to the Plan, the Council may either initiate a Plan amendment as described below, or, if conditions justify, may direct the MAG Community Development Department to undertake a complete update of the Plan.

Plan Amendments

An amendment to the Plan should be initiated only by the Executive Council, either at its own initiative or upon the recommendation of the Executive Director, Community Development Director, Mayor of an affected community or the State Department of Emergency Services and Homeland Security.

Upon initiation of an amendment to the Plan, Mountainland will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full Ad-Hoc committee may be reconstituted or the MAG Regional Growth Committee may review the amendment. At a minimum, the information will be made available through public notice in a newspaper of general circulation and on the Mountainland Website at www.mountainland.org. Information will also be forwarded to the Utah Department of Public Safety, Division of Emergency Services and Homeland Security. This information will be sent out in order to seek input on the proposed Plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Executive Director (or his/her designee) for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Executive Director (or his/her designee) will review the proposed amendment along with comments received from other parties and submit a recommendation to the Executive Council within sixty (60) days.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or

New issues or needs have been identified which were not adequately addressed in the Plan; and/or

There has been a change in information, data or assumptions from those on which the Plan was based.

The nature or magnitude of risks has changed.

There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, the Executive Council will hold a public hearing. The Executive Council will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Executive Council will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Refer the amendment request back to the Executive Director for further consideration.

4. Defer the amendment request for further consideration and/or hearing.

5. Reject the amendment request.

Implementation through Existing Programs

Process

The Mountainland Association of Governments Pre-Disaster Hazard Mitigation Plan will be implemented through the Capital Improvement Plans (CIP) of each local jurisdiction. It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Prioritization

For this plan projects were prioritized using that STAPLEE method and given a rating of high, medium or low. These rankings were reviewed by the Ad-Hoc Committee listed in Table 3.2 on page 22. The projects were also reviewed by the local elected officials in an Executive Council meeting in February 2004. The Planning Advisory Committee comprised of planners from each jurisdiction in the Utah County also reviewed and commented on the projects. These rating take into account the following evaluation criteria: social, technical, administrative, political, legal, and funding. Emphasis was given to funding which is a fundamental consideration in any hazard mitigation project. The projects were prioritized by the number of households potentially impacted by the hazard. Benefit cost analysis was not formally conducted on any of the projects suggested in the mitigation strategies. With few exceptions, none of the projects in the plan were developed far enough to derive a meaningful benefit to cost ratio. Should funding become available the extent by which benefits are maximized with regard to cost, would play a significant roll in determining which, projects get funded and which do not.

Administrative

Project administration is purely a function of project size and complexity, for given jurisdictions within the planning area. Jurisdictions have self-funded or received state and federal funding for numerous projects in the past. The larger the project the more administration resources are needed. Local jurisdictions with current staff could administer small projects or request county or state assistance. Larger projects would most likely still by managed “in-house” but would require additional staff be hired and may request state technical assistance.

Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The Mountainland jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the Plan identifies the primary Federal and State grant programs for Mountainland jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.
FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.
Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants fro post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

STATE PROGRAMS

See the Capabilities Assessment Annex of this document for a full description of the State Programs available.

LOCAL

Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

NON-GOVERNMENTAL

Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this Plan.

Continued Public Involvement

Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. On a yearly basis the plan will be profiled at Mountainland's Annual Open House, which is held in the fall of every year. There are typically 250-300 local citizens who attend the Open House. The plan will also be available on the MAG website to provide additional opportunities for public participation and comment.

Mountainland Association of Governments staff has been designated by its Executive Council as the lead agency in preparing and submitting the Mountainland Pre-Disaster Hazard Mitigation Plan, which includes coverage for all incorporated cities and counties within the three county region, i.e. Summit, Utah and Wasatch Counties. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The AOG will publicly advertise all hearings, requests for input and meetings directly related to the Pre-Disaster Hazard Mitigation Plan process. Executive Council meetings where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the AOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the Provo Herald, the Wasatch Wave and the Summit County Bee. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Pre-Disaster Hazard Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the Hazard Mitigation Plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the Plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Hazard Mitigation Plan will be presented to the Mountainland Executive Council at its regularly scheduled monthly meeting for adoption and approval to submit the document to State authorities. Executive Council policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the Plan, the Plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Hazard Mitigation Plan as open and convenient as possible:

A. Participation: All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings: Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information: Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Hazard Mitigation Plan, and/or any other documents prepared for distribution by the Association of Governments that may be adopted as part of the plan by reference. The AOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance: Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings: The AOG will plan and hold public hearings according to the following priorities: 1- Hearings will be conveniently timed for people who might benefit most from Mitigation programs, 2- Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy), and 3- Hearings will be adequately publicized.

Hearings may be held for a number of purposes or functions including to: a-identify and profile hazards, b-develop mitigation strategies, and c-review plan goals, performance, and future plans.

F. Comment Period: The AOG will sponsor a 30-day public comment period prior to final plan submission. The comment period will begin with a public hearing to open the 30-day solicitation of input. Comments may be made orally, or in writing, and as far as possible, will be included in the final Pre-Disaster Hazard Mitigation Plan according to the outlined participation rules.

Part VI Additional State Requirements Capability Assessment

INTRODUCTION

What follows is a description of the organizational, technical and political capacity of the Mountainland Region to implement hazard mitigation strategies and goals. The best plan in the world will do nothing to improve hazard mitigation efforts in the region without sufficient implementation capacity and capability; particularly local level capacity (town, city and county government). The purpose of this section is to analyze gaps and potential capability weaknesses for local level jurisdictions in the region.

LOCAL ORGANIZATIONAL AND TECHNICAL CAPABILITY

Only a handful of communities in the Mountainland region have full time professional staff of any kind. In many cases a limited tax base means that hiring full time professional staff in the smaller cities and towns is financially unobtainable. Often these smaller communities rely on local volunteers or elected and appointed officials to perform many of the tasks normally handled by professional staff. It's not uncommon to have a volunteer city council persons or planning commissioner assigned the task of emergency management, grant writing or long range planning. Professional staff at MAG (and each of the three counties to some degree) help provide some technical and planning assistance to these smaller communities. This regional assistance is often limited by staffing capacity and funding. As funding allows, some communities are able to contract for professional services from private consultants.

Only Provo City and Orem City have staffs that are, for the most part, dedicated full time to emergency management related tasks. While Summit, Utah and Wasatch Counties have emergency managers, all of these individuals have other responsibilities in addition to core emergency management functions.

Table 6.1: State and Regional Hazard Mitigation Resources MAG District

Agency/Group	Description
Utah Div. of Emergency Services and Homeland Security	Training, technical assistance and funding.
Utah League of Cities and Towns	Training, technical assistance and planning assistance
Utah Geologic Survey	Technical assistance, plan review
Mountainland Association of Governments	Technical assistance, plan review, GIS and Community Development Block Grants.
Local Health Departments	Emergency preparedness and response. Homeland security planning.
Local Chapters of the American Red Cross	Training, emergency preparedness and response.
Utah Association of Conservation Districts	Technical assistance and planning assistance.

Table 6.2: Local Level Hazard Mitigation Capability MAG District		
Jurisdiction	**Professional Staffing (e.g. City Manger, Engineer, Planner)**	**Technical Capacity (In House)**
SUMMIT COUNTY	County Emergency Management Coordinator , County Planner, Public Works, Building Inspector	GIS Staffing and equipment
Coalville	Volunteer\contracted consultant	None
Francis	Volunteer\contracted consultant	None
Henefer	Volunteer\contracted consultant	None
Kamas	Police, Planner, Public Works, Consultant	None
Oakley	Police, Planner, Public Works, Consultant	None
Park City	Emergency Manager, Planning Department, Public Works	GIS Staffing and equipment
UTAH COUNTY	Countywide Planner, Emergency Manager, Sheriff	Advanced GIS capability with customized application to Emergency Management.
Alpine	City Administrator, Planner, Public Works	None
American Fork	Chief of Staff, Public Works, Police	GIS Capability and staffing
Cedar Fort	Volunteer\contracted consultant	None
Cedar Hills	City Administrator, Planner, Public Works	None
Eagle Mountain	City Administrator, Planner, Public Works	Some GIS Capability
Elk Ridge	Planner, Volunteer	Some GIS Capability
Genola	Volunteer\contracted consultant	None
Goshen	Volunteer\contracted consultant	None
Highland	City Administrator, Planner, Public Works	None
Lehi	City Administrator, Planner, Public Works	GIS Capability and staffing
Lindon	City Administrator, Planner, Public Works	Some GIS Capability
Mapleton	City Administrator, Planner, Public Works	None
Orem	Emergency Management Department, Planning Department, City Engineers & Public Works.	Advanced GIS capability with customized application to Emergency Management.
Payson	City Administrator, Planner, Public Works	None
Pleasant Grove	City Administrator, Planner, Public Works	Some GIS Capability
Provo	Emergency Management Department, Planning Department, City Engineers & Public Works.	Advanced GIS capability with customized application to Emergency Management.
Salem	City Administrator, Public Works	None
Santaquin	City Administrator, Planner, Public Works	Some GIS Capability
Saratoga Springs	City Administrator, Planner, Public Works	Some GIS Capability
Spanish Fork	City Administrator, Planner, Public Works	Some GIS Capability
Springville	City Administrator, Planner, Public Works	Some GIS Capability
Vineyard	Volunteer\contracted consultant	None
Woodland Hills	Volunteer\contracted consultant	None

Table 6.2: Local Level Hazard Mitigation Capability MAG District		
Jurisdiction	**Professional Staffing (e.g. City Manger, Engineer, Planner)**	**Technical Capacity (In House)**
WASATCH COUNTY	County Administrator, Countywide Planner , Emergency Manager, Sheriff	Advanced GIS capability with customized application to Emergency Management.
Charleston	Volunteer\contracted consultant	None
Heber	City Administrator, Planner, Public Works	Some GIS Capability
Midway	City Administrator, Planner, Public Works	Some GIS Capability
Wallsburg	Volunteer\contracted consultant	None

POLICY AND PROGRAM CAPABILITY

All thirty-six jurisdictions in the MAG Region have an adopted General Plan. Although many communities have recently updated their General Plan, many are very outdated and have not been revised in years. Generally speaking, if these plans address natural hazards at all, it is usually limited to flood related hazards.

All of the thirty-six municipalities have an adopted zoning ordinance. Again, often these ordinances are outdated and often are not consistent with the jurisdiction's General Plan. Most zoning ordnances do not address natural hazards in any way. A few communities have a "sensitive area" or "hazard area" overlay zone. All communities issue building permits and enforce local building codes. Often this service is contracted for with the county.

Many of the smaller communities lack emergency response plans.

Authority

Federal: Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidentially declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

The Disaster Mitigation Act of 2000 was signed into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a

mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards, risks and vulnerabilities in that plan.

State: The State of Utah derives it's authority under the Emergency Management Act of 1981 (Utah Code 53-2, 63-5) as well as the Governor's Emergency Operations Directive and Executive Order of the Governor 11.

Association of Governments: The Association of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

Local: Utah Code, Title 17, Chapter 27 is the County Land Use Development and Management Act that grants authority to counties. Utah Code, Title 10 Chapter 9 grants similar authority to municipalities.

The state of Utah maintains a philosophy of local responsibility for hazard mitigation. State agencies still provide an integrated network of support, services, and resources for hazard mitigation activities. As demonstrated during past disasters, these agencies are well organized in their delivery and coordination of services. The following is a review of State departments with disaster responsibilities describing their existing and planned mitigation programs.

An evaluation of the laws, regulations, authorities, policies, and programs used in Utah to mitigate hazards demonstrate that they work exceptionally well, as evidenced by the massive amount of mitigation accomplished in Utah, the few numbers of disasters, and the limited nature of those emergencies that do occur. According to the Utah SHMT, the only changes that could be considered by the Legislature might be ones that parallel the Federal Disaster Mitigation Act of 2000, which would integrate predisaster mitigation considerations into the code of various state agencies.

Utah Division of Emergency Services and Homeland Security

For Associated state laws see "Authority" at the beginning of this plan.

Capabilities of DESHS Hazard Mitigation Program
Prepare, implement, and maintain programs and plans to provide for preventions and minimization of injury and damage caused by disasters.
Identify areas particularly vulnerable to disasters.
Coordinate hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters.
Assist local officials in designing local emergency actions plans.
Coordinate federal, state, and local emergency activities.
Coordinate emergency operations plans with emergency pans of the federal governments.

Through the State Hazard Mitigation Program, the following occurs:

- Provides a state coordinator for hazard mitigation, the State Hazard Mitigation Officer.
- Provides a central location of the coordination of state hazard mitigation activities.
- Provides coordination for the Federal Pre-Disaster Mitigation Program.
- Provide for coordination of Project Impact.

- Provide coordination for Comprehensive Multi-hazard Mitigation Plan development, implementation, and monitoring.
- Provide for interagency coordination
- Provide development of procedures for grant administration and project evaluation.
- Provide State Hazard Mitigation Team assistance to local governments.
- Provide for development of specific hazard mitigation plans, such as drought and wildfire.
- Provide for local hazard and risk analysis.
- Provide for development of SHMT mitigation recommendations following disasters.

Utah Department of Agriculture

The Utah Department of Agriculture administers programs serving the state's large agricultural sector. The department's response role during and after a disaster period has been to coordinate damage reports for funding needs and provide loan and recovery program information and assistance to disaster victims. This service is provided for flood, drought, insect infestation, fire, livestock disease, and frost.

Assistance During Drought Disasters:

A damage reporting network coordinated through the existing County Emergency Board was established during the drought disaster of 1996. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

Loans Handbook
The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and applications procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage: 1) Rural Rehabilitation Loan Program (federally funded and operated by the state); 2) Agriculture Resource Development Loan Program (state funded); and 3) Emergency Loan Program (state funded).

Soil Conservation Program
The Department of Agriculture also administers the ongoing Soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service which provides most of the technical assistance. The ongoing program is not regulatory, but is directed at improved water use and soil conservation.

Disaster Easements:
Because of the similarity between past events the department in now working on a permanent hazard mitigation concept known as "Disaster Easements", which may have widespread agreements with irrigation companies, water districts, or water users associations for the purpose of routing flood water through town.

Monitoring Ground Water Quality:
The Department also monitors groundwater quality of private individuals wells and springs throughout the State.

Non-Point Source Pollution:
The Departments Non-Point Source Pollution Program focuses on flood prevention through reduction of erosion, vegetating streams, and restoring “natural stream structure” The Department also monitors drought conditions, which are a precursor to wildfire.

Department of Community and Economic Development

Community Impact Board
The Utah Permanent Community Impact Fund Board provides loans and/or grants to state agencies and sub-divisions of the state, which may be socially or economically impacted by mineral resource development of federal lands.

Permanent Community Impact Fund:
The Permanent Community Impact Fund provides loans and/or grants to state agencies and subdivisions of the state, which are or may be socially or economically impacted, directly or indirectly, by mineral resource development on federal lands.

Under the Federal Mineral Lease Act of 1920, leaseholders on public land make royalty payments to the federal government for the development and production of non-metalliferous minerals. In Utah, the primary source of these royalties is the commercial production of fossil fuels on federal land held by the U.S. Forest Service and the Bureau of Land Management. Since the enactment f the Minerals Lease Act of 1920, a portion of these royalty payments, called mineral lease payments, have been returned to the state in an effort to help mitigate the local impact of energy and mineral developments on federal lands.

Funding Options:
The Board has the option of funding projects with loans and/or grants. The Board’s preferred financing mechanism is an interest-bearing loan.

Loan Requirements:
In providing financial assistance in the form of a loan, the Board may purchase an applicant’s bonds only if the bonds are accompanied by legal opinion of recognized municipal bond counsel to the effect that the bonds are legal and binding under applicable Utah Law.

The Board may purchase either a taxable or tax-exempt bond. The board may purchase taxable bonds if it determines, after evaluating all relevant circumstances, including the applicant’s ability to pay, that the purchase of the taxable bonds is in the best interest of the state and the applicant.

Grants
Grants may be provided only when the other financing mechanisms cannot be utilized, where no reasonable method of repayment can be identified, or in emergency situations regarding public health and/or safety.

Community Development Block Grant:
The Community Development Block Grant, or CDBG program, provides funding from the federal government’s Department of Housing and Urban Development or HUD, to small cities and counties in the State of Utah.

Utah Division of State History

The Utah State Historical Society, Utah's Division of State History, was founded in 1897 on the 50th anniversary of the first settlement in the Salt Lake Valley by the Mormon Pioneers. The Society became a state agency in 1917, now housed in the historic Rio Grande Depot since 1980. The Division stimulates archaeological research, study; oversees the protection and orderly development of sites; collects and preserves specimens; administers site surveys; keeps excavation records; encourage and supports the preservation of historic and pre-historic sites and publishes antiquities records. The Division also issues archaeological permits and consults with agencies and individuals doing archaeological work.

Preserving and Sharing Utah's Past
The mission of the State Division of History is "preserving and sharing Utah's past for the present and the future."

State Historical Preservation Officer (SHPO)
The SHPO administers the Section 106 process (national Historic Preservation Act) in Utah. The SHPO also serves on the Utah State Hazard Mitigation Team, providing guidance on historical and cultural preservation regulations.

Historic properties include districts, buildings, structures, objects, landscapes, archeological sites, and traditional cultural properties that are included in, or eligible for inclusion in, the National Register of Historic Places. These properties are not just "old buildings" or "well-known historic sites, but places important in local, state, or national history. Facilities as diverse as bridges and water treatment plants my, be considered historic.

Utah Geological Survey (UGS)

The Utah Geologic and Mineral Survey is the principal state agency concerned with geologic hazards. Through years of study, the UGS has developed considerable information on Utah's geologic hazards. When geologic events occur or threaten to occur, the UGS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat from natural hazards. The UGS works in partnership with other agencies, such as DESHS, in relating the threats from natural hazard to the communities at risk.

Functions:
The functions of the UGS include the following:
Evaluation of individual geological hazards;
Participation on local government and state agency technical teams;
Prediction of the performance on individual slides once they began to move;
Coordination and awareness of research efforts undertaken by other agencies;
Provide information on status of individual geologic hazards;
Reconnaissance reports on status of hazards statewide;
Advise Division of Water Rights on geologic hazards associated with dam sites; and
Provide geologic information for use during planning of remedial actions.

Laws/authorities/policies of the Utah Geological Survey for conducting mitigation

Utah Code Annotated
Chapter 73 Geological and Mineral Survey
Section 68-73-6 Objectives of Survey

(e) Determine and investigate areas of geologic and topographic hazards that could affect the safety of, or cause economic loss to, the citizens of this state; (f) assist local and state government agencies in their planning, zoning, and building regulations functions by publishing maps, delineating appropriately wide special earthquake risk areas, and, at the request of state agencies, review the siting of critical facilities:
Utah State Office of Education (USOE) Rule R277-455 Standards and Procedures for building plan review

R277-455-4 Criteria for Approval

To receive approval of a proposed building site, the local school district must certify that:
Staff of the Utah Geologic Survey have reviewed and recommended approval of the geologic hazards report provided by the school districts geotechnical consultant.
Division of Water Resources
Mitigation Functions
The Divisions role of planning, funding and constructing water projects serves as both active and passive hazard mitigation against drought and flood situations throughout the state. The various State water plans contain brief summaries of flood threat and risk for each drainages.

The Division is one of seven agencies in the State Department of Natural Resources. The eight member Water Resources Board, appointed by the governor, administers three state water conservation and development funds. They are:
Revolving Construction fund – This fund started in 1947 with 1 million legislative appropriation to help construct irrigation projects, wells and rural culinary water systems. Further appropriations have added to this fund.
Conservation and Development Fund – This fund was created in 1978 wit the sale of 25 million in general obligations bonds. Money was added to this fund with bond sales in 1980 and 1983. The C & D Fund generally helps sponsors finance larger multi-purpose dams and water systems.
Cities Water Loan Fund – Established with an initial legislative appropriation of 2 million dollars in 1974, and with continued appropriations, this fund provides financing to help construct new culinary water projects for cities, towns, improvement districts, and special service districts.

Construction Funds: In addition to overseeing these three construction funds, the Division also manages the State funds appropriated each year for renovation and reconstruction of unsafe dams. As the funding arm of the state for water resource projects the Division works closely with Water Rights, the Regulatory arm of the state charged with jurisdiction over all private and state owned dams.

Water Resource Planning: The Division is also charged with the general water resource planning for the state. The State Water Plan is a process that is coordinated to evaluate existing water resources in the state, determine water-related issues that should be confronted and recommend how and by whom issues can be resolved. The plan identifies programs and practices of state and federal agencies, water user groups and environmental interests and describes the state's current, future, and long-term water related needs. The plan is continually updated using current hydrologic databases, river basin simulations, water supply and demand models and water related land use inventories. Revisions reflect the latest water conservation and development options concerning water rights, water transfers, population, zoning, and many other complex issues for the next 50 years in the state's major river basins.

Utah Division of Forestry, Fire, and State Lands

The Division of Forestry, Fire & State Lands utilizes the principles of stewardship and ecosystem management to assist non-federal landowners in management of their natural resources. The agency provides wildland fire protection for non-federal landowners commensurate with risk; and optimizes the benefits from ecosystem based, multiple-use management of resources held in the public trust. Wildfires are managed from six area offices 1) Bear River Office, 2) Northeast Area, 3)Wasatch Front Area, 4) Central Area, 5) Southwest Area, and 5) Southeast Area.

The Division operates under the authority of the Utah Code Annotated 65-A-3-1 though 10.

The Flame-n-Go's (pronounced Flamingoes): In 1978 the Division of Forestry, Fire, and State Lands and the Utah State Prison signed a cooperative agreement establishing Utah's first volunteer, inmate wildland fire hand-crew. The inmates named themselves the "Flame-N-Go's" and designed a logo that has become well known in the wildland fire fighting community.

All Flame-N-Go's are carefully screened for the program. They must complete rigorous training and sign a yearly contract committing themselves to preserving Utah's natural resources and building responsible lives.

The Flame-N-Go's are divided into three crews, each of which can respond to fires anywhere in the United States. A twenty-man type II handline crew is the backbone of the group, responding to each assignment with all tools and equipment needed to do battle on the fireline. An Engine Strike Team, (five fire engines, outfitted with men and equipment) is ready to respond when needed as an Engine Strike Team or a Type II Handline Crew. The Hotshot crew is trained to tackle the most dangerous fires in the most rugged terrain. All crews during peak fire season are on 24-hour call to respond within an hour's notice. These crews respond to an average of 50 fires per year and typically spend 45,000 hours fighting fires each season. At least one Division of Forestry, Fire, and State Lands supervisor and two Department of Corrections staff accompany each crew.

Each year, Flame-N-Go's are put through at least 80 hours of extensive training including classroom work and practical field exercises. Safety, individual, and team skills, and professionalism are stressed.

National Fire Plan: The Division administers the State responsibilities of the National fire Plan, a current emphasis of the U.S. Congress, which also addresses hazard and risk analysis and hazard mitigation.

Living With Fire Committee: The Division works in partnership with the U.S. Forest Service, Bureau of Land Management, and various other entities tasked with suppressing wildland fires on the "Living With Fire" program promoting wildland fire mitigation.

Utah Division of State Parks and Recreation

The goal of the Division of Parks and Recreation is to enhance the quality of life for residents and visitors of our state through parks, people, and programs. They are responsible for protecting, preserving, and managing many of Utah's natural and heritage resources.

Hazard and Risk Analyses: The Division develops hazard and risk analyses for the State Parks as part of the park resource management plans. The Utah Division of Emergency Services and Homeland Security produced one analysis for Snow Canyon State Park in Washington County.

Non-Motorized Trail Program: The Recreational Trails Act of 1991 charged Utah State Parks and Recreation with coordinating the development of a statewide network of non-motorized trails. The Non-Motorized Trail program makes state and federal funds available on a 50/50 matching basis to any federal, state, or local government agency, or special improvement district for the planning, acquisition, and development of recreational trails.

Grants from State Parks Boards: The council advises the Division of Parks and Recreation on non-motorized trail matters, reviews requests for matching grant fiscal assistance, rates and ranks proposed trail projects and along with State Park's staff provides recommendations for funding to the State Parks Board.

Riverway Enhancement Program: In 1986, the Utah Legislature passed a bill which established the Riverway Enhancement Program. The program makes state funds available on a 50/50 matching basis to state agencies, counties, cities, towns, and/or special improvement districts for property acquisition and/or development for recreation, flood control, conservation, and wildlife management, along rivers and streams that are impacted by high density populations or are prone to flooding. Public outdoor recreation should be the primary focus of the project.

Utah Division of Water Rights

The Division of Water Rights is the state agency that regulated appropriation and distribution of water in the State of Utah. It is an office of public record. The Utah State Engineer's Office was created in 1897. The State Engineer's Office is the chief water rights administrative officer. A complete "water code" was enacted in 1903 and was revised and reenacted in 1919. This law, with succeeding complete reenactments of State statutes, and as amended, is presently in force mostly as *Utah Code, Title 73*. In 1963, the name was changed from State Engineers office to the Division of Water Rights.

All water in Utah are public property. A water right is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use.

Regulate Dams: The State engineer has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.

Stream Alterations Program: The Utah state Engineer's Office administers a Stream alterations program with the purpose of regulation activities affecting the bed or banks or natural streams. The State Engineer's working definition of a natural stream is any natural waterway in the state, which has flows of sufficient duration to develop a characteristic ecosystem distinguishing it from the surrounding

environments. Any individual planning an activity that will affect a natural stream must first obtain a Stream Alterations Permit from this office.

Most proposals reviewed by the State, are covered by General Permit 40, which authorizes the state to have its Stream Alteration Permit fulfill the requirements of Section 404 of the Clean Water Act for most activities. General permit 40 does not apply in some instances and a U.S. Army Corps of Engineers Individual Permit is required. Projects requiring this additional permit include those involving wetlands, threatened or endangered species, properties listed on the National Historic Register, stream relocation, or the pushing of streambed material against a stream bank.

Dam Safety Program: The Dam Safety Section of the Division of Water Rights was established under Chapters 73-5a 101 thru 73-5a 702 including chapters 73-2-22 for Flood Control and the Chapter 63-30-10 Waiver of Immunity of the Utah Code and Rules R655-10 thru R655-12-6A. The program basically has jurisdiction over all private and state owned dams in the state during design, construction, operation, and decommissioning. This involved periodic inspections according to hazard classifications, inventory maintenance, design, and construction approval and systematic upgrade of all the high hazard structures to current dam safety Minimum Standards and creation of Emergency Action Plans for High Hazard dams. Since 1991, detailed dam reviews have been undertaken by the staff and by private consulting firms. Since 1995, the State Legislature has provided 3-4 million dollars per year to finance 50 % of the instrumentation, investigations, and design and 80 to 90 % of the construction costs of retrofitting and upgrading deficient dams, starting with the worst dams in the most hazardous locations.

The impetus for this dam safety program has been in reaction to dam failures, both in Utah and in other states, including the Teton Dam in Idaho and the Trial Lake Dam in Summit County and the Quail Creek Dam near St. George Utah. Since the establishment of our Minimum Standards program we have fostered the repair of dozens of dams and have not had a catastrophic failure since.

Future recommendations include continuation of the funding for dam upgrades for all the high hazard dams, and then the moderate hazard dams, continued annual inspections for maintenance items and dangerous deficiencies, upgrading EAP, and hazard assessment to reflect downstream development. Inclusion of the scanned design drawings and inundation maps from the EAP studies is being considered for our web page for public information and emergency access. Possible expansion of the program to cover canals and dikes has been considered.

Utah Division of Wildlife Resources

It is the mission of the Utah Division of Wildlife Resources to serve people of Utah as trustee and guardian of the State's wildlife. Regulates hunting, fishing and trapping, and promotes recreational, educational, scientific and aesthetic enjoyment of wildlife.

Wildlife Habitats and Hazards: Wildlife species and/or their habitats are frequently exposed to hazards. These may be either natural or human influenced (i.e. drought, flood, fire, wind, snow, wetland drainage, water diversions, hazardous material spills, improper/illegal chemical use, earthquake, and other land or water construction/development). Impact resulting either directly or indirectly, from individuals or an accumulation of several hazards, may cause but not be limited to: decreased water supply, stream/lake channel/basin morphology change, riparian/upland vegetation loss or degradation, and impairment of water quality. These in turn have a varying influence, in the extreme causing death or at a minimum temporary stress, on wildlife populations and their habitats. Hazards mentioned may affect a fairly large geographic area or be very localized in nature.

While the Division of Wildlife Resources (DNR) is charged with the management of wildlife, they do not have regulatory authority over water appropriations, water quality, development, or land management; except as allowed or occurring on properties they own. Therefore, when hazards occur, outside DWR property, DWR is limited to be a participating influence only through comments to the other regulatory agencies or individuals.

DWR management of wildlife is carried out largely through regulation of taking controlling, disturbance and/or possession of wildlife, and introduction of movement of species. However, there are numerous non-regulatory means (i.e. conservation agreements, memorandum of understanding, contract, lease agreements, cooperative agreements, and technical assistance) by which DWR interacts with other agencies, groups and individuals, to have an influence on wildlife and/or their habitat.

Hazard Areas of Commentary Interaction
While not being able to control/regulate many of the elements necessary for the benefit of wildlife; DWR provides technical comments for the maintenance, protection, and enhancement of wildlife and/or habitats for various value reasons. It is too extensive list all the areas of comment; however, the following are examples of fairly frequent concern:

- Steam Channel Alteration Permit Applications
- Water Rights Filings
- Energy and Mineral Exploration and Extraction Applications
- Federal Agency land management plans
- Waste Water Discharge Permit Applications
- Hydroelectric plant licensing or regimenting
- Urban and rural development project planning
- Utility transmission line style and locations
- Wetland alteration
- Federal land management planning
- Highway constructions

The Utah Division of Drinking Water

Division of Drinking Water's Mission Statement is to " protect the public against waterborne heath risks through assistance, educations, and oversight". The Division acts as the administrative arm of the Utah Drinking Water Board. It implements the rules, which they adopt. As such, it is engaged in a variety of activities related to the design and operation of Utah's public drinking water system. The Utah Drinking Water Board is an 11-person board appointed by the Governor. It is empowered by Title 19, Chapter 4 of the Utah Code to adopt rules governing the design, operations, and maintenance of Utah's "public drinking water system".

Safe Drinking Water Act: There is a Federal Safe Drinking Water Act which applies to all public drinking water systems in the country. The U.S. Environmental Protection Agency (EPA) has given Utah "primacy" for enforcing the federal act within its boundaries. To qualifiy for this Utah's laws and rules governing public drinking water systems must be at least as strict as the federal law.

Sanitary Surveys: The Division performs sanitary surveys on the water systems, which is a compliance action that identifies system deficiencies.

Emergency Response Plans: The Division of Drinking Water requires water utilities to prepare emergency response plans under the State Safe Drinking Water Act, Utah Code Section 19-4. The Division operates according to DDW Rules: R309 gives them authority to administer actions: R309-301 through R309-104 and R309-113, R309-150, R309-301, and R309-211.

Utah Division of Solid and Hazardous Waste

The Tier II Chemical Inventory report, required by the Federal Emergency Planning and community Right-to-Know Act, requires facilities to submit lists of hazardous chemicals present on site. These reports are computerized and the information is provided to local emergency planning committees, the general public, and others for contingency planning purposes. To implement the Federal law, the State operates under Utah State Code, Section 63-5-5. The Division of Solid and Hazardous Waste requires that hazardous waste treatment storage and disposal facilities prepare and emergency response plan as required by regulations authorized by the State Solid and Hazardous Waste Act, Utah Code Section 19-6.

Other Agency programs are regulatory in nature requiring proper use or disposal of hazardous substances or pollutants. For example the Division of Solid and Hazardous Waste regulates the disposal of hazardous waste, the Division of Radiation Control regulates the proper usage and disposal of radioactive materials. As such there is a threat mitigation nature to these programs.
Utah Division of Water Quality

The Utah Division of Water Quality protects, maintains, and enhances the quality of Utah's surface and underground water for appropriate beneficial uses; the Division of Water Quality regulates discharge of pollutants into surface water, and protects the public health through eliminating and preventing water related health hazards which can occur as a result of improper disposal of human, animal, or industrial wastes while giving reasonable consideration to the economic impact.

Water Quality Fund and Wastewater Treatment Project Fund: The Division Manages the Water Quality Revolving Fund that can be used by local governments for water quality projects and a Wastewater Treatment Project Fund.

Abating Watershed Pollution: Federal and State regulations charge the Division with "preventing, controlling, and abating" watershed pollution. Other state and local agencies have similar responsibilities.

The Watershed Approach forms partnerships with these groups to pool resources and increase the effectiveness of existing programs. For each watershed management unit, a watershed plan will be prepared. The watershed plan addresses management actions at several spatial scales ranging from those that encompass a watershed management unit to specific sites that are tailored to specific environmental conditions. Ground water hydrologic basins and eco-region areas encompassed within the units will also be delineated.

State Revolving Fund Program: In 1987, Congress replaced the Construction Grants Program, with the State Revolving Fund Program. Rather than provide direct grants to communities, the federal government provides each state with a series of grants, then each state contributes a 20 percent state match. Grants from the federal government are combined with state funds in the Water Quality Project Assistance Program (WQPAP) and are used to capitalize a perpetual source of funds to finance water quality construction control activities at below market interests rates. Projects eligible for WQPAP financing include such traditional activities as construction of wastewater treatment plants and sewers. The program also will finance non-traditional water quality-related activities such as agricultural runoff control, landfill closures, contaminated industrial property (Brownfield) remediation, stream bank restoration, and wellhead protection.

Appendix

The following table list critical facilities, which may be affected by hazards

Table A-1

NAME	ADDRESS	CITY	DESC_	Dam Failure	Landslide	Flood	Wild Fire	Wetland	Liqufaction
Treasure Mt Middle	2530 Kearns Blvd, Park City 84	Park City	SCHOOL	0	0	0	1	0	0
North Fork Fire Station	8838 N Alpine Loop Rd.	Sundance	Fire Station	0	0	0	1	0	0
SUMMITT COUNTY SHERIFFS OFC			police station	0	0	0	1	0	0
Alpine Fire Department	20 N Main	Alpine	Fire Station	0	0	0	0	0	0
Alpine City Hall	20 N Main	Alpine	Government	0	0	0	0	0	0
Alpine School	400 E 300 N, Alpine 84004	Alpine	SCHOOL	0	0	0	0	0	0
LONE PEAK FIRE STATION		Alpine	Fire Station	0	0	0	0	0	0
National Guard Armory	251 S 200 East	American Fork	Government	0	0	0	0	0	1
Greenwood School	50 E 200 S, American Fork 8400	American Fork	SCHOOL	0	0	0	0	0	1
American Fork City Hall	31 N. Church	American Fork	Government	0	0	0	0	0	0
American Fork Hospital	170 N 1100 East	American Fork	Hospital	0	0	0	0	0	0
American Fork Ambulance Office	96 N Center	American Fork	Ambulance	0	0	0	0	0	0
American Fork Fire Department	98 N Center	American Fork	Fire Station	0	0	0	0	0	0
Barratt School	168 N 900 E, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
Forbes School	281 N 200 E, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
Legacy School	28 E 1340 N, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
Shelley School	550 N 200 W, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
American Fork Junior High	20 W 1120 N, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
American Fork High	510 N 600 E, American Fork 840	American Fork	SCHOOL	0	0	0	0	0	0
Dan W Peterson School	169 N 1100 E, American Fork 84	American Fork	SCHOOL	0	0	0	0	0	0
Ensign School	215 N Center, American Fork 84	American Fork	SCHOOL	0	0	0	0	0	0
Cedar Fort Town Hall	173 N Church	Cedar Fort	Government	0	0	0	0	0	0
Cedar Valley School	40 E Center, Cedar Fort 84013	Cedar Fort	SCHOOL	0	0	0	0	0	0
CEDAR FORT FIRE DEPT		Cedar Fort	Fire Station	0	0	0	0	0	0
Cedar Hills Town Office	4393 W Cedar Hills Dr.	Cedar Hills	Government	0	0	0	0	0	0
Cedar Ridge School	4501 W Cedar Hills Dr, Cedar H	Cedar Hills	SCHOOL	0	0	0	0	0	0
CEDAR HILLS FIRE DEPT		Cedar Hills	Fire Station	0	0	0	0	0	0
North Summit School	Box 497, 240 S Beacon Dr, Coal	Coalville	SCHOOL	0	0	0	0	0	0

North Summit Middle	Box 497, 76 S 100 E, Coalville	Coalville	SCHOOL	0	0	0	0	0	0
North Summit High	Box 497, 53 S 100 E, Coalville	Coalville	SCHOOL	0	0	0	0	0	0
COALVILLE FIRE DEPT		Coalville	Fire Station	0	0	0	0	0	0
Eagle Mountain City Offices	1700 Eagle Mountain Blvd	Eagle Mountain	Government	0	0	0	0	0	0
Eagle Mountain Fire Department	1700 Eagle Mountain Blvd	Eagle Mountain	Fire Station	0	0	0	0	0	0
Elk Ridge City Offices	80 Park Dr.	Elk Ridge	Government	0	0	0	0	0	0
Elk Ridge Fire Department	80 Park Dr	Elk Ridge	Fire Station	0	0	0	0	0	0
Genola City Offices	74 W. 800 South	Genola	Government	0	0	0	0	0	1
GENOLA FIRE DEPT		Genola	Fire Station	0	0	0	0	0	1
Goshen City Offices	12 W Main	Goshen	Government	0	0	0	0	0	1
Goshen School	PO Box B, 60 N Center, Goshen	Goshen	SCHOOL	0	0	0	0	0	1
GOSHEN FIRE DEPT		Goshen	Fire Station	0	0	0	0	0	1
WASATCH COUNTY FIRE DEPT		Heber	Fire Station	0	0	0	0	0	0
Heber Valley School	730 S 600 W, Heber City 84032	Heber City	SCHOOL	0	0	0	0	0	0
J R Smith School	235 E 500 N, Heber City 84032	Heber City	SCHOOL	0	0	0	0	0	0
Wasatch Middle	200 E 800 S, Heber City 84032	Heber City	SCHOOL	0	0	0	0	0	0
Wasatch High	64 E 600 S, Heber City 84032	Heber City	SCHOOL	0	0	0	0	0	0
Wasatch Alter High	301 S Main, Heber City 84032	Heber City	SCHOOL	0	0	0	0	0	0
HENEFER FIRE DEPT		Henefer	Fire Station	0	0	0	0	0	0
Highland City Offices	5378 W 10400 North	Highland	Government	0	0	0	0	0	0
Highland School	10865 N 6000 W, Highland	Highland	SCHOOL	0	0	0	0	0	0
Mt Ridge Junior High	5500 W 10400 N, Highland	Highland	SCHOOL	0	0	0	0	0	0
Lone Peak High	10189 N 4800 W, Highland 84003	Highland	SCHOOL	0	0	0	0	0	0
South Summit School	535 E 300 S, Kamas 84036	Kamas	SCHOOL	0	0	0	0	0	0
South Summit Middle	355 E 300 S, Kamas 84036	Kamas	SCHOOL	0	0	0	0	0	0
South Summit High	45 S 300 E, Kamas 84036	Kamas	SCHOOL	0	0	0	0	0	0
SOUTH SUMMIT FIRE DEPT		Kamas	Fire Station	0	0	0	0	0	0
Lehi School	765 N Center, Lehi 84043	Lehi	SCHOOL	0	0	1	0	0	1
Lehi City Fire Department	176 N Center	Lehi	Fire Station	0	0	0	0	0	1
Lehi City Hall	153 N 100 East	Lehi	Government	0	0	0	0	0	1
National Guard Armory	348 E Main	Lehi	Government	0	0	0	0	0	1
Eaglecrest School	2760 N 300 W, Lehi 84043	Lehi	SCHOOL	0	0	0	0	0	1

Meadow School	176 S 500 W, Lehi 84043	Lehi	SCHOOL	0	0	0	0	0	1
Lehi High	180 N 500 E, Lehi 84043	Lehi	SCHOOL	0	0	0	0	0	1
Sego Lily School	550 E 900 N, Lehi 84043	Lehi	SCHOOL	0	0	1	0	0	0
Lehi Junior High	700 E Cedar Hollow Rd, Lehi 84	Lehi	SCHOOL	0	0	0	0	0	0
U. S. B. O. R. Field Materials Control Lab	3979 W 5600 North	Lindon	Government	0	0	0	0	0	1
Oak Canyon Junior High	750 E 200 S, Lindon 84042	Lindon	SCHOOL	0	0	0	0	0	1
Lindon City Center	100 N State	Lindon	Government	0	0	1	0	0	0
Lindon Ambulance Office	100 N State	Lindon	Ambulance	0	0	0	0	0	0
Lindon Fire Department	100 N State	Lindon	Fire Station	0	0	0	0	0	0
Lindon School	30 N Main, Lindon 84042	Lindon	SCHOOL	0	0	0	0	0	0
Rocky Mt. School	55 S 500 E, Lindon 84042	Lindon	SCHOOL	0	0	0	0	0	0
Mapleton Fire Department	35 E Maple	Mapleton	Fire Station	0	0	0	0	0	1
Mapleton City Offices	35 E Maple	Mapleton	Government	0	0	0	0	0	1
Mapleton Ambulance Office	35 E Maple	Mapleton	Ambulance	0	0	0	0	0	1
Mapleton School	120 W Maple, Mapleton 84664	Mapleton	SCHOOL	0	0	0	0	0	1
MAPLETON FIRE DEPT		Mapleton	Fire Station	0	0	0	0	0	1
Midway School	225 S 100 E, Midway 84049	Midway	SCHOOL	0	0	0	0	0	0
OAKLEY FIRE DEPT		Oakley	Fire Station	0	0	0	0	0	0
Vineyard School	950 W 800 S, Orem 84058	Orem	SCHOOL	1	0	0	0	0	1
Orem Community Hospital	331 N 400 West	Orem	Hospital	1	0	0	0	0	0
Orem City Ambulance Office #2	911 N Main St.	Orem	Ambulance	1	0	0	0	0	0
Orem City Hall	56 N. State	Orem	Government	1	0	0	0	0	0
Orem City Fire Station #2	911 N Main St.	Orem	Fire Station	1	0	0	0	0	0
Cascade School	160 N 800 E, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Geneva School	400 N 665 W, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Orem School	450 W 400 S, Orem 84058	Orem	SCHOOL	1	0	0	0	0	0
Scera Park School	450 S 400 E, Orem 84058	Orem	SCHOOL	1	0	0	0	0	0
Sharon School	525 N 400 E, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Suncrest School	668 W 150 N, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Canyon View Junior High	625 E 950 N, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Lakeridge Junior High	951 S 400 W, Orem 84058	Orem	SCHOOL	1	0	0	0	0	0
Orem Junior High	765 N 600 W, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0

Mountain View High	665 W Center, Orem 84058	Orem	SCHOOL	1	0	0	0	0	0
Orem High	175 S 400 E, Orem 84057	Orem	SCHOOL	1	0	0	0	0	0
Columbia Timpanogos Regional Hospital	750 W 800 North	Orem	Hospital	0	0	0	0	0	0
Orem City Fire Station #3	275 N 1200 West	Orem	Fire Station	0	0	0	0	0	0
Orem City Ambulance Office #3	275 N 1200 West	Orem	Ambulance	0	0	0	0	0	0
Orem City Ambulance Office #1	300 E 1000 South	Orem	Ambulance	0	0	0	0	0	0
Orem City Fire Station #1	300 E 1000 South	Orem	Fire Station	0	0	0	0	0	0
Aspen School	945 W 2000 N, Orem 84057	Orem	SCHOOL	0	0	0	0	0	0
Cherry Hill School	250 E 1650 S, Orem 84058	Orem	SCHOOL	0	0	0	0	0	0
Hillcrest School	651 E 1400 S, Orem 84058	Orem	SCHOOL	0	0	0	0	0	0
Orchard School	1035 N 800 E, Orem 84057	Orem	SCHOOL	0	0	0	0	0	0
Northridge School	1660 N 50 E, Orem 84057	Orem	SCHOOL	0	0	0	0	0	0
Westmore School	1150 S Main, Orem 84058	Orem	SCHOOL	0	0	0	0	0	0
Windsor School	1315 N Main, Orem 84057	Orem	SCHOOL	0	0	0	0	0	0
Timpanogos High	1450 N 200 E, Orem 84057	Orem	SCHOOL	0	0	0	0	0	0
Ecker Hill Middle	2465 W Kilby, Park City 84098	Park City	SCHOOL	0	0	0	0	0	0
Park City High	1750 Kearns Blvd, Park City 84	Park City	SCHOOL	0	0	0	0	0	0
PARK CITY FIRE DISTRICT STN 31		Park City	Fire Station	0	0	0	0	0	0
PARK CITY FIRE DISTRICT STN 32		Park City	Fire Station	0	0	0	0	0	0
PARK CITY FIRE DISTRICT STN 33		Park City	Fire Station	0	0	0	0	0	0
Payson City Offices	425 W Utah Ave	Payson	Government	0	0	0	0	0	1
Taylor School	40 S 500 W, Payson 84651	Payson	SCHOOL	0	0	0	0	0	1
Wilson School	590 W 500 S, Payson 84651	Payson	SCHOOL	0	0	0	0	0	1
Payson Fire Department	45 E 100 South	Payson	Fire Station	0	0	1	0	0	0
Parkview School	360 S 100 E, Payson 84651	Payson	SCHOOL	0	0	1	0	0	0
Columbia Mountain View Hospital	1000 E Hwy 198	Payson	Hospital	0	0	0	0	0	0
Payson Ambulance Office	388 E 100 North	Payson	Ambulance	0	0	0	0	0	0
Barnett School	333 E 400 N, Payson 84651	Payson	SCHOOL	0	0	0	0	0	0
Payson Middle	851 W 450 S, Payson 84651	Payson	SCHOOL	0	0	0	0	0	0
Payson Junior High	1025 S Highway 6, Payson 84651	Payson	SCHOOL	0	0	0	0	0	0
Payson High	1050 S Main, Payson 84651	Payson	SCHOOL	0	0	0	0	0	0
U. S. B. O. R. Regional Drill Shop	315 W 1100 North	Pleasant Grove	Government	0	0	0	0	0	0

Pleasant Grove City Hall	70 S 100 East	Pleasant Grove	Government	0	0	0	0	0	0
Pleasant Grove Ambulance Office	110 S 100 East	Pleasant Grove	Ambulance	0	0	0	0	0	0
Pleasant Grove Fire Department	110 S 100 East	Pleasant Grove	Fire Station	0	0	0	0	0	0
Central School	95 N 400 E, Pleasant Grove 840	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Grovecrest School	200 E 1100 N, Pleasant Grove 8	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Manila School	1726 N 600 W, Pleasant Grove 8	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Valley View School	941 Orchard Dr, Pleasant Grove	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Pleasant Grove Junior High	810 N 100 E, Pleasant Grove 84	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Pleasant Grove High	700 E 200 S, Pleasant Grove 84	Pleasant Grove	SCHOOL	0	0	0	0	0	0
American Heritage	125 N 100 E, Pleasant Grove 84	Pleasant Grove	SCHOOL	0	0	0	0	0	0
Elementary School	600 N 1300 W, Pleasant View 84	Pleasant View	SCHOOL	0	0	0	0	0	1
Utah Valley Regional Medical Center	1034 N 500 West	Provo	Hospital	1	0	0	0	0	1
Utah County Offices	100 E Center	Provo	Government	1	0	0	0	0	1
Provo City Hall	351 W Center	Provo	Government	1	0	0	0	0	1
Provo City Electric Energy Department	251 W 800 North	Provo	Government	1	0	0	0	0	1
Provo Ambulance Office #3	601 W Columbia Ln	Provo	Ambulance	1	0	0	0	0	1
Provo Fire Station #4	2050 W 95 South	Provo	Fire Station	1	0	0	0	0	1
Provo City Ambulance Dept Station #4	2050 W 95 South	Provo	Ambulance	1	0	0	0	0	1
Provo Fire Station #3	601 W Columbia Ln	Provo	Fire Station	1	0	0	0	0	1
National Guard Armory	222 W 500 North	Provo	Government	1	0	0	0	0	1
Provo Fire Station #1	80 S 300 West	Provo	Fire Station	1	0	0	0	0	1
Provo City Ambulance Office #1	80 S 300 West	Provo	Ambulance	1	0	0	0	0	1
Valley Ambulance	925 N 500 West	Provo	Ambulance	1	0	0	0	0	1
Amelia Earhart School	2585 W 200 S, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Franklin School	350 S 600 W, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Sunset View School	525 S 1600 W, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Timpanogos School	449 N 500 W, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Dixon Middle	750 W 200 N, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Farrer Middle	100 N 600 E, Provo 84606	Provo	SCHOOL	1	0	0	0	0	1
Provo High	1125 N University Ave, Provo 8	Provo	SCHOOL	1	0	0	0	0	1
Mt Brook/Eastwood	1300 E Center, Provo 84601	Provo	SCHOOL	1	0	0	0	0	1
Utah County Health Department	589 S State	Provo	Government	0	0	0	0	0	1

Provo City Ambulance Office #2	2737 N Canyon Rd	Provo	Ambulance	0	0	0	0	0	1
Provo Fire Station #2	2737 N Canyon Rd	Provo	Fire Station	0	0	0	0	0	1
Joaquin School	550 N 600 E, Provo 84606	Provo	SCHOOL	0	0	0	0	0	1
Provost School	629 S 1000 E, Provo 84606	Provo	SCHOOL	0	0	0	0	0	1
Westridge School	1720 W 1460 N, Provo 84604	Provo	SCHOOL	0	0	0	0	0	1
Centennial Middle	305 E 2320 N, Provo 84604	Provo	SCHOOL	0	0	0	0	0	1
Canyon Crest School	4664 N Canyon Rd, Provo 84604	Provo	SCHOOL	0	1	0	0	0	0
Rock Canyon School	2405 N 650 E, Provo 84604	Provo	SCHOOL	0	0	0	0	0	0
Wasatch School	1080 N 900 E, Provo 84604	Provo	SCHOOL	0	0	0	0	0	0
Timpview High	3570 N 650 E, Provo 84604	Provo	SCHOOL	0	0	0	0	0	0
Oakridge School	1165 Birch Lane, Provo 84604	Provo	SCHOOL	0	0	0	0	0	0
Salem School	140 W 100 S, Salem 84653	Salem	SCHOOL	0	0	0	0	0	1
Salem City Offices	30 W 100 South	Salem	Government	0	0	0	0	0	0
Salem Ambulance Office	30 W 100 South	Salem	Ambulance	0	0	0	0	0	0
Salem Fire Department	30 W 100 South	Salem	Fire Station	0	0	0	0	0	0
Santaquin City Hall	45 S 100 South	Santaquin	Government	0	0	0	0	0	0
Santaquin Ambulance Office	30 S 100 East	Santaquin	Ambulance	0	0	0	0	0	0
Santaquin Fire Department	30 S 100 East	Santaquin	Fire Station	0	0	0	0	0	0
Santaquin School	25 S 400 W, Santaquin 84655	Santaquin	SCHOOL	0	0	0	0	0	0
SANTAQUIN FIRE DEPT		Santaquin	Fire Station	0	0	0	0	0	0
Saratoga Springs City Offices	6394 S Redwood Rd	Saratoga Springs	Government	0	0	0	0	0	1
Canyon School	1492 E 1240 S, Span Fork 84660	Span Fork	SCHOOL	0	0	0	0	0	0
Brockbank School	340 W 500 N, Spanish Fork 8466	Spanish Fork	SCHOOL	1	0	0	0	0	1
Spanish Fork City Offices	40 S Main	Spanish Fork	Government	0	0	0	0	0	1
Utah County Security Center	3075 N Main St.	Spanish Fork	police station	0	0	0	0	0	1
Spanish Fork Ambulance Station	360 N Main St.	Spanish Fork	Ambulance	0	0	0	0	0	1
Spanish Fork Fire Station	360 N Main St.	Spanish Fork	Fire Station	0	0	0	0	0	1
National Guard Armory	2801 N Main	Spanish Fork	Government	0	0	0	0	0	1
Park School	90 N 600 E, Spanish Fork 84660	Spanish Fork	SCHOOL	0	0	0	0	0	1
Rees School	185 E 400 N, Spanish Fork 8466	Spanish Fork	SCHOOL	0	0	0	0	0	1
Spanish Fork Middle	50 N 900 E, Spanish Fork 84660	Spanish Fork	SCHOOL	0	0	0	0	0	1
Spanish Fork High	99 N 300 W, Spanish Fork 84660	Spanish Fork	SCHOOL	0	0	0	0	0	1

Landmark High (Alt HS)	320 S Main, Spanish Fork 84660	Spanish Fork	SCHOOL	0	0	0	0	0	1
Larsen School	1175 E Flonette Dr, Spanish Fo	Spanish Fork	SCHOOL	0	0	0	0	0	0
Spanish Fork Junior High	600 S 820 E, Spanish Fork 8466	Spanish Fork	SCHOOL	0	0	0	0	0	0
Springville City Hall	50 S Main	Springville	Government	0	0	0	0	0	1
Springville Ambulance Office	45 S Main	Springville	Ambulance	0	0	0	0	0	1
Springville Fire Department	45 S Main	Springville	Fire Station	0	0	0	0	0	1
National Guard Armory	125 S 700 East	Springville	Government	0	0	0	0	0	1
Art City School	121 N 900 E, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Brookside School	750 E 400 S, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Grant School	105 S 400 E, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Sage Creek School	1050 S 700 E, Springville 8466	Springville	SCHOOL	0	0	0	0	0	1
Westside School	570 S Main, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Springville Middle	485 S 100 E, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Springville Junior High	165 S 700 E, Springville 84663	Springville	SCHOOL	0	0	0	0	0	1
Springville High	1205 E 900 S, Springville 8466	Springville	SCHOOL	0	0	0	0	0	1
GENEVA STEEL FIRE DEPT		Vineyard	Fire Station	1	0	0	0	0	1
Geneva Steel Ambulance Office	10 S Geneva Rd	Vineyard	Ambulance	0	0	0	0	0	1
Vineyard City Offices	240 E Gammon	Vineyard	Government	0	0	0	0	0	1
WANSHIP FIRE DEPT		Wanship	Fire Station	0	0	0	0	0	0
WOODLAND FIRE DEPT		Woodland	Fire Station	0	0	0	0	0	0
Woodland Hills Fire Department	Woodland Hills Dr	Woodland Hills	Fire Station	0	1	0	0	0	0
Woodland Hills City Offices	125 E Lakeview Wy	Woodland Hills	Government	0	1	0	0	0	0
PROVO POLICE DEPT			police station	1	0	0	0	0	1
UTAH COUNTY SHERIFFS OFC			police station	1	0	0	0	0	1
Lehi City Ambulance Office	54 N Center		Ambulance	0	0	0	0	0	1
LEHI POLICE DEPT			police station	0	0	0	0	0	1
MAPLETON POLICE DEPT			police station	0	0	0	0	0	1
SPANISH FORK POLICE DEPARTMENT			police station	0	0	0	0	0	1
SPRINGVILLE POLICE DEPT			police station	0	0	0	0	0	1
UTAH COUNTY JUSTICE CENTER			police station	0	0	0	0	0	1
UTAH VALLEY STATE COLLEGE PD			police station	0	0	0	0	0	1
PLEASANT GROVE PD - LINDON			police station	0	0	1	0	0	0

STN									
OREM POLICE DEPT			police station	1	0	0	0	0	0
ALPINE POLICE DEPT			police station	0	0	0	0	0	0
BRIGHAM YOUNG UNIVERSITY PD			police station	0	0	0	0	0	0
HEBER POLICE DEPT			police station	0	0	0	0	0	0
KAMAS POLICE DEPT			police station	0	0	0	0	0	0
PARK CITY POLICE DEPT			police station	0	0	0	0	0	0
PAYSON POLICE DEPT			police station	0	0	0	0	0	0
PLEASANT GROVE POLICE DEPT			police station	0	0	0	0	0	0
SALEM POLICE DEPARTMENT			police station	0	0	0	0	0	0
SANTAQUIN POLICE DEPARTMENT			police station	0	0	0	0	0	0
WASATCH COUNTY HOSPITAL			Hospital	0	0	0	0	0	0
WASATCH COUNTY SHERIFF'S OFC			police station	0	0	0	0	0	0
Park City City Hall			Government	0	0	0	0	0	0
Francis City Hall			Government	0	0	0	0	0	0
KAMAS CITY HALL			Government	0	0	0	0	0	0

Uintah Basin Association of Governments

Comprising:

Daggett, Duchesne, and Uintah Counties

Pre-Disaster Mitigation Plan (PDM)

Prepared By:

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Part I. Pre-requisite Adoption by the local jurisdiction

The Uintah Basin Executive Board, as well as the counties and communities participated in and promulgated this plan:

Daggett County

- Town of Manila

Duchesne County

- Town of Altamont, City of Duchense, Myton City, Roosevelt City, Town of Tabiona.

Uintah County

- Ballard Town, City of Naples, Vernal City.

Promulgation letter copies have been included in *Appendix K* of this plan.

Acknowledgements

Uintah Basin Association of Governments would like to extend their appreciation to the following agencies, which assisted in the development of this plan.

- Division of Emergency Services and Homeland Security
- Utah Geologic Survey
- Automated Geographic Reference Center
- United States Army Corps of Engineers
- Division of Water Rights Dam Safety Section
- Federal Emergency Management Agency Region VIII
- National Weather Service
- Utah Division of Forestry Fire, and State Lands
- Councils of Governments (Tribal and local)
- Daggett County Emergency Management
- Duchesne County Emergency Management
- Uintah County Emergency Management
- Uintah Basin Mayors and Commissioners
- Uintah Basin Emergency Managers and city personnel
- Utah Division of Water Resources
- Wasatch Front Regional Council

In addition we offer a sincere thanks to Clackamas County, Dunn County, Salt Lake City, Kidder County, Jefferson County for allowing review of their mitigation plans.

Preface

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. It is an essential element of emergency management, along with preparedness, response, and recovery. There is a cyclical relationship between the four phases of emergency management. A community prepares for a disaster, and then responds when it occurs. Following the response, there is a transition into the recovery process, during which mitigation measures are evaluated and adopted. This, in turn, improves the preparedness posture of the community for the next incident, and so on. When successful, mitigation will lessen the impacts to such a degree that succeeding incidents will remain incidents and not become disasters.

Hazard mitigation strives to reduce the impact of hazards on people and property through the coordination of resources, programs, and authorities so that, at the very least, communities do not contribute to the increasing severity of the problem by allowing repairs and reconstruction to be completed in such a way as to simply restore damaged property as quickly as possible to pre-disaster conditions. Such efforts expedite a return to “normalcy”; however, replication of pre-disaster conditions results in a cycle of damage, reconstruction, and damage again.

Hazard mitigation is needed to ensure that such cycles are broken, that post-disaster repairs and reconstruction take place after damages are analyzed, and that sounder, less vulnerable conditions are produced. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage. Hazard mitigation provides the mechanism by which communities and individuals can break the cycle of damage, reconstruction, and damage again.

Recognizing the importance of reducing community vulnerability to natural and technological hazards, the Counties of Daggett, Duchesne, and Uintah are actively addressing the issue through the development of this plan in conjunction with Uintah Basin Association of Governments. Implementing this plan is the responsibility of the cities and counties with the Uintah Basin planning district. The many benefits to be realized from this effort include protection of the public health and safety, preservation of essential services, prevention of property damage, and prevention of the local economic base, to mention just a few - will help ensure that the Uintah Basin and all of it’s communities remain vibrant, safe, and enjoyable places in which to live, raise a family, and conduct business. *For information regarding economic and demographic data in the Uintah Basin Region see Appendix J.*

Executive Summary

Plan Mission

The mission of the Uintah Basin Association of Governments (UBAOG) Pre-Disaster Mitigation Plan is to substantially and permanently reduce, communities within the UBAOG, vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer more sustainable community.

Plan Organization

The Uintah Basin Association of Governments plan was developed and organized within the rules and regulations established under 44 CRF 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within UBAOG, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the ability of community within the UBAOG planning district to handle disasters and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing

The UBAOG Pre-Disaster Mitigation Plan has been financed and developed under the Pre-Disaster Mitigation Program provided by the Federal Emergency Management Agency (FEMA) and the Department of Public Safety Division of Emergency Services and Homeland Security. The UBAOG aided in funding, providing in-kind assistance to local governments.

Plan Participation

The UBAOG Pre-Disaster Mitigation Plan has been completed as a result of a collaborative effort between Uintah Basin Association of Governments, Department of Public Safety Division of Emergency Services and Homeland Security, public agencies, and the citizens, elected officials, and public employees of the cities and towns within Daggett, Duchesne, and Uintah Counties. Interviews were conducted with stakeholders from the communities, and a workshop was conducted during the plan developments. Additionally, through public hearings, workshops, and draft plan displays; ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan. Completion of this multi-jurisdiction mitigation plan was completed with assistance and input from:

Daggett County

- Emergency Manager; Roads Department; GIS Department, and Town of Manila

Duchesne County

- Emergency Manager, Roads Department, Sheriff's Department, Town of Altamont, City of Duchesne, Myton City, Roosevelt City, and the Town of Tabiona.

Uintah County

- Emergency Manager, Roads Department, Sheriff's Department, Town of Ballard, City of Naples, and Vernal City.

Hazards Identified

It was suggested by the Division of Emergency Services and Homeland Security, at a minimum, Uintah Basin Association of Governments address the hazards of: earthquake, flood, landslide, problem soils, wildfire, dam failure, severe weather, and drought. However, there are other hazards that were identified which are not in the minimum criteria established by DESHS that were added to the discussion.

The hazard identification study recognized the following hazards as being the most prevalent and posing the most potential risk to the counties and towns within the UBAOG planning district.

- Dam Failure, Drought, Earthquake, Flood, Insect Infestation, Landslide, Wildfire, and Severe Weather.

Plan Goals

In an effort to ensure that the mission of the Uintah Basin Association of Governments Pre-Disaster Mitigation Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan.
The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by

combining hazard loss reduction with the community's environmental, social and economic needs.

- Protection of natural resources and the environment, when considering mitigation measures.
- Promoting public awareness through education of community hazards and mitigation measures.
- Preserving and/or restoring natural features that provide mitigation such as floodplains.
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be lessened when attention is turned to mitigating their impacts and effects before they occur or re-occur.

Hazard mitigation actions must be practical, cost effective, and environmentally and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

The primary focus of hazard mitigation actions must be at the point at which capital investment decisions are made and based on vulnerability. Capital investments, whether for homes, roads public utilities, pipelines, power plants, chemical plants or warehouses, or public works, determine to a large extent the nature and degree of hazard vulnerability of a community. Once a capital facility is in place, very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which insure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

What is Hazard Mitigation

Hazard mitigation is defined as any cost-effective action(s) that have the effect of reducing, limiting, or preventing vulnerability of people, property, and the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation measures, which can be used to eliminate or minimize the risk to life and property, fall into three categories. First; are those that keep the hazard away from people, property, and structures. Second; are those that keep people, property, and structures away from the hazard. Third; are those that do not address the hazard at all, but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Previously, mitigation measures have been the most neglected programs within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures take time to implement. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to eliminating long-term risk to people and property living in Utah from hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

The State Division of Emergency Management and Homeland Security (DESHS) have identified the following hazards to be analyzed by each county. These hazards include avalanche, dam failure, debris flow, drought, earthquake, flood, flash flooding, infestation, landslide, problem soils, summer storm, tornado, urban and rural fires, and winter storm.

This regional/multi-jurisdictional plan evaluates the impacts, risks and vulnerabilities of natural hazards in a jurisdictional area affected by a disaster. The plan supports, provides assistance, identifies and describes mitigation projects for each annex. The suggestive actions and plan implementation for local and tribal governments could reduce the impact of future disasters. Only through the coordinated partnership with emergency managers, political entities, public works officials, community planners and other dedicated individuals working to implement this program was it accomplished.

To develop the mitigation plan, The Utah DESHS, based on the Governor's Office of Planning and Budget, the Utah League of Cities and Towns, and the U.S. Department of Housing and Urban Development, chose to use the planning services of the Utah Associations of Governments.

Seven regional Associations of Governments:

1. Bear River Association of Governments
2. Wasatch Front Association of Governments / Wasatch Front Regional Council
3. Mountainland Association of Governments
4. Six County Association of Governments
5. Southeast Utah Association of Local Governments
6. Southwestern / Five County Association of Governments
7. Uintah Basin Association of Governments

Scope

Uintah Basin Association of Governments, which encompasses all of Northeastern Utah, including the counties of Daggett, Duchesne, and Uintah, was placed under contract by the Utah Division of Emergency Services to complete a Pre-Disaster Mitigation Plan, which meets the requirements of the Disaster Mitigation Act of 2000, for the areas they serve.

This plan is applicable of not only the six counties served by the Association but also for the cities, towns, and municipalities within each county. The scope of this plan only includes natural hazards defined as a concern to local counties and jurisdictions. These natural hazards identified by stack holders include: earthquakes, floods, landslides, wildfires, problem soils, dam failures, sever weather, and drought. Although there were the only hazards considered much of the data is applicable to other federally funded planning currently taking place.

Planning included local level data for each incorporated area within the Uintah Basin Region.

Purpose

The purpose of the Uintah Basin Association of Government Natural Hazard Mitigation Plan is to fulfill federal, state, and local hazard mitigation planning responsibilities; to promote pre and post disaster mitigation measures, short/long range strategies that minimize suffering, loss of life, and damage to property resulting from hazardous or potentially hazardous conditions to which citizens and institutions within the state are exposed; and to eliminate or minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the state of Utah. This plan is to aid in enhancing city and state officials, agencies, and public awareness to the threat hazards pose to property and life and what can be done to help prevent or reduce the vulnerability and risk to jurisdiction with in the Uintah Basin planning area.

Authority

Federal:

Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation (HMGP), if they submit for approval a mitigation plan, which is a summary of local and/or regional mitigation plans, that identifies natural hazards, risks, vulnerabilities, and describes actions to mitigate the hazards risks and vulnerabilities in that plan.

State:

- The Governor's Emergency Operation Directive
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended.
- Title 44, CFR, Federal Emergency Management Agency Regulations, as amended.
- State Emergency Management Act of 1981, Utah Code 53-2, 63-5.
- Disaster Response Recovery Act, 63-5A.
- Executive Order of the Governor, Executive Order 11
- Emergency Interim Succession Act, 63-5B.

Uintah Basin Association of Governments:

The Associations of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

Local:
Local governments play an essential role in implementing effective mitigation, both before and after disaster events. Each local government will review all damages, losses, and related impacts to determine the need or requirement for mitigation action and planning whenever seriously effected by a disaster, or when applying for state or federal recovery assistance. In the counties and cities making up the Uintah Basin Association of Governments the local executive responsible for carrying out plans and policies are the County Commissioners and City Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

Goals

To coordinate with each participating local government to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document and any additional State planning expectation, both regionally and specifically, as needed, by gathering local input. Also, to reduce risk from natural hazards in Central Utah, through the implementation and updating of regional plans.

Short Term Goals

These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster.
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated.
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
    - Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs.
    - Protection of natural resources and the environment, when considering mitigation measures.
    - Promoting public awareness through education of community hazards and mitigation measures.
    - Preserving and/or restoring natural features that provide mitigation such as floodplains.

Long Term Goals

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards.
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks.
- Avoid risk of exposure to identified hazards.
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards.
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized.
- Provide a basis for funding of projects outlined as hazard mitigation strategies.
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources. If an earthquake occurs outside of the county seat it will still affect the county seat. This is similar to many natural hazards.
- Establish a framework and data base for the county seat to use to apply for aid.

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation.
- Projecting a time frame for implementation.
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available.
- Identifying alternative measures, should financing not be available.
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties.
- Be based on the county seat Vulnerability Analysis.
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters.
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options.
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal.
- Property, damage to critical facilities, economic loss, and hardship or human suffering.
- Meet applicable permit requirements.
- Not encourage development in hazardous areas.
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem.
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation.
- Have manageable maintenance and modification costs.
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement.
- Whenever possible, use existing resources, agencies and programs to implement the project.

Environmental Considerations

Natural hazards are naturally occurring phenomena, only becoming natural disasters when humans and there structures become involved. The events themselves play an integral part in maintaining balance in our world. Meteorological, geological, and hydrological processes have shaped Utah for millions of years and will continue to shape the state for millions more years. Modern engineering has made it possible to prevent damage from natural hazards; however, the economic and environmental costs can be rather high. Tampering with natural systems can also create an imbalance in the natural environment. The effects of many of these imbalances are still unknown. It is better to live will a small amount of risk, respecting the natural process where appropriate, than to construct mitigation at every chance. Nature provides its own mitigation measures that need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation projects all applicable city codes; county codes, state and federal laws pertaining to the environment will and must be followed. A description of all federal laws can be found in *Appendix C*.

Part II. Planning Process

Documentation of the Planning Process

This plan was prepared in the offices of the Uintah Basin Association of Governments by appointed staff members Planning Coordinator, Yankton Johnson, and was supported by Ryan Pietramali of DES. Other local agencies that have aided in the process include the city and county GIS departments of the Uintah Basin region. Elected officials including tribal leaders, local officials, emergency managers, police and fire staff members, planning departments, and local governmental agencies have all aided in the planning and implementation process. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 and supporting guidance documents developed by FEMA and the Utah Division of Emergency Services and Homeland Security. The planning process included the following steps.

1. Organize Resources
2. Public Officials Out Reach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. Hazard Risk Identification and Analysis
6. County Vulnerability Assessment
7. Community Goals Assessment
8. Contact Regional Mitigation Emergency Managers (County & Tribal)
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

Step 1: Organize Resources

The seven regional Associations of Governments (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah Division of Emergency Services and Homeland Security contracted the seven AOGs as sub-grantees to coordinate, develop, and write the seven multi-regional hazard mitigation plans under he planning guidelines included in the Disaster Mitigation Act of 2000.

Uintah Basin Association of Governments contracted with by the Division of Emergency Services and Homeland Security (DESHS) to conduct the planning for the Uintah Basin region. The association worked closely with local jurisdictions to ensure their input, was incorporated into the plan.

Uintah Basin Association of Governments designated a core planning team. The core planning team made up of members outlined in Table 1 were the main constituents of the planning process from the initiation of the plan to the development and coordination to the resolution of the plan's adoption. Adjunct to

the core planning team a technical team committee was created on a technical level that is identified in Table 2. Table 3 identifies the Uintah Basin Association of Governments regional Disaster Mitigation Planning committee that was formed to assure that the Natural Disasters were covered region wide. The Executive Board (Table 4) was utilized to assure and affirm their respective county local inputs.

Table 1. Core Planning Team

Name	Organization
Yankton Johnson	Uintah Basin Association of Government
Mike Brennan	Uintah Basin Association of Government
Ryan Pietramali	Division of Emergency Services and Homeland Security

Table 2. Technical Team Committee

Name	Organization
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council
Jeff Adams	Southeastern Utah Association of Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Table 3. Region-wide Planning Committee

Name	Organization
Melba Markham	Altamont Town employee
Maris Secrest	Ballard City Manager
Shirley Slaugh	Daggett County Emergency Manager
Stewart Leith	Daggett County Commissioner
Winston Slaugh	Daggett County Emergency Manager
Clint Park	Duchesne City Mayor
Georg Adams	Duchesne County Emergency Manager
Lorna Stradinger	Duchesne County Commissioner
Chuck Dickison	Manila Town Mayor
Kathleen Cooper	Myton Town Mayor
Craig Blunt	Naples City Manager
Brad Hancock	Roosevelt City Manager

Name	Organization
Jerry Turnbow	Tabiona Town Mayor
Dale Peterson	Uintah County Emergency Manager
Jim Abegglen	Uintah County Commissioner
Mechelle Miller	Uintah County employee
Russ Pearson	Vernal City Planner

Table 4. Executive Board

Name	Organization
Chuck Dickison	Mayor, Chairman
Kathleen Cooper	Mayor, 1st Vice Chairperson
Mike McKee	Uintah County Commissioner, 2nd Vice Chairman
Stewart Leith	Daggett County Commissioner
Craig Collett	Daggett County Commissioner
Chad Reed	Daggett County Commissioner
Kent Peatross	Duchesne County Commissioner
Lorna Stradinger	Duchesne County Commissioner
Larry Ross	Duchesne County Commissioner
Dave Haslem	Uintah County Commissioner
Jim Abegglen	Uintah County Commissioner
Loyd Burton	Roosevelt City Mayor
Clint Park	Duchesne City Mayor
Travis Mitchell	Altamont Town Mayor
Jerry Turnbow	Tabiona Town Mayor
Niles Mott	Naples City Mayor
William Kremin, Jr.	Vernal City Mayor
Vaughn Parrish	Ballard City Mayor

Step 2: Public Officials Outreach
To ensure the planning process had backing from the elected officials a representative from Uintah Basin Association of Government met with each County Commission and each city mayor to inform them of the need for the plan and how it can better help the communities. With local support in place the plan was introduced to commissioners and other elected officials along with public entities by means of an informational brochure that was created by the Wasatch Front AOG *(refer to Appendix L).*

Step 3: Establish Continuity in the Planning Process
Mitigation planning within Uintah Basin Association of Governments was part of a Pre-Disaster Mitigation Planning initiative to meet the requirements of the Disaster Mitigation Act of 2000. To meet this requirement the seven Associations of Government were contracted by the Division of Emergency Services and Homeland Security to assist the 29 counties with completion of a mitigation plan, which meets the requirements of sections 322. The Seven Associations of Government formed a Technical Team Planning committee to share ideas and

ensure the plans were similar and that there was little duplication of effort. Planners from the Uintah Basin Association of Governments were involved with this committee. Please refer to Table 2 above.

Step 4: Data Acquisition
Contact was made with designated personnel in each city and county to assess what data was available on the local level. Agreements were put in place, where needed, to allow the Association of Governments planning staff use of county and city data. Data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs, and land development data.

Step 5: Hazard Risk Identification and Analysis
This step was conducted by gathering data on the hazards that occurred in the planning area. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations, surveys, interviews, and meetings with key informants within the planning area. Mitigation discussions were held during this process and are explained in further detail in Table 4 below. During these meeting attendees had the opportunity to review the general information on previous hazards and comment on them in a more specific manner. These meeting also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation, natural resources, and water resources of the Planning Area. These initial contacts with local entities also provided visual understanding of the planning area for planners of the Core Planning Team.

Table 4. Uintah Basin Association Governments Pre-Disaster Mitigation Planning Process Timeline

Date	Activity	Purpose
March 29, 2002	Letter of Intent that identifies the seven Associations of Governments as sub-grantees of the state to write the PDM plans. The AOGs were chosen by the Utah Interagency Technical Team who are part of Nature-Safe Utah (Utah's Pre-Disaster Mitigation Program).	Continue the relationship with local council members and municipalities.
May 15-16, 2002	Utah's first regional mitigation planning training piloted toward the seven AOGs	Establish a guideline and timeframe.
June 18, 2002	LEPC meeting on DMP	Introduction of Plan and public comment.
July 12,2002	News Release from Governor Michael Leavitt announcing the new program to develop local hazard mitigation plans statewide.	Conduct public awareness and involvement.
August, 2002	Gather information.	Data Collection.
September 10, 2002	Meeting. Met with all AOGs and DESHS to discuss the planning process.	Identify planning team and available resources.
September 30, 2002	Contacted Emergency Managers in the Uintah Basin Region.	Identify level of involvement.
October-November, 2002	Met with all three counties commissions and 9 mayors in the Uintah Basin region to identify hazards.	Hazard Identification. Went over questionnaires with mayors and commissioners.
October 2, 2002	Met with the Tri-County LEPC in Duchesne to identify regional hazards.	Data Collection
October 17, 2002	Met with UBAOG board of directors and public	Introduction of plan and public comment.
November 2002	Gathered community data for regional data section of the plan.	Data Collection.
November 6, 2002	Public Meeting. Met with Uintah Basin Association of Governments Executive Board.	Obtain Approval to conduct mitigation planning.

Date	Activity	Purpose
November 12, 2002	DMP training mtg with State	Purpose of the DMP
November 22, 2002	Meeting. Met with technical team members.	Solicit public involvement, Army Corps proposal for flood study, GIS training, timeline, review the regional plans
December 19, 2002	Gathering data.	Data Collection and public input.
January 10, 2003	Gathering data.	Data Collection.
January 22, 2003	Public Meeting. AOG executive director's meeting.	Signed contracts for Army Corps flood proposal.
January 27, 2003	Met with all 3 County Emergency Managers.	Chose to start with Uintah Counties Annex first.
February 2, 2003	Met with Uintah County, Naples City, and Vernal City.	Data Collection and discussion of progress reviewed the crosswalk.
February 6, 2003	Met with Uintah County, Naples City, and Vernal City.	Data Collection and discussion of progress.
February 27, 2003	Meeting. Met with technical team members in St. George.	Review of plans, mapping.
March, 2003	Information gathering	Data Collection, plan
April, 2003	Drafting of the plan.	For review.
April 9, 2003	Partners Mtg.	Data Collection and discussion of progress.
May 14, 2003	Meeting. UBAOG Executive Board meeting.	Discussion of progress; plans to DESHS by December with additional money.
May 22, 2003	Meeting. Met with technical team members at DESHS.	Progress report, deadlines, mapping, mitigation actions, internal webpage.
May, 2003	Gather mapping data.	Complete hazard identification and profile.
June, 2003	Website addressing Natural Hazards.	Public involvement and comment.
July 17, 2003	Meeting. Met with technical team members in Orem City.	Discussed mapping and plan review.
September 2, 2003	Meeting. Met with Duchesne County Commissioner and Emergency Manager	Vulnerability Assessment
September 11, 2003	Discussed Draft of PDM Plan with Duchesne County	Commissioners and Emergency Manager

Date	Activity	Purpose
October 6, 2003	Met with Daggett County Commissioners and Emergency Manager	Hazard Identification. Reviewed draft plan with emergency manger and commissioners.
October 10, 2003	Discussed Draft of PDM Plan with Executive Board.	Public Involvement
November 20, 2003	Discussed Draft corrections from the state with the Duchesne County Commissioner and planner	Reviewed corrections to be made and the crosswalk.
November 24, 2003	Discussed recommended changes for State Review with Daggett County	Public Involvement; Local LEPC members, Mayor of Manila, Emergency Managers and County Commissioner
December 5, 2003	Discussed Revised Draft of PDM with the Executive Board	Public Involvement
December 11, 2003	Discussed Mitigation Strategies with Daggett County.	Local LEPC, Mayor of Manila, Emergency Manager, Commissioners
December 17, 2003	Discussed Revised changes from the Mitigation Strategies	Local LEPC, Mayor of Manila, Emergency Manager in attendance
January 9, 2004	Discussed Revised changes from the State.	Public involvement and input.

Step 6: County Vulnerability Assessment
This step was conducted through a review of local base maps, topographical maps, floodplain maps, and other data. A detailed vulnerability analysis was completed with the use of Geographic Information Systems for each county within the Uintah Basin Association of Governments. HAZUS MH was used to determine vulnerability to earthquakes, for the hazards such as floods, landslides, and wildfire of loss estimation methodology was developed by the core planning team, with assistance from the technical team, to determine vulnerability to hazards. Each county section explains the data sources and the methodology used can be found in *Appendix H*. During these meetings attendees had the opportunity to review the specific information on all GIS products and to review areas of vulnerability in association with specific hazards.

Step 7: Community Goals Assessment
This step was conducted through a review of the governing documents of the planning area, as well as, conversations, interviews, and meetings with key responsible individuals within the planning area. This step identified what goals

are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

Step 8: Contact Regional Mitigation Emergency Managers (County & Tribal)
Daggett, Duchesne, and Uintah counties along with their respective communities were contacted to ascertain mitigation strategies. These counties and communities have volunteers and individuals with an interest in mitigation and public employees with technical expertise pertinent to mitigation. They include elected officials, county/city planners, county staff, and emergency managers. County emergency managers and their assistants were tasked with completing the Mitigation Strategies Workbook issued by the State Division of Emergency Services and Homeland Security.

Step 9: Mitigation Strategy Development
Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each County was asked to evaluate the vulnerability assessment completed by Uintah Basin Association of Governments and complete the Mitigation Strategies Workbook that can be found in Appendix N. Several counties opted to participate in the County PDM Mitigation Grant sponsored by the State of Utah Division of Emergency Services. Counties identified committee members and conducted meetings. These members consisted of City and County Mayors, planners, emergency managers and land managers (see table 3). These committee members then identified mitigation needs be assessing completed vulnerability analysis and looking at in placed county and city plans.

Step 10: Prioritization of Identified Mitigation Strategies
The Disaster Mitigation Act of 2000 requires state, tribal, and local governments show how mitigation actions were evaluated and prioritized. This was completed by the AOGs with assistance from each county and city. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, 386-3, April 2003 (available online at http://www.fema.gov/fima/planning_howto3.shtm). Using this method, mitigation strategies were assigned a priority of low, medium, or high.

Step 11: State Review
The Division of Emergency Services and Homeland Security pulled together a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003 and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

Step 12: Adoption
The plan went through a public hearing process on (date) and was adopted by:

Daggett County

- Town of Manila

Duchesne County

- Town of Altamont, City of Duchense, Myton City, Roosevelt City, Town of Tabiona.

Uintah County

- Ballard Town, City of Naples, Vernal City.

A. Public Involvement

Public involvement opportunities were available throughout the design and completion of this plan. Such opportunities included a public website for comment and review and public meetings. Emergency managers, the Fire Department, Sheriff Department, State and Local Agencies, all community members that could be affected by a natural disaster within the region, business leaders, educators, non-profit organizations, private organizations, and other interested members were all a part of the planning process.

The Uintah Basin Association of Governments (UBAOG) has developed a local Disaster Mitigation Plan. UBAOG was responsible for development of the plan. The UBAOG Planning Coordinator formed a planning team comprised of representatives form Altamont Town, Ballard City, Daggett County, Duchesne City, Manila Town, Myton City, Naples City, Roosevelt City, Tabiona Town, Uintah County, Vernal City, and the State government. Community groups were also involved in the planning process, such as, but not limited to the Partners Committee, the Local Emergency Preparedness Committee, the Tri-County Local Emergency Preparedness Committee, Forest Service, Bureau of Land Management, and the Tri-County Health Department, which are located in the Uintah Basin region. This team met once a week for the first three months, and twice a month for the next six months, and once a month thereafter. The plan was developed over one year.

An effort was made to solicit public input during the planning process and seven public meetings were held during the formation of the plan. Three at the beginning, two after the first draft was produced, and two after the final draft was produced. Feedback received from the public proved valuable in the development of the plan. Listed below are the dates, location, attendance, and discussions that took place during the meetings.

June 18, 2002, The Tri-County LEPC meeting held in Duchesne. The Uintah Basin Association of Governments Planning Coordinator discussed the Disaster Mitigation Planning Process. Questionnaire's were handed out to all those who were in attendance to provide input on possible natural disasters within the Tri-County Region. *(See Appendix L)* Those agencies in attendance were; Tri-County emergency managers, Uintah County LEPC, DES & Homeland Security, NRCS, Farm Service Agency, Water Rights, Uintah Water Conservancy, Forest Service, Ballard Water, UBAOG Planning Coordinator, and Tridell/Lapoint Water,

Tri-County Health Department, Representatives from the Oil and Gas producers, and several local citizens representing the Tri-County region.

October 17, 2002, UBAOG Board of Directors Meeting held in Vernal City at the Western Park. Notices were posted two days prior to the meeting to allow public involvement. UBAOG Planning Coordinator discussed the Disaster Mitigation Planning Process. Questionnaire's were handed out to all those in attendance to provide input on possible natural hazards within the Tri-County Region. *(Appendix L)* Those in attendance were; Duchesne County Citizens, Uintah County Citizens, two Duchesne County Commissioner's, two Uintah County Commissioner's, Myton City Mayor, Vernal City Mayor, Roosevelt City Citizens, Vernal City Citizens, Daggett County Commissioner, Uintah County Public Lands Specialist, Representation from Senator Bennett's office, Consultant for Public Lands, UBAOG Planning Coordinator, Altamont Town citizen, UBAOG Executive Director, and the Uintah County Building Inspector.

December 19, 2002, UBAOG Board of Directors Meeting held in Vernal City at the Western Park. Notices were posted two days prior to the meeting to allow public involvement. UBAOG Planning Coordinator explained that letters have been sent out to each city, town, and county to designate an individual to act in behalf of their jurisdiction. The information will be collected and compiled as a rough draft for public comments and input. Individuals were appointed for each jurisdiction to be a part of the Disaster Mitigation Planning Committee. UBAOG Planning Coordinator explained that the Director of DESHS met with them on November 12, 2002 regarding the Plan. Those in attendance were; All three Duchesne County Commissioner's, Ballard City Mayor, Myton City Mayor, all three Uintah County Commissioner's, Roosevelt City Mayor, two Daggett County Commissioner's, Duchesne County citizens, Uintah County citizens, Uintah County public lands specialist, Representation from Senator Bennett's office, Duchesne County Water Conservancy District, Representation from Congressman Cannon's office, Public lands Consultant, Representation of the local radio station, UBAOG Planning Coordinator, UBAOG Executive Director, and Engineering Services, Inc.

April 9, 2003, Partners meeting held at the Vernal BLM office. Notices were emailed to those in attendance two weeks prior to the meeting. UBAOG Planning Coordinator explained the purpose the Disaster Mitigation plan. The Planning Coordinator explained how they would like to get more involvement from the BLM offices and the Forest Service regarding Wildfire, Drought, and Insect Infestation issues. Questionnaire's were handed out to all those who were in attendance to provide input on possible natural disasters within the Tri-County Region. *(See Appendix L)* The Planning Coordinator explained the importance of obtaining information regarding past natural hazards that have occurred for documentation in the plan. The planning Coordinator mentioned that he would like to sit down with the Bureau of Indian Affairs (BIA) and get their involvement and input into the plan. The planning Coordinator mentioned that he is currently

meeting once a week with the Disaster Mitigation Planning Committee every Friday at the Uintah County Building Conference room and extended an invitation to the all those who wanted to attend. Those in attendance were; Dave Howell Vernal Bureau of Land Management (BLM), Walt Donaldson, Division of Wildlife Resources (DWR), Chester D. Mills, Bureau of Indian Affairs (BIA), George Weldon, Forest Service, Larry Ross and Kent Peatross, Duchesne County Commissioners, Heather Hoyt, Uintah County Grants administrator, Howard Cleavinger, BLM, Dave Moore, BLM, Laura West, Forest Service, Rhonda Ayala, Dinosaurland Resource Conservation Development, Craig Collett, Daggett County Commissioner, Robert Specht, BLM, Yankton Johnson, UBAOG Planning Coordinator, and Kirt Higgins, State Institution Trust Lands Association.

October 10, 2003, UBAOG Board of Directors Meeting held in Vernal City at the Western Park. Notices were posted two days prior to the meeting to allow public involvement. The UBAOG Planning Coordinator handed out a copy of the Disaster Mitigation rough draft to each of the elected officials for all 12 entities in which the plan will represent. He explained that the portion he was handing out covered each of the 12 entities. He explained, that the portion he was handing out was put together with the help of each Counties Emergency Managers, GIS people, County Commissioner's, City Planner's, and public involvement. The UBAOG Planning Coordinator explained that the plan would be sent back to the state by October 15, 2003 for the first review. Those in attendance included; Myton City Mayor, two Duchesne County Commissioner's, two Daggett County Commissioner's, one Uintah County Commissioner, Ballard City Mayor, Naples City Mayor, Altamont Town citizen, Tabiona Town citizen, Daggett County citizens, Duchesne County citizens, Uintah County citizens, Representative from Senator Bennett's office, Hanna Water and Sewer District, Ballard City citizens, Roosevelt City citizens, UBAOG Executive Director, and Myton City citizen.

December 5, 2003, UBAOG Board of Directors Meeting held in Vernal City at the Western Park. Notices were posted two days prior to the meeting to allow public involvement. The UBAOG Planning Coordinator handed out a copy of the Disaster Mitigation rough draft to each of the elected officials for all 12 entities in which the plan will represent. He explained that the portion he was handing out covered each of the 12 entities. He explained, that the portion he was handing out was put together with the help of each Counties Emergency Managers, GIS people, County Commissioner's, City Planner's, and public involvement. The UBAOG Planning Coordinator explained that the plan would be sent back to the state by December 30 for a second review. After which, the following motion was made. **UBAOG MOTION: Commissioner Ross made the motion to move to the second report, Mayor Burton seconded, motion carried.** The Capital Improvements Plan rating and ranking was also discussed and how the Capital Improvements Planning that occurs in the future will contribute and be a reflection of the goals in the Disaster Mitigation Plan. Those in attendance included; Manila Town Mayor, Myton City Mayor, all three Uintah County Commissioner's, two Duchesne County Commissioner's, two Daggett County

Commissioner's, Ballard City Mayor, Roosevelt City Mayor, Duchesne City Mayor, Naples City Planner, Small Business Development Center Representative, Vernal Area Chamber of Commerce, Duchesne County Chamber of Commerce, Uintah County Economic Development, Department of Workforce Services, Executive Assistant to Daggett County, Altamont Town Citizen, Roosevelt City citizens, Ballard City citizens, Uintah County citizens, Daggett County citizens, UBAOG Planning Coordinator, UBAOG Executive Director, and Duchesne County citizens.

January 9, 2004, UBAOG Board of Directors Meeting held in Uintah County at the Uintah County Courthouse. Notices were posted two days prior to the meeting to allow public involvement. The UBAOG Planning Coordinator explained that the plan was submitted to the State for review with them responding that it looked really good and only a minimal changes needed to be made. He said, that once he makes the changes he will send it back to the State and if it meets State approval they will forward the plan on to FEMA for final approval. He reminded the Board that between March and June of 2004 he will be requesting signatures from each of the 12 jurisdictions covered in the plan stating that they agree with the contents in the plan and that they will sign a resolution to that affect. The Capital Improvements Plan rating and ranking was also discussed and how the Capital Improvements Planning that occurs in the future will contribute and be a reflection of the goals in the Disaster Mitigation Plan. Those in attendance included; Myton City Mayor, two Uintah County Commissioner's, two Duchesne County Commissioner's, Roosevelt City Mayor, Ballard City Mayor, Naples City Planner, Vernal City Mayor, Daggett County Administrator, Johnson Water District, Sunrise Engineering, Inc., Department of Workforce Services, Duchesne County Chamber of Commerce, Uintah County Economic Development, Duchesne County Economic Development, Vernal City residents, Roosevelt City residents, Altamont Town residents, Uintah County residents, UBAOG Planning Coordinator, and UBAOG Executive Director.

B. Information Sources

- Federal Emergency Management Agency (How-to Guides).
- National Weather Service (Hazard profile).
- National Climate Data Center (Drought, Severe Weather)
- Army Corps of Engineers (Flood data).
- Utah Division of Emergency Services and Homeland Security (Salt Lake City Mitigation Plan, GIS data, Flood data, HAZUS data for flood and earthquake).
- Utah Geologic Survey (GIS data, Geologic information).
- Utah Division of Forestry, Fire and State Lands (Fire data).
- Utah Avalanche Center, Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service.
- Utah Automated Geographic Resource Center (GIS data).

- University of Utah (drought climate charts from internship students).
- University of Utah Seismic Station (Earthquake data).
- Utah State University (climate data).
- Councils or Government
- Association of Governments
- Daggett County and municipalities (Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Duchesne County and municipalities (Water Master Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).
- Uintah County and municipalities (Municipal Water Plans, Greenwich Water Plan, Emergency Operations Plans, Histories, mitigation actions, public input, GIS data, Assessor data, Transportation data, Property and Infrastructure data).

Other Plans:

- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah
- Natural Disaster Analysis, State of Utah Office of Emergency Services 1976
- State of Utah Mitigation Plan 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Salt Lake City Mitigation Plan 2002
- Planning for a Sustainable Future
- Town of Merrimack, NH Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Hazard Mitigation Plan Dunkerton, Iowa
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001
- Jefferson County West Virginia All Hazard Mitigation Plan 2003

Plan Methodology

The information in this mitigation plan is based on research from a variety of sources. UBAOG/DES conducted data research and analysis, facilitated steering committee meetings and public workshops, developed the final mitigation plan, and presented the plan for formal adoption with participating jurisdictions. The research methods and various contributions to the plan include:

State and federal guidelines and requirements for mitigation plans:

During the completion of this plan UBAOG examined and followed state and federal guidelines and requirements. These guidelines included FEMA planning standards, National Flood Insurance Program's Community Rating system, FEMA Flood Mitigation Assistance Program and various State reference material. A list of guidelines and requirements is as follows:

- FEMA 386-1,2,3,4,5,6,7,8,9
- FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12
- Disaster Mitigation Act of 2000
- 44 CRF parts 201 and 206, Interim Final Rule
- FEMA Region VIII "crosswalk"

Previous plans and studies:
UBAOG examined existing mitigation plans from around the country and incorporated numerous plans and studies from within the jurisdictions they serve. These plans include:

- City of Naples Storm Water Master Plan
- State Water Plan
- Utah State Water Plan Uintah Basin (December, 1999)
- Utah Statewide Fire Risk Assessment Project
- Natural Disaster Hazard Analysis, State of Utah Office of Emergency Services 1976
- Salt Lake City Mitigation Plan 2002
- State of Utah Mitigation Plan 1984, 1985, 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Uintah Basin Flood Hazard Identification Study
- Emergency Operations Plans for Daggett, Duchesne, and Uintah Counties.
- University of Utah Seismograph Stations History of Utah Earthquakes
- National Weather Service "Flood and Flash Flood Deaths in Utah"
- Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service Utah Avalanche Center.
- Town of Merrimack, New Hampshire Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001

Hazard specific research and Vulnerability Methodology
UBAOG collected data and compiled research on nine hazards: dam failure, drought, earthquake, flooding, infestation, slope failure, problem soils, severe weather, and wildfire. Research materials came from a variety of agencies including DES, AGRC, USGS, USACE, UGS, UFFSL, county GIS, city GIS, County Assessors, and County Emergency Managers. Historical data used to define historic disasters was researched through local newspapers, interviewing residents, local knowledge derived through committee meetings, historic state

publications, Utah Museum of Natural History, and recent and historic scientific documents and studies.

Vulnerability Methodology

Geographic Information Systems (GIS) were used as the basic analysis tool to complete the hazard analysis for the Uintah Basin Association of Governments Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. Fortunately digital data exist statewide for landslides, quaternary faults, wildfire, dam locations, and epicenter locations. The goal of the vulnerability study is to estimate the number of homes, and infrastructure vulnerable to each hazard and assign a dollar value to this built environment. To this end, census data and natural hazard maps are the basic information used in the analysis. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

Earthquakes

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS-MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS-MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS-MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS-MH Earthquake Model, possibly *at best* a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS-MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

Landslides and Wildfire

The methodology used to determined vulnerability for landslides and wildfire within the study area was almost identical. Demographic information from census 2000 was manipulated to obtain vulnerability numbers. The methodology used, assumes and even distribution of built housing across the county and each city within the county. Assuming even distribution a housing density was determined by dividing the total number of homes (census 2000) by the total number of acres. For example the Town of Maeser in Uintah County is 4,153 acres in size and contains 954 housing units. Thus the housing density is .229 i.e. each acre contains .229 housing units.

From this point the number of acres of extreme, high, and moderate wildfire along with acres of historically active landslides were determined for each city and the unincorporated county. Once and acre total was know it was multiplied by the density value for each particular city or county to determine the total number of homes. This new figure was then multiplied by the average housing value as reported by the County assessors office, to determine the total value of potential loss residents. The County assessor gave an average value of $80,000.00 for both Uintah and Duchesne Counties, and $75,000 for Daggett County. In the case of wildfire the value of the land (20% of total) was subtracted from the totals reported in the vulnerability tables. This was done because wildfires do not render the land useless as landslides often do. Additionally content values are not included, which would raise the potential loss numbers for housing by approximately 50%.

Transportation and utilities information was determined using the Geoprocessing Wizard an extension in ArcView 3.2. This extension allows the GIS user to clip one theme based on another. For example the roads theme was clipped by the

landslide theme, resulting in a new shape file containing all of the roads within a historically active landslide area. The new database was then queried through several simple equations to determine the length in miles of each linear feature (pipelines, electric lines, and roads). Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These cost include:

Item	Cost per Mile
Local Roads	2,000,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to the linear features point data such as critical facilities, dams, care facilities, schools, power generation facilities, and substations were analyzed to determine if the feature was within a hazard area. Where point data was determined to be within a hazard area the following values from HAZUS MH were assigned:

Item	Cost
Small Power Plant	100,000,000
Large Power Plant	500,000,000
Low Voltage Substation 115 KV	10,000,000
Medium Voltage Substation 230 KV	20,000,000
Large Voltage Substation 500 KV	50,000,000
Facility value was assigned based on Square footage.	

Limited availability of digital data represented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, landslides, and wildfires in this plan. Additional limitations to the above described analysis method includes:

- Assuming random distribution
- Limited data sets for water, gas, electrical, resulting in, incomplete numbers for these features.
- Lack of digital parcels data from the county assessors office.
- HASUZ MH is not designed for small population counties.
- No digital data for dam failure inundation, flood plains, or infestation.
- Relied on state wide data not intended for manipulation at the scale it was used.
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data.
- Meta data was lacking on some of the used data sets.

In terms of hazard mapping presentation in this document, simple maps were created to provide a graphical illustration of location. These maps are done at a scale, which allows them to fit on a standard letter sized page rendering the useless. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool, to be used, by interested persons within the Uintah Basin Association of Governments and the jurisdictions the AOG serves. This information should not take the place of accurate field verified mapping from which ordinances need to be based off of.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas, which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available but this data does not necessarily indicate which, areas will be developed and which will not.

Part III. General Regional Data

Geographic background

Uintah Basin Association of Government UBAG serves the following counties and municipalities with this counties: Daggett, Duchesne, and Uintah. The three counties in the study area are very rural, with the total population of the Uintah Basin being only 40,516. Each counties population is: Daggett 921, Duchesne 14,371, and Uintah 25,244. The principle draining in the area is the Green River with the Duchesne and White Rivers as major tributaries. The Uintah basin is divided into two drainages—the North Slope and the south slope of the Uinta Mountains. Elevations in the basin range from 13,528 feet and Kings Peak in the Uinta Mountains to 4,600 feet along the green river near it’s excite from Uintah

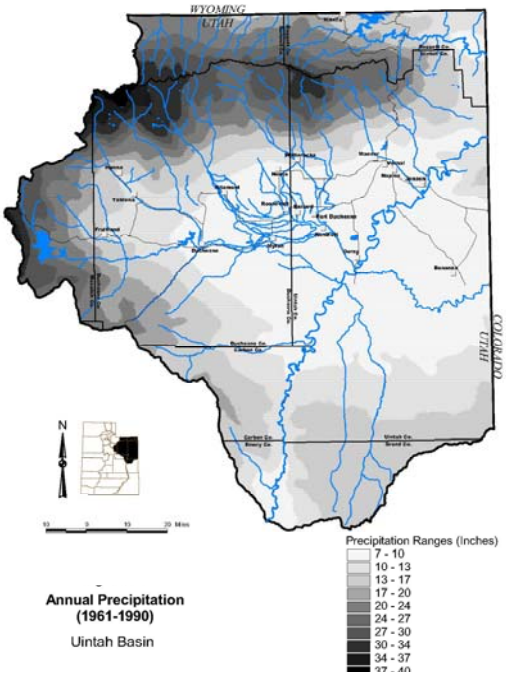
County. *For more information regarding the Demographics, population, and future growth see Appendix J.*

The Uinta Mountain range is unique, being the only major range of mountains in North America running east and west. The Uintah Mountains were extensively glaciated, and glacial features dominate the present landscape. Glacial erosion has created many picturesque examples of horns, arêtes, cirques, and glacial troughs. Lateral and terminal moraines often form natural dams, creating over a thousand small lakes that dot the region.

Numerous small streams exit the north and south slope of the Uinta range. These include such streams as the Sheep Creek, Carter Creek, Currant Creek, Red Creek, Rock Creek, Yellowstone, Whiterocks, and Strawberry River.

Climate

Mean annual temperatures in the valleys range from 44° to 47° F. Mean monthly maximum temperatures reach 94.6° F in July, and the mean monthly minimum falls as low as 2.5° F in January. The number of frost-free days ranges from 134 at Roosevelt to 57 near Flaming Gorge. Mean annual precipitation ranges from 7.1 inches at Roosevelt to 12.5 inches at Flaming Gorge Reservoir. The Uinta Mountains receive about 40 inches.



Geology

The Uinta Mountain range is Mountains were extensively glaciated, and glacial features dominate the present landscape. Glacial erosion has created many picturesque examples of horns, aretes, cirques and glacial troughs. Deposition by the ice and glacial-melt water has partially filled the many U-shaped valleys with ground moraine and valley trains. It has also lined them with lateral and terminal moraines that have often formed natural dams, creating over a thousand small lakes that dot the region.

Uintah Basin Generalized Geologic Units

<u>Quaternary</u>

Qa Unconsolidated deposits of alluvium, colluvium, windblown and landslide origin.

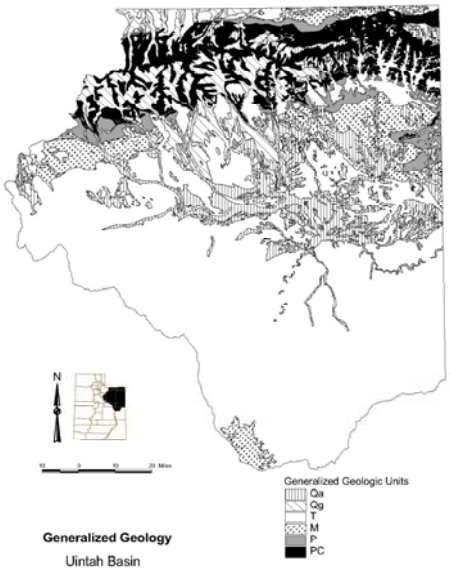
Qg Unconsolidated deposits of glacial origin.

Tertiary

Weakly to semi-consolidated sedimentary basin-filling rocks of the Browns Park, Bishop Conglomerate, Duchesne River, Uinta, Bridger, Green River and Flagstaff formations.

Mesozoic

M Consolidated sedimentary rocks locally include the North Horn, Current Creek, Mesa Verde Group, Mancos Shale, Frontier Sandstone, Mowry Shale, Dakota, Cedar Mountain, Morrison, Curtis, Entrada, Carmel, Nugget (Navajo), Chinle, Moenkopi and Dinwoody Formations.



Paleozoic

P Consolidated sedimentary rocks locally include the following formations: Park City, Weber Sandstone, Morgan, Round Valley Limestone, Doughnut Shale, Humbug, Deseret Limestone, Madison Limestone, Maxfield Limestone and Lodore Sandstone.

Precambrian

Pc Consolidated sedimentary and metamorphic rocks locally include the following: Red Pine Shale, Uinta Mountain Group and Red Creek Quartzite.

DAGGETT COUNTY

Daggett County identified six natural hazards they wanted addressed in the Daggett County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire

In identifying these hazards the PDM planning committee relied on technical experts, public input, research of past events, and risk assessments completed by the county emergency manager for their Pre-Disaster Mitigation Plan.

The Daggett County PDM planning committee consisted of one County Commissioner, the Mayor of Manila, the County Emergency Managers, the TRI-County Health Department, the County Planning and Zoning, the Executive Assistant to the County Commissioners, several local citizens and the Uintah Basin Association of Governments planning coordinator.

DUCHESNE COUNTY

Duchesne County identified six natural hazards they wanted addressed in the Duchesne County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire.

In identifying these hazards the PDM planning committee relied on technical experts, public input, research of past events, and risk assessments completed by the county emergency manager for their Pre-Disaster Mitigation Plan.

The Duchesne County Disaster Mitigation Planning committee consisted of one County Commissioner, the Mayor of Duchesne, the Mayor of Altamont, the

Mayor of Tabiona, the Roosevelt City Manager, the Mayor of Myton, the County Emergency Manager and the Uintah Basin Association of Governments planning Coordinator.

UINTAH COUNTY

Uintah County identified six natural hazards they wanted addressed in the Uintah County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire.

In identifying these hazards the Uintah County PDM planning committee relied on technical experts, public input, research of past events, and risk assessments completed by the county emergency manager for there Pre-Disaster Mitigation Plan.

The Uintah County Disaster Mitigation Planning committee consisted of one County Commissioner, the County Emergency Manager, the Vernal City Planner, the Naples City Manager, and Ballard City in and the Uintah Basin Association of Governments planning coordinator.

Natural Hazards

Natural hazards differ throughout the state and throughout the UBAOG study area, based on variables such as underlying geology, topography, hydrology, development patterns, and climate. For this reason a risk assessment was conducted by the Uintah Basin Association of Governments to determine what natural hazards might affect the Pre-Disaster Mitigation planning. Table 2 illustrates the results of UBAOG risk assessment and how and why each hazard with the potential of affecting areas within the Uintah Basin Association of Governments was identified. In the annexes of this plan identified hazards are planned for on a county-by-county basis, with the exception of drought and severe weather, these hazards are planned for on a region wide (Daggett, Duchesne, and Uintah Counties) basis. It is understood hazards don't recognized political boundaries, politics and the availability of GIS data dictated the planning scope for this mitigation plan.

Natural Hazard Identification Table 2.

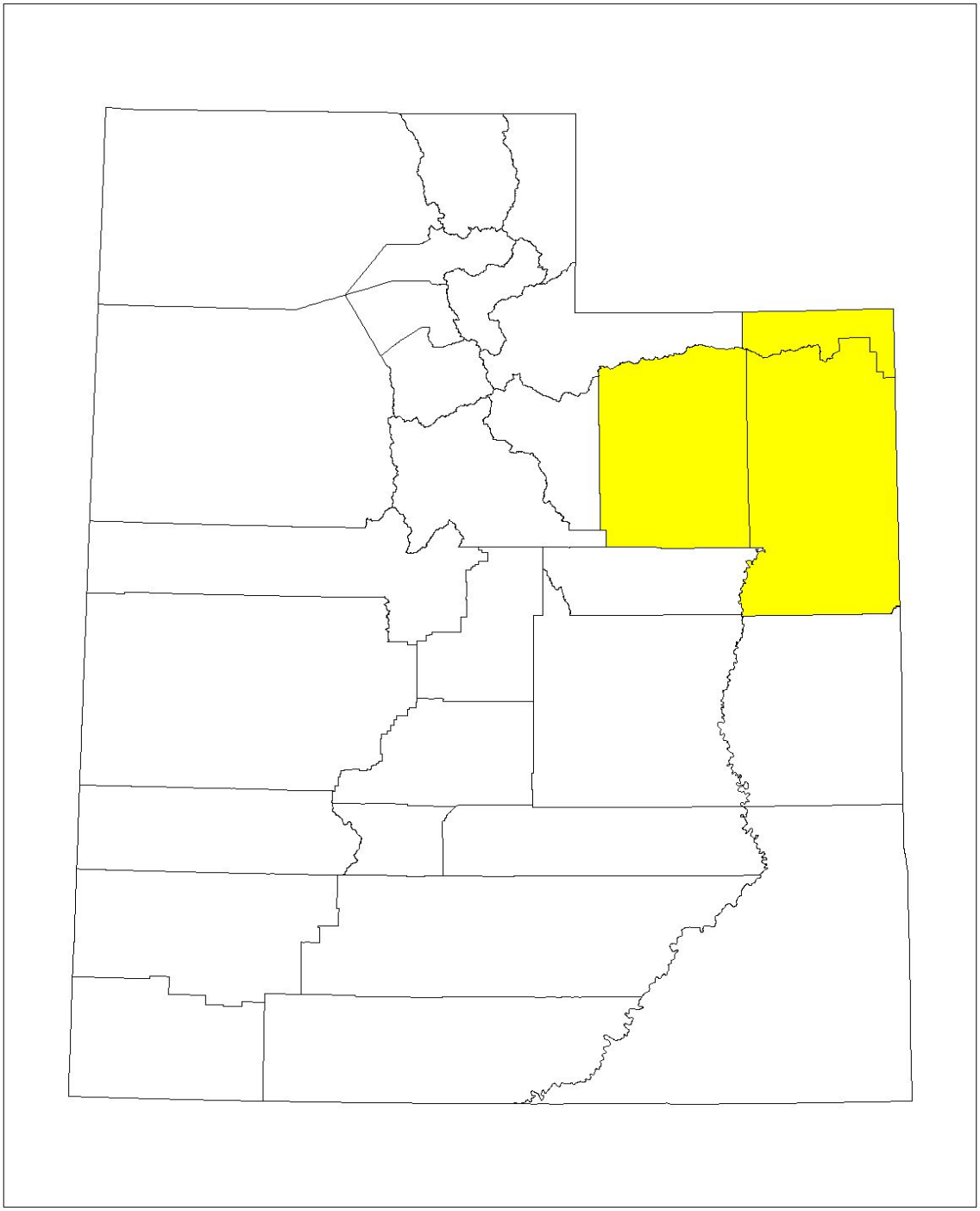
Hazard	How Identified	Why Identified
Dam Failure	• Review of County Emergency Operations Plans • Assistance from Utah Division of Water Rights, Dam Safety Section • Community's profile	• Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc.
Drought	• Review of County Emergency Operations Plans • Community's profile • National Climate Data Center • Palmer Drought Severity Index readings	• Affects local economy, water reservoirs, soil • Previous experiences
Earthquake	• Review of County Emergency Operations Plans • Input from City and County Emergency Operations Managers • United States Geological Survey • Utah Geological Survey • HAZUS analysis	• Utah is predicted, 1/5 chance, to experience a large earthquake within the next fifty years. • Numerous faults throughout Utah • Utah experiences approximately 13 earthquakes a year with a magnitude over 3.0. • Can create fire, flooding, hazardous materials incident, transportation and communication limitations
Flooding	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Division of Water Resources • Utah Geological Survey • Flood Insurance Studies • Army Corps of Engineers • Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Division of Water Resources • Utah Geological Survey • Army Corps of Engineers	• Associated with drought and dry soils • Several previous incidents have caused severe damage and loss of life • Many of the rivers and streams are located near neighborhoods • Many neighborhoods are located on floodplains, alluvial fans • Associated with drought and dry soils that the State is frequented with • Previous incidents have caused severe damage and loss of life • Many neighborhoods are located near canyon mouths and on floodplains
Infestation	• Review of County Emergency Operations Plans • Input from County Emergency Managers	• Affects local economy and vegetation

Hazard	How Identified	Why Identified
Sever Weather (Winter storms, Avalanches, tornados, lightening)	• Review of County Emergency Operations Plans • Community's profile • Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers • Utah Avalanche Forecast Center • Utah Department of Transportation • Review of County Emergency Operations Plans • National Climate Data Center • National Weather Service Special Publication	• Communities, homes, infrastructure, roads, ski areas, and people can be affected by an Avalanche • Avalanches have caused property damage and loss of life in the past • Have caused property damage and loss of life
Wildland Fire	• Past Wildfire Occurrences • Review of County Emergency Operations Plans	• Potential structure damage • Watershed damage
Slope Failure (landslide, debris flow and slide)	• Review of County Emergency Operations Plans • Utah Geological Survey • Input from County Emergency Managers • Community's profile • Community's profile • National Climate Data Center • GIS analysis • Past State Mitigation Plans	• Past incidents have caused loss of life property damage, disruption of power lines and communication • Have caused damage in the past

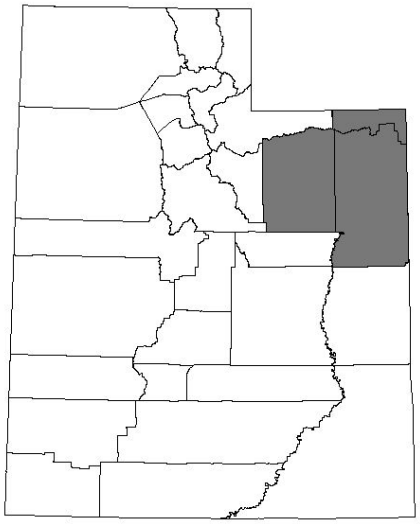
Annex 1-Uintah Basin Natural Hazard Mitigation Plan Regional Annex

Tri-County Regional Annex

Figure 1: Tri-County Map



Description of the Study Area



Uintah Basin Association of Government UBAG serves the following counties and municipalities with this counties: Daggett, Duchesne, and Uintah. The three counties in the study area are very rural, with the total population of the Uintah Basin being only 40,516. Each counties population is: Daggett 921, Duchesne 14,371, and Uintah 25,244. The principle draining in the area is the Green River with the Duchesne and White Rivers as major tributaries. The Uintah basin is divided into two drainages—the North Slope and the south slope of the Uinta Mountains. Elevations in the basin range from 13,528 feet and Kings Peak in the Uinta Mountains to 4,600 feet along the green river near it's excite from Uintah County.

The Uinta Mountain range is unique, being the only major range of mountains in North America running east and west. The Uintah Mountains were extensively glaciated, and glacial features dominate the present landscape. Glacial erosion has created many picturesque examples of horns, arêtes, cirques, and glacial troughs. Lateral and terminal moraines often form natural dams, creating over a thousand small lakes that dot the region. The Uintah Basin is very dependant upon their runoff for water supply. Drought years in the Uintah Basin can be divesting, causing a huge economic impact to the agricultural business. *For more information regarding the economic and demographic data of the region see Appendix J.*

NATURAL HAZARD: DROUGHT

FEMA Hazard Profile for Drought

Frequency	Seven – year cycle (currently in fifth year)		
Severity	**X**	Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire tri- county area, state, or region		
Seasonal Pattern	Year – round		
Duration	Up to several years, currently area is suffering from 5 years of below average precipitation.		
Speed of Onset	Not measurable		

VULNERABILITY: High

AFFECT:

The current drought situation in Daggett, Duchesne, and Uintah County will present a serious threat to the health and safety of its residents, private property, agriculture, the environment and the economy. The severe drought has reduced soil moisture, stream flows, and ground water and reservoir levels. This could result in agricultural, residential and commercial losses of millions of dollars.

The planning areas economy is still tied to agriculture, an economic sector hit hard by drought. Agriculture can with stand one or two years of drought but as the years of below average precipitation grow so do the affects. The affects of drought are cumulative with longer droughts having more affect particularly on the economy and the environment.

Native vegetation has evolved to deal with Utah's dry climate and some amount of variation in precipitation, yet as the length of the drought extends vegetation begins to die off increasing fuel for wildfires. The potential for wildfires throughout the planning area is high and the availability of firefighting resources is expected to be limited as drought conditions worsen. Immediate action is required to protect public health and safety and private property, wildfire, agriculture and the environment. *For a description of drought and possible causes see the drought section in Appendix A*.

Impacts of Drought

- Decreased land prices
- Loss to industries directly dependent on agricultural production (machinery and fertilizer manufactures, food processors, dairies, etc)
- Unemployment from drought related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capitol shortfalls)
- Revenue losses to federal, state, and local governments from reduced tax base.
- Reduction of economic development.
- Rural population loss and relocation to larger cities.
- Loss to recreation and tourism industry
- Energy related effects
- Water suppliers revenue shortfalls
- Higher cost of water transport
- Decline in food production causes increase in food prices and increase in importation of food

Social

- Mental and physical stress
- Health related low flow problems including cross-connection contamination diminished sewage flows, increased pollutant concentrations, and reduced fire-fighting capabilities.
- Loss of human life
- Public safety concerns caused by increased threat of forest and range fires
- Increases in conflicts of water users.
- Changes lifestyles of those living in rural areas.
- Reduction of modification of recreation activities.
- Public dissatisfaction with government drought response plan

Environmental

- Damage to animal species
- Reduction and degradation of fish and wildlife habitat
- Increased contact of wild animals with agricultural producers.
- Loss of biodiversity
- Lower water levels in reservoirs and lakes

- Reduced stream flow.
- Loss of wetlands
- Increased ground water depletion, land subsidence, reduced recharge.
- Increased number and severity of wild fires.
- More dust and pollutants in the air.
- Visual and landscape qualities diminished.

Generic Mitigation:

- Educate Daggett County residents on conserving water.
- Reduce water consumption.
- Quickly deal with leaks and breaks in irrigation equipment.
- Monitor water system efficiency.

Drought History in Uintah Basin

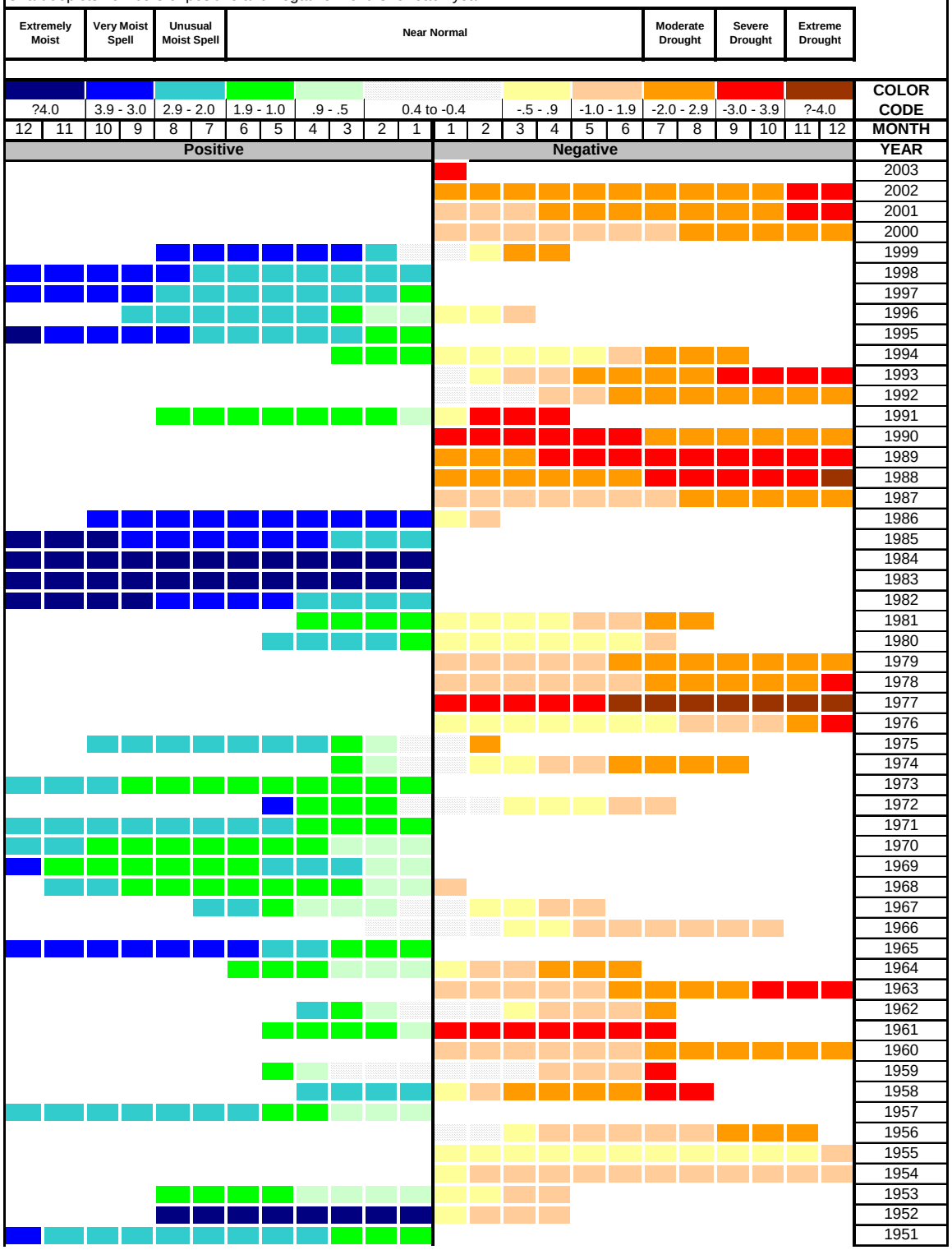
According to Utah's annual Palmer Drought Severity Index Charts, Utah has experienced as many as 60 years of drought out the past 100 years, with several of these being multi-year droughts" (35). Multi-year droughts affecting the entire state occurred during 1896-1905, 1930-1936, 1939-1940, 1953-1956, 1958-1964, 1976-1979, and 1995-1996. Single year droughts occurred during "1924, 1966, and 1974" (State of Utah 35). The Chart below provides a drought history for the Uintah Basin, using date for Utah climate zone five and six, from the present back to 1895. Drought severity is measured using the Palmer Drought Severity Index (PDSI). The PDSI drought severity is represented monthly with a numerical id between +6 and –6 with server droughts having higher negative numbers.

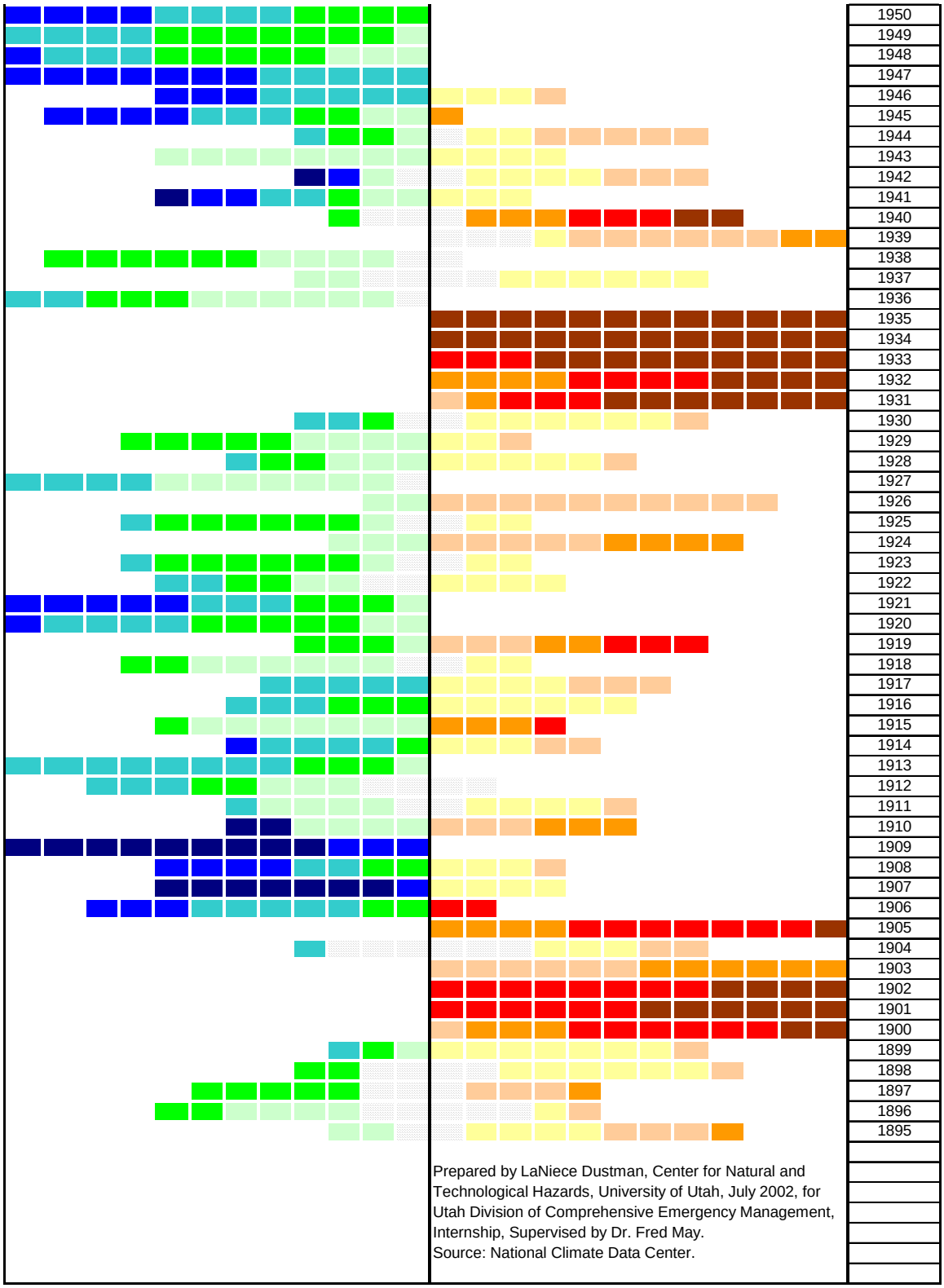
The Palmer Drought Severity Index

Palmer Drought Severity Index, an index, developed by Wayne Palmer in the 1960's, which measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is "standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc.

PALMER DROUGHT SEVERITY INDEX CHART
UTAH CLIMATE DIVISION 5
1895 - 2001

Chart depicts numbers of positive and negative months for each year.

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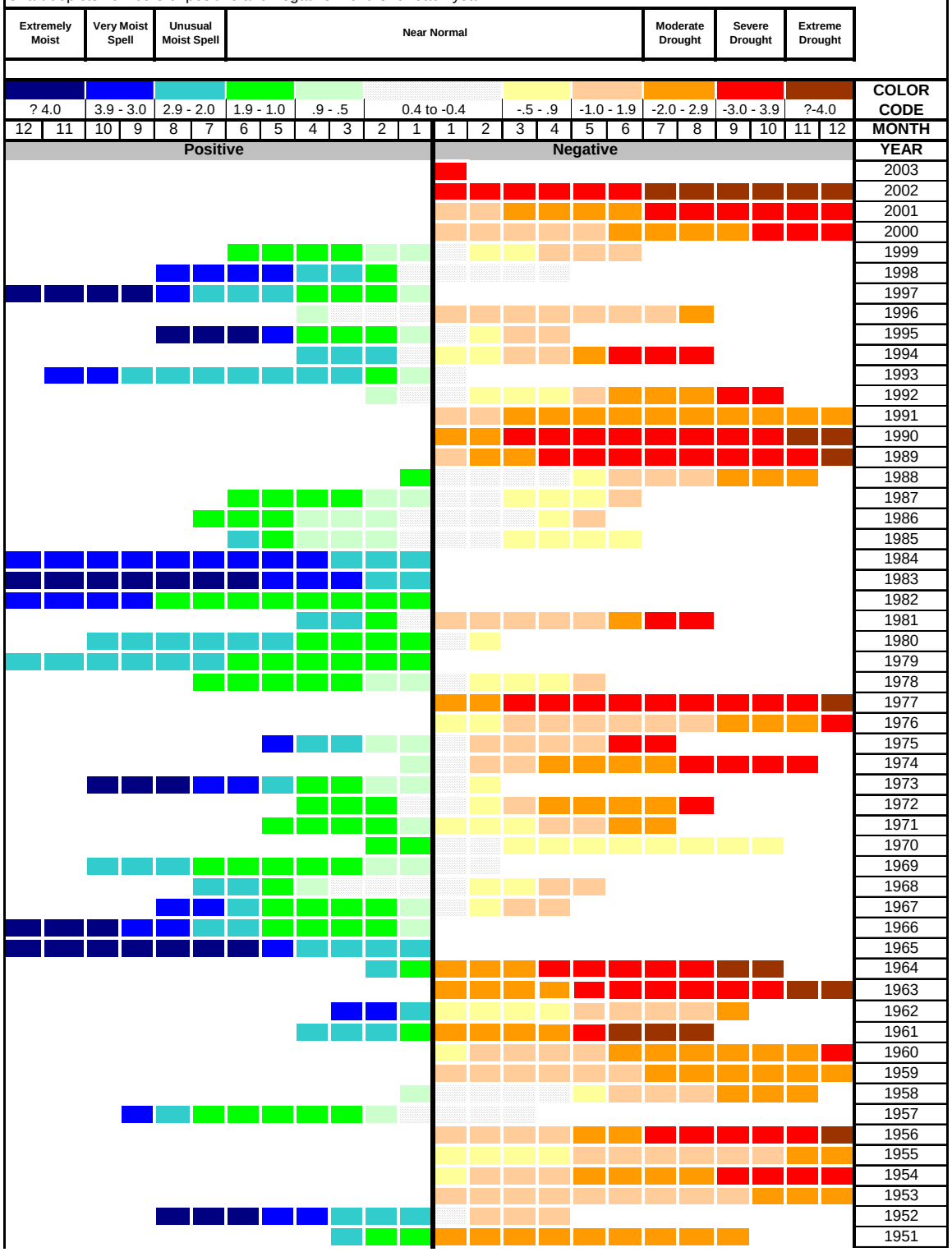
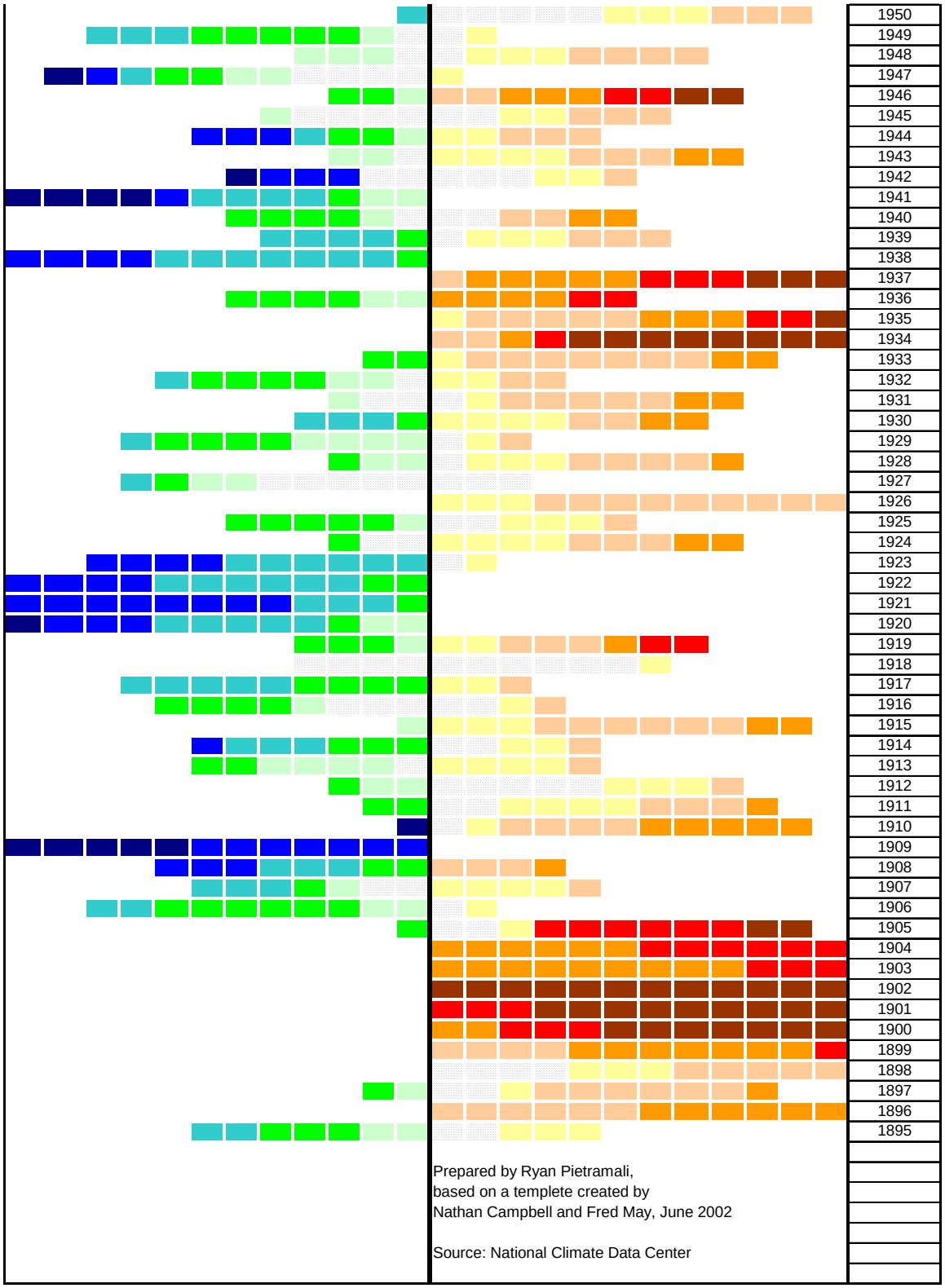
Prepared by LaNiece Dustman, Center for Natural and Technological Hazards, University of Utah, July 2002, for Utah Division of Comprehensive Emergency Management, Internship, Supervised by Dr. Fred May.
Source: National Climate Data Center.

PALMER DROUGHT SEVERITY INDEX CHART
UTAH CLIMATE DIVISION 6
1895 - 2002

Chart depicts numbers of positive and negative months for each year.

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Prepared by Ryan Pietramali,
based on a templete created by
Nathan Campbell and Fred May, June 2002
Source: National Climate Data Center

NATURAL HAZARD: TORNADO

FEMA Hazard Profile for Tornado

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity		**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
	X	**Negligible**	**Less than 10%** (of the jurisdiction that can be affected)
Location	Daggett County		
Seasonal Pattern	Summer		
Duration	Five minutes or less		
Speed of Onset	Minimal or no warning		

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. It is spawned by a thunderstorm and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Tornados rarely occur in Utah because of the topography and predominant weather patterns. Several small tornados have occurred in the tri-county area over the past 50 years meaning they could happened again in the future. It is not expected the tornados will be above an F2. It is impossible to predict where tornados will occur, how big they will be, or which areas are more vulnerable or have a hire risk. Research for this plan determined the risk to be the same in any given area.

The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. They tend to occur in the afternoons and evenings: over 80 percent of all tornadoes strike between noon and midnight.

When a tornado threatens, individuals need to have a safe place to go and time to get there. Even with advances in meteorology, warning times may be short or sometimes not possible. Lives are saved when individuals receive and understand the warning, know what to do, and know the safest place to go.
Source: http://www.fema.gov/hazards/tornadoes/
For a description of tornados and possible causes see the tornados section in Appendix A.

NATURAL HAZARD: WINTER STORMS

FEMA Hazard Profile for Winter Storms

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
	X	**Possible**	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Duchesne County		
Seasonal Pattern	November, December, January, February		
Duration	Weeks and sometimes Months		
Speed of Onset	6 to 12 hours warning		

A winter storm can range from moderate snow over a few hours to blizzard conditions with blinding wind-driven snow that last several days. Some winter storms may be large enough to affect several states while others may affect only a single community. All winter storms are accompanied by low temperatures and blowing snow, which can severely reduce visibility. A severe winter storm is one that drops four or more inches of snow during a 12- hour period, or six or more inches during a 24-hour span. An ice storm occurs when freezing rain falls from clouds and freezes immediately on impact.
Source: http://www.fema.gov/hazards/winterstorms/

Winter storms can cause havoc in the planning area and in some cases be life threatening. Highway 191 from Vernal to Manila can become impassable during winter storms. Several of the small communities can become isolated during winter storms as the roads become impassable. Because of the elevation and surrounding topography the tri-county planning area has experienced winter storms in the pass and will continue to experience those events.

For a description of winter storms and possible causes see the severe weather section in Appendix A.

VULNERABILITY: Medium

AFFECT:

All winter storms make driving and walking extremely hazardous. The aftermath of a winter storm can impact a community or region for days, weeks, and even months. Storm effects such as extreme cold, flooding, and snow accumulation can cause hazardous conditions and hidden problems for people in the affected area. A harsh winter storm affects the transportation of food and fuel to and from the Wasatch Front, and impacts all retail and grocery stores, restaurants, and gas stations.

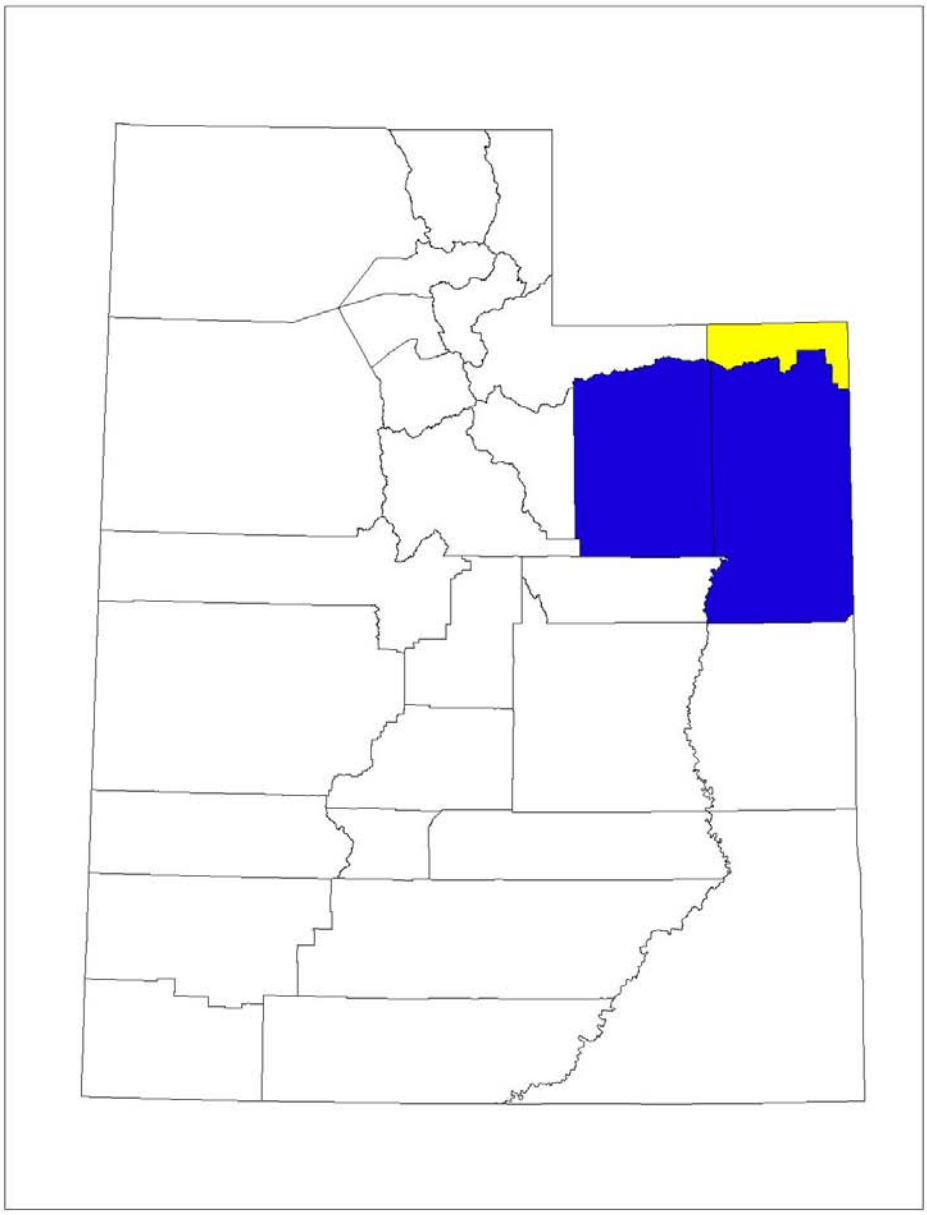
Generic Mitigation:

1. Work with UDOT on transportation and road conditions.
2. Revise and up-date building codes for carports, barns and the residential roofs.
3. Public education programs that provide back-up power and heat.
4. Research alternative forms of heat source.
5. Obtain 72 hour kits.
   http://www.co.multnomah.or.us/sheriff/prepare/supplykit.htm

Annex 2-Daggett County

Daggett County Annex

Figure 1: Tri-county map



DAGGETT COUNTY

Past Hazard Events in Daggett County

Understanding the past is often the key to discovering what the future holds; this is especially true when planning for natural disasters. The fact that the towns within Daggett County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of the risk has been mitigated, events with low frequency of occurrence often result in hazards with little or no mitigation. Table 1 provides a brief history of Daggett County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 1 Daggett County Natural Disaster History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flooding	Summer of 1936	County Wide	Damage to roads, bridges	No Loss of Life
Flash Flooding	June 10, 1965	Palisades Campground	Sheep Creek flash flood took out nearly 10 miles of State Highway	7 deaths
Drought	1977 Summer	All of Daggett County	Heavy impact on agriculture and drinking water for local residents	No Loss of Life
Wildfire	Summer 1977	Daggett County	Hundreds of Acres burnt	3 deaths
Flooding	Spring of 1983	County Wide	Damage to culverts and roads. The one lane bridge over Green River was destroyed.	No Loss of Life
Wildfire	August 18, 1993	Ruples Assist Fire	Unknown	Unknown

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Drought	Fall of 2000	All of Daggett County	Heavy impact on agriculture and drinking water for local residents	No Loss of Life
Wildfire	Summer of 2002	Daggett County (Dutch John)	20,000 acres burnt in Daggett County that cost 1.5 million dollars to put the fire out.	No Loss of Life
Drought	Currently (2003)	All of Daggett County	Heavy impact on agriculture and drinking water for local residents	No Loss of Life

Daggett County identified six natural hazards they wanted addressed in the Daggett County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire

In identifying these hazards the PDM planning committee relied on technical experts, public input, research of past events, and risk assessments completed by the county emergency manager for their Pre-Disaster Mitigation Plan.

The Daggett County PDM planning committee consisted of one County Commissioner, the Mayor of Manila, the County Emergency Managers, the TRI-County Health Department, the County Planning and Zoning, the Executive Assistant to the County Commissioners, several local citizens and the Uintah Basin Association of Governments planning coordinator.

The Disaster Mitigation Plan for Daggett County identifies critical facilities located in the County *(See Appendix B).* A critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the County, or fulfills important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in the County were not located in the natural hazard area. *The Uintah Basin Association of Governments did not map the location of the critical facilities in Daggett County. Although GIS analysis found no facilities in hazard prone areas.*

NATURAL HAZARD: DAM FAILURE

FEMA Hazard Profile for Dam Failure

Frequency		**Highly likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
	X	**Possible**	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire County		
Seasonal Pattern	Spring		
Duration	Several months to over one year		
Speed of Onset	30 Minutes or less (Minimal or no warning)		

A Word About Dams

Dams are a critical support function for water managers in the State and also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 117 dams within Uintah Basin of these 20 have received an high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on

hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years. *For a description of dam failure and possible causes dams failure in Daggett County see the Flood Hazard Identification Study in Appendix M.*

VULNERABLIITY: High
Low-lying areas down stream from dams are at risk. Under lying geologic conditions in the planning area create difficulties during dam construction. Dams in similar geologic setting in the state have failed in the past; Trial Lake Dam is an example. The aged fractured rock of the Uinta Mountain range contains numerous passages for water through the dams. During dam building these fractures require extensive engineering and grouting.

AFFECT:

Dam failure would cause significant downstream flooding to low lying areas. Impacts could include destroyed homes, bridges, roads, crops, utilities, and business loss. Natural dam failures are rare but terrorist could target large dams such as Flaming Gorge.

Description of Hazard

The following high hazard dams exist within Daggett County according to the Utah Division of Dam Safety database.

- Brownie Lake Dam
- East and West Green Lakes
- Flaming Gorge Dam
- Longs Park Dam
- Sheep Creek Lake Dam
- Spirit Lake Dam

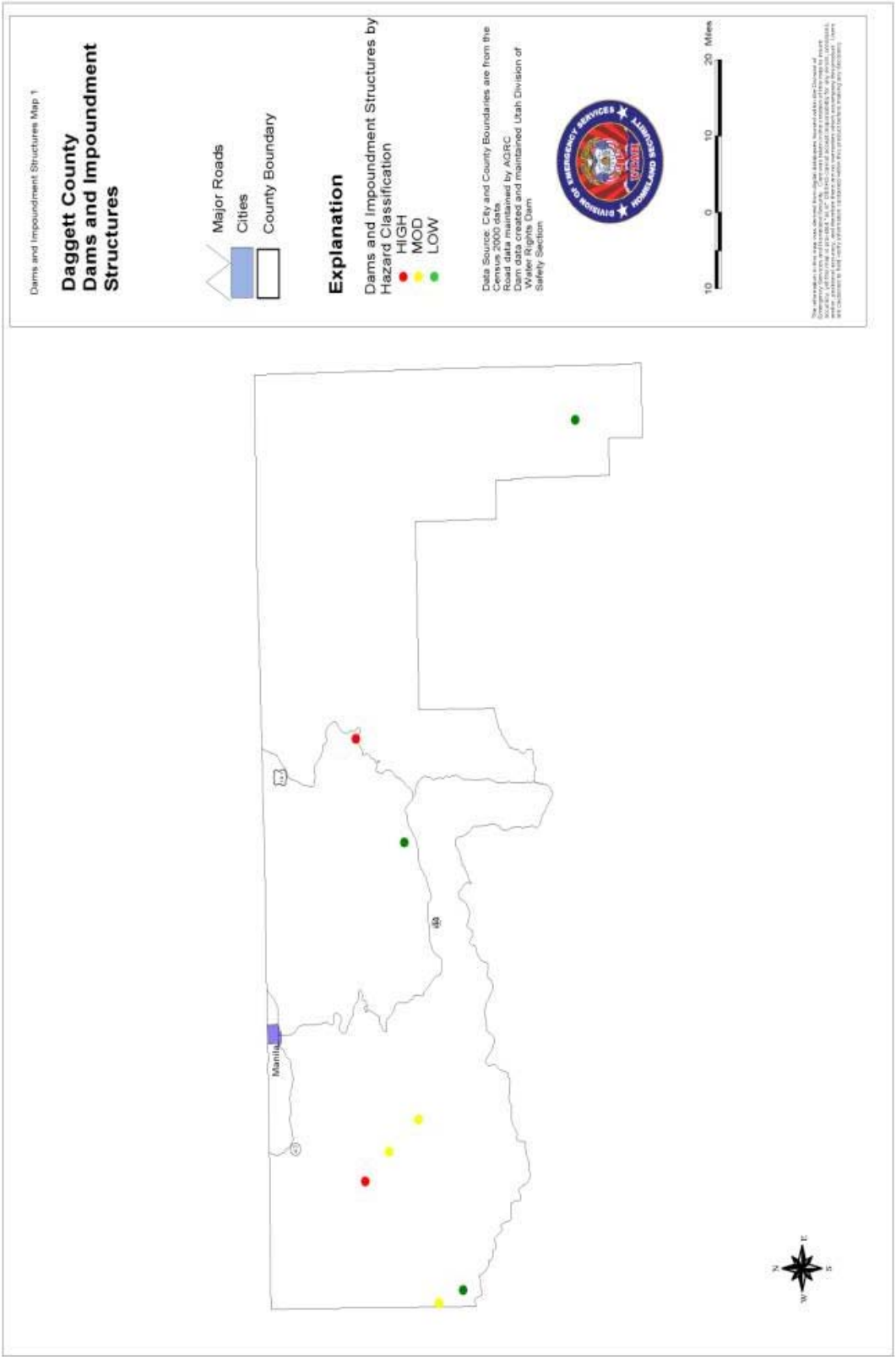
The map on page 7 illustrates the location of each dam.

Low-lying areas down stream of these dams are particularly at risk, if a dam were to fail. *For a description of dam failure and possible causes see the dams failure section in Appendix A.*

Generic Mitigation:

- Proper mapping of flood plains, including mapping of dam breach flood potential.
- Knowledge must be made public so that emergency managers are aware and the public is aware when they buy and sell property.
- Updated Emergency Action Plans (EAP) and integration with GIS Systems.
- Maintaining proper flood plain and wetland geometry and vegetation will help route floods.

- Flood plain usage should be compatible with flood plain needs.
- More debris dams would help with floods and debris, and mud, and maintaining a flood control pool in existing dams would be beneficial.
- Protection of roads and bridges.
- General infrastructure protection.
- More authority to order releases and better forecasting would help in snowmelt floods and runoff.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.


Dams and Impoundment Structures Map 1
Daggett County
Dams and Impoundment
Structures
Major Roads
Cities
County Boundary
Explanation
Dams and Impoundment Structures by
Hazard Classification
HIGH
MOD
LOW
Data Source: City and County Boundaries are from the
Census 2000 data
Road data maintained by AGRC
Dam data created and maintained Utah Division of
Water Rights Dam
Safety Section
DIVISION OF EMERGENCY SERVICES
HOMELAND SECURITY
10 0 10 20 Miles
Manila
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NATURAL HAZARD: EARTHQUAKE

FEMA Hazard Profile for Earthquake

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
	X	**Possible**	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire county		
Seasonal Pattern	Near fault lines of the County		
Duration	Hours		
Speed of Onset	Minimal or no warning		

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. This shaking can cause buildings and bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill, old waterways, or other unstable soil are most at risk. Buildings or trailers and manufactured homes not tied to a reinforced foundation anchored to the ground are also at risk since they can be shaken off their mountings during an earthquake. Earthquakes can occur at any time of year.
Source: http://www.fema.gov/hazards/earthquakes/
For a description of earthquakes and possible causes see the earthquake section in Appendix A.

Daggett County is an area of limited seismic activity. The Pot Creek faults in eastern Daggett County are the only faults located within the County. This poorly understood group of faults has moved within the last 1.6 million years. However,

because of the limited seismic danger Daggett County is zoned for little or no activity. *The map on page 14 and 15 identify Epicenters and Quaternary Faults and gives an explanation for each in Daggett County.*

VULNERABILITY: Low

The map on page 10 shows the national Peak Ground Acceleration (PGA) values for the United States with a 10% chance of being exceeded over 50 years. This is a common earthquake measurement that shows three things: the geographic area affected (all colored areas on the map), the probability of an earthquake of each given level of severity (10% chance in 50 years), and the severity (the PGA is indicated by color). ***2. Locate your planning area on the map.***

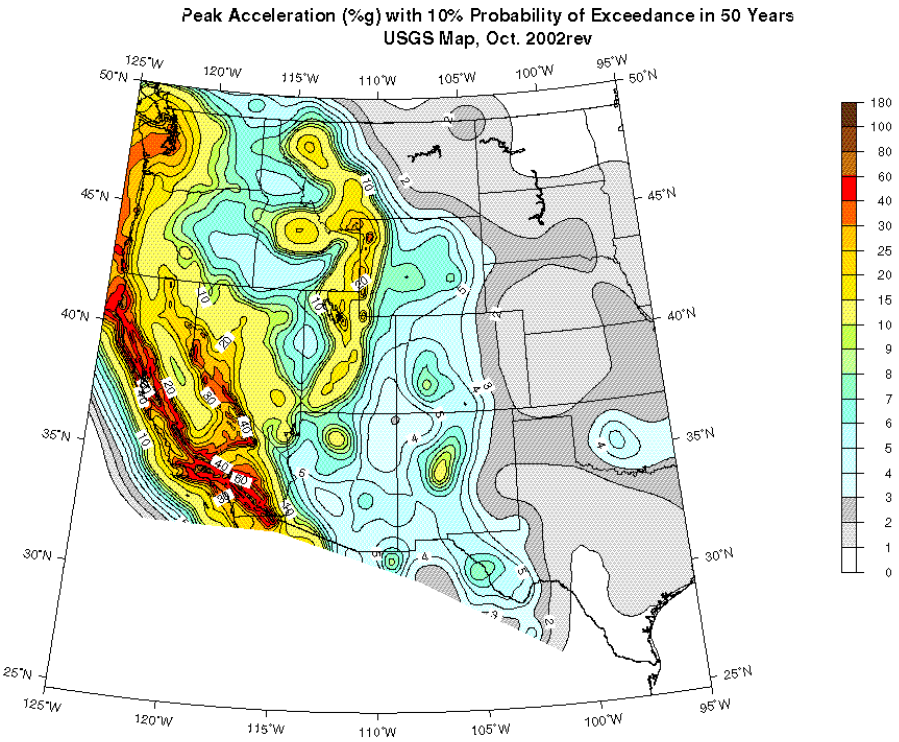
You can also generate maps based on zip codes or longitude and latitude by following the directions on the Website. ***3. Determine your Peak Ground Acceleration.***
Determine the PGA zone(s) in which your planning area is located. This is done by identifying the color associated with your planning area and correlating it with the color key located on the map. Large planning areas may be located in more than one zone.

Peak ground acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (g) (980cm/sec/sec). For example, In an earthquake with an acceleration of the ground surface of 244 cm/sec/sec, the PGA or rate in change of motion is 25% g where:

%g= Ground Surface Acceleration / Rate of Acceleration due to Gravity

%g= 244 cm/sec/sec/980 cm/sec/sec

%g= 25%


Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
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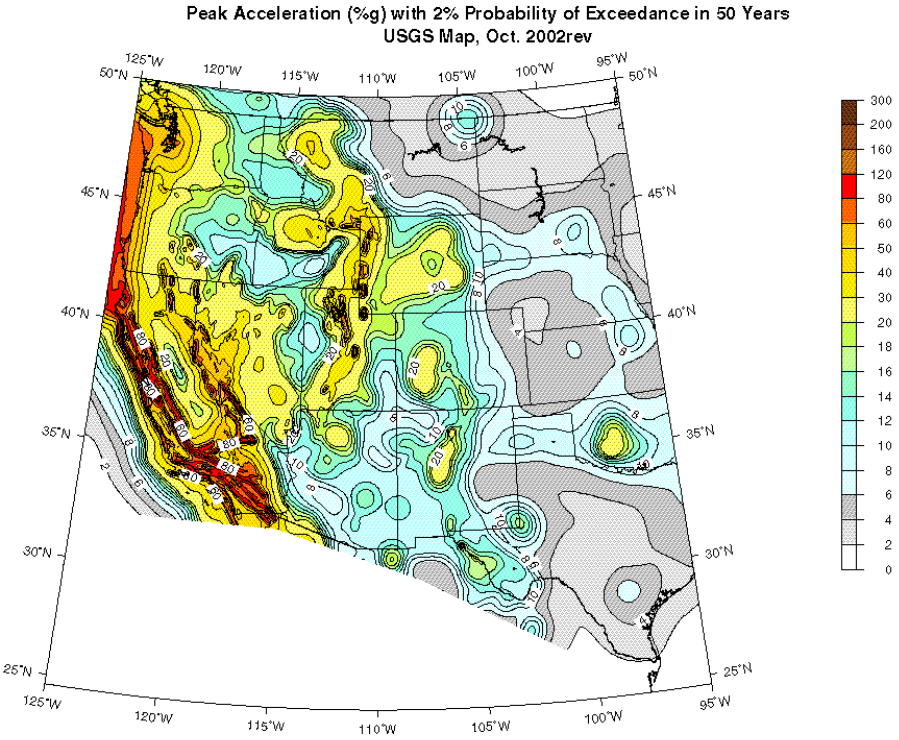
Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
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115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
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POTENTIAL AFFECT:

A potential earthquake could affect water, oil and gas produced for the Uintah Basin as well as the Wasatch Front. An earthquake could affect transportation and dams. Many homes in Daggett County were not built to meet earthquake standards. *A Full Hazus MH Event Report can be found in Appendix H for earthquakes in Daggett County.*

HAZUS MH Vulnerability Assessment

Table 1.1 Casualties

Casualties	Nighttime –Minor	2
	Nighttime –Major	0
	Nighttime -Fatalities	0
	Daytime –Minor	1
	Daytime –Major	0
	Daytime- Fatalities	0
	Commute –Minor	1
	Commute –Major	0
	Commute-Fatalities	0

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table1.2 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 1.2 –Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	311
Commercial	1
Industrial	0
Totals	312

Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	3	0	0	0
EOCs	0	0	0	0
Police Stations	1	0	0	0
Fire Stations	2	0	0	0

Debris Removal –Table 1.4 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.

A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of one yard.

Table 1.4 –Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	0.04
Loads (25 tons per load)	2,000

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a Town could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 1.5 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 1.5 –Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

*The extremely low loss numbers represented by HAZUS MH are due to Daggett County's limited built infrastructure and low seismic risk.

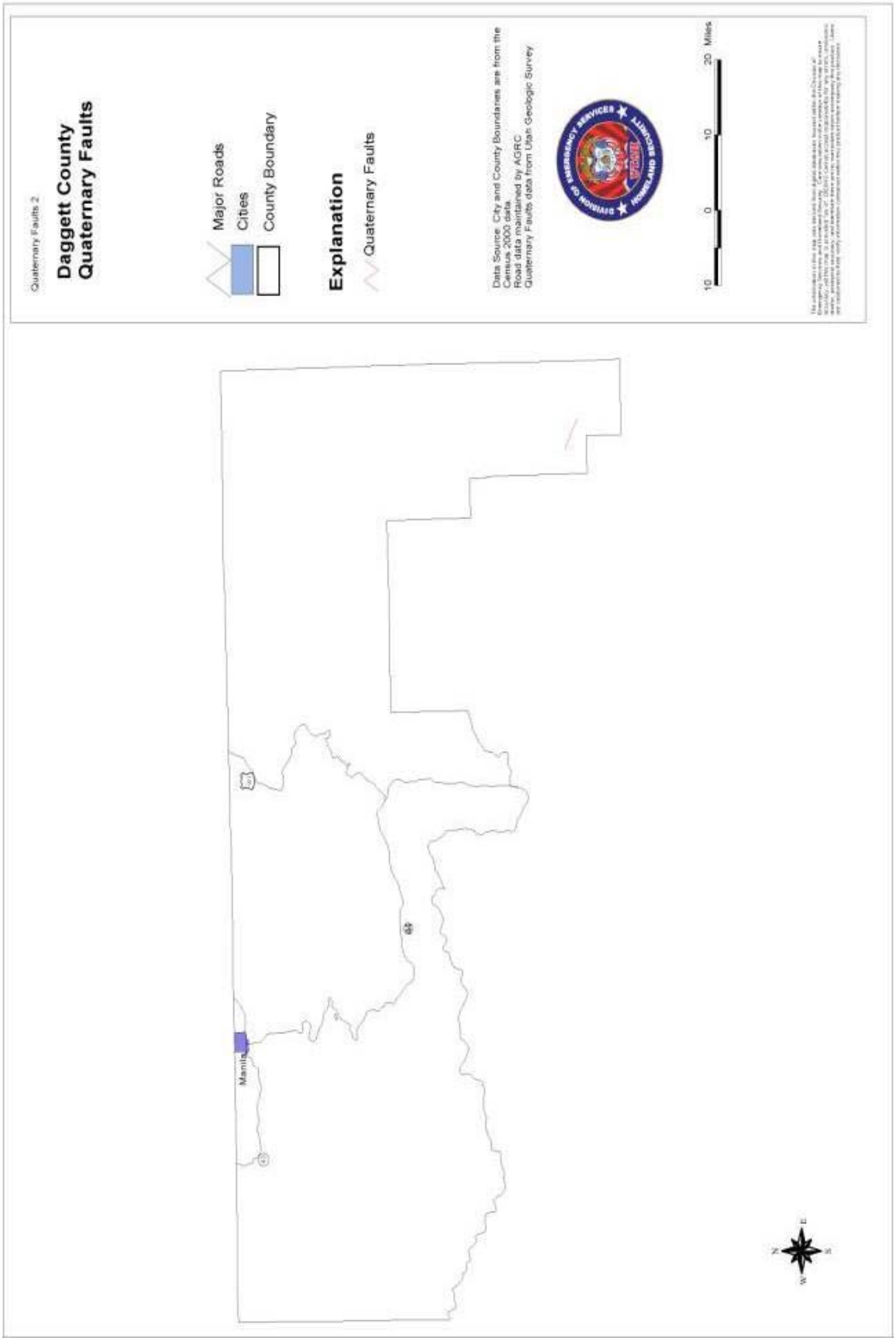
These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. *The complete HAZUS MH run for Daggett County is available in appendix H.*

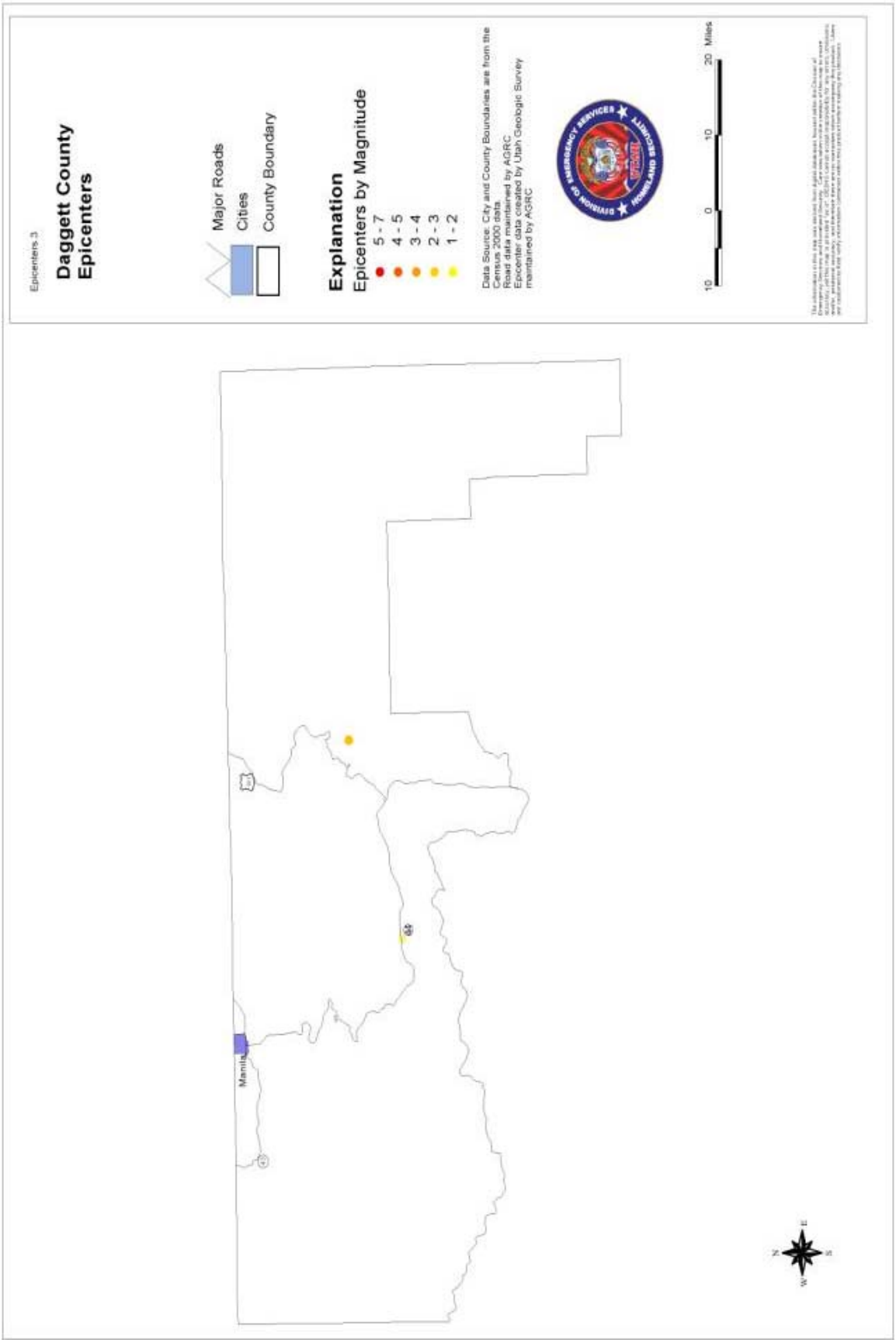
Generic Mitigation:

Generic Ground Shaking Mitigation
- Understand peak horizontal acceleration and recurrence interval.
- Design appropriately.
- Zoning ordinances and building codes.

Generic Liquefaction Mitigation
- Move soil out.
- Densify soils in place.
- Remove ground water.
- Structural design.

Generic Surface Fault Rupture Mitigation
- Avoidance
- Zoning ordinances


Quaternary Faults 2
Daggett County
Quaternary Faults
Major Roads
Cities
County Boundary
Explanation
Quaternary Faults
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey
10 0 10 20 Miles
Manila
44
43
N
E
S
W


Epicenters-3
Daggett County Epicenters
Major Roads
Cities
County Boundary
Explanation
Epicenters by Magnitude
5 - 7
4 - 5
3 - 4
2 - 3
1 - 2
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC
10 0 10 20 Miles
Manila
44
43
N
E
S
W

NATURAL HAZARD: FLOODING

FEMA Hazard Profile for Flooding

Frequency		**Highly Likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity		Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
	X	Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Flooding would affect all communities in the county that are in and along the flood plains		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring thaws		
Duration	Rainstorms can last for hours and possibly days. Spring run-off can last weeks		
Speed of Onset	Six to twelve hours		

Floods are the most common and widespread of all natural disasters except fire. Most communities in the United States have experienced some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws.

Precipitation in Daggett County originates from two major sources. Moisture laden polar pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate intensity rainfall in the lower elevations.

The second major source of precipitation in the area arises from tropical air masses entering from the south and southwest out of the Gulf of Mexico during the summer months. Often wrongly referred to as monsoons these air masses cause high intensity convective cloudburst storms, which are augmented by the orthographic lifting which occurs as the air mass passes over neighboring mountains.

Precipitation from these two types of storms can produce flash floods, snowmelt floods, post wildfire/damaged watershed floods, and severe winter weather

VULNERABILITY: High

Using the best available data UBAOG planners were unable to determine vulnerable structures. Currently neither Daggett County nor the Town of Manila has flood plain maps. The majority of Manila's 401 homes sit down grade from the Sheep Creek Canal. This unlined earthen canal has failed before causing damage to the KOA camp ground on the western edge of Manila.

Using GIS technology and flow velocity Town models, it would be possible to map the damage that can be expected from flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties. *For a description of flooding and possible causes see the flooding section in Appendix A.*

At this time, data was insufficient to conduct a risk analysis for flood events in Daggett County. However, the Map Modernization Program being led by the state will result in better data, assisting the county in understanding its flood risk. As part of its efforts to mitigate hazards and protect lives and property from the devastating effects of natural disasters, FEMA has provide planning tools to individuals, businesses, and communities. Information is a key ingredient needed to work proactively to mitigate hazards and prevent losses resulting from disasters. One of the tools developed to provide information is HAZUS MH or Hazards U.S., a natural hazard loss estimation methodology developed by FEMA under contract with the National Institute of Building Sciences. Using Geographic Information Systems (GIS) technology, HAZUS allows users to compute estimates of damage and losses that could result from an earthquake. To support FEMA's mitigation and emergency preparedness efforts, HAZUS has being expanded into HAZUS-MH, a multi-hazard methodology with new modules for estimating potential losses from wind and flood (riverine and coastal) hazards. HAZUS and HAZUS data was used in vulnerability analysis in this plan. It is expected future plan revisions will utilize the flood models available in HAZUS. *For more information regarding Flooding in Daggett County see the Flood Hazard Identification Study in Appendix M.*

Generic Mitigation:

- Avoidance
- Better flood routing through communities.
- Annual warning of risk information on how to protect property and lives.
- Flood insurance awareness, emphasis, and marketing.
- Projects such as levees/dams.
- Funding by a storm water tax in cooperation with Federal and State programs.
- Additional SNOTEL sites and enhanced instrumentation.
- Protection of roads and bridges.
- Greater reservoir capacities.
- Curtail development in flood-prone areas.
- General infrastructure protection.
- Develop river corridor parkways.
- Protection of wastewater treatment facilities from excessive inflows.
- Protection of drinking water supply systems.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.

NATURAL HAZARD: INSECT INFESTATION

FEMA Hazard Profile for Insect Infestation

Frequency	**X**	**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Daggett County		
Seasonal Pattern	Spring, summer, and fall		
Duration	Months and possibly years		
Speed of Onset	Minimal or no warning		

Agriculture has historically dominated the economic life of Daggett County. The county remains a significant producer of crops and livestock.
Daggett County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation. Damage to the economic base and to the health of the citizens is also a direct result of insects. Insects most notable are grasshoppers, Mormon Crickets, Bark Beetles, and mosquitoes. Currently the West Nile Virus spread by mosquitoes is a serious threat to humans and animals in Daggett County.

NATURAL HAZARD: LANDSLIDE

FEMA Hazard Profile for Landslide

Frequency		**Highly Likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity		**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
	X	**Limited**	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Carter Creek and Sheep Creek roads		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring snow thaws		
Duration	Depending upon conditions		
Speed of Onset	Minimal or no warning		

Overall Summary of Impacts

The Uintah Basin Association of Governments identified and mapped possible landslide threats to Daggett County that would have a potential risk to pedestrians, vehicle traffic, and residential areas.
The map on page 23 illustrates Landslides and gives an explanation for Landslides in Daggett County.

In Daggett County there are several areas namely Carter Creek that could have a potential risk to pedestrians and vehicle traffic due to landslides. Landslides exist in Daggett County but the small population puts very few if any people or there structures at risk .

In Daggett County there are approximately 12.8 residential structures at potential risk from landslide. Based upon figures provided by the Daggett County Assessors Office, the market value of those structures is estimated to be

$960,000. *For a description of Landslides and possible causes see the Landslides section in Appendix A.*

VULNERABILITY: Low

Structure Loss and Value as a Percentage of Total Acreage.

Town Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost
Daggett County	5551	12.8/960,000

*Includes value of land.

Transportation

Name	Miles	Estimated Cost
Local Neighborhood/local/Town street	4.07 miles	8,140,000
State Route 44	.4154 miles	1,002,567

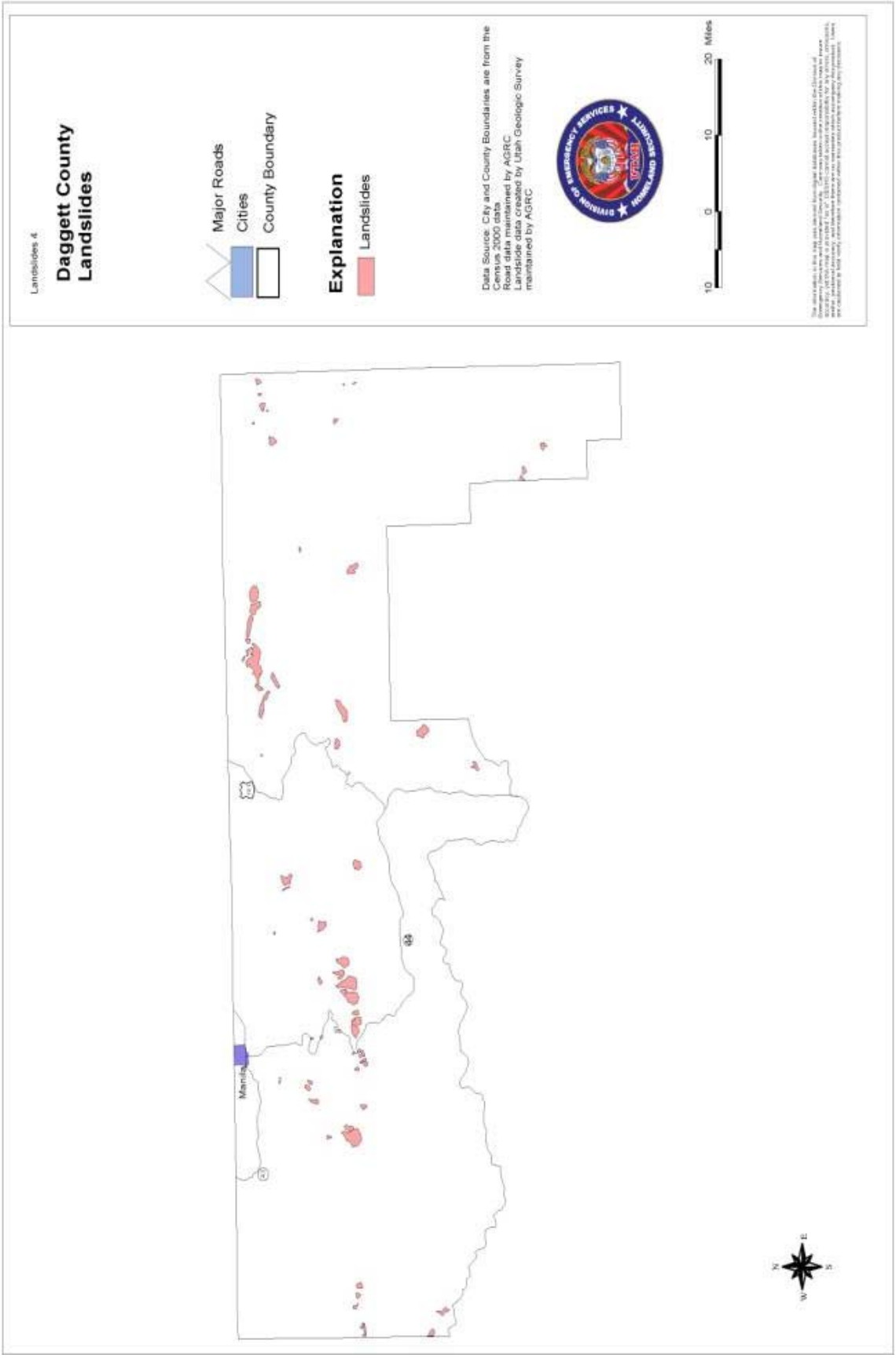
Table data represents total length of roads and rail lines, which overlay historically active landslides.

Utilities

Name	Description	Estimated Cost
Power lines	.747 miles	36,065

Generic Mitigation:

- Avoidance
- Recognize landslide area
- Zoning ordinances
- Remove landslide materials
- Drain subsurface materials
- Install surface drains
- Remove materials for the head of the landslide.
- Re-grade.
- Build buttress or retaining wall at the toe of the slope.
- Install soil nails and rock anchors.
- Maintain natural vegetation.


Landslides 4
Daggett County
Landslides
Major Roads
Cities
County Boundary
Explanation
Landslides
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES
HOMELAND SECURITY
10 0 10 20 Miles
Manila
44
43
W
N
E
S

NATURAL HAZARD: WILDFIRE

FEMA Hazard Profile for Wildfire

Frequency	**X**	**Highly likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Daggett County		
Seasonal Pattern	June through October		
Duration	Minutes to days and months		
Speed of Onset	Minimal or no warning		

There are three different classes of wild land fires. A **surface fire** is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A **ground fire** is usually started by lightning and burns on or below the forest floor. **Crown fires** spread rapidly by wind and move quickly by jumping along the tops of trees. *For a description of wildfires and possible causes see the wildfire section in Appendix A.*

Wild land fires are usually signaled by dense smoke that fills the area for miles around. Source: http://www.fema.gov/hazards/fires/
The map on page 27 illustrates fire risk and gives a wildfire explanation for Duchesne County.

A Word about Wildfires

Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have

conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk associated with alluvial fans is always of concern. Post fire revegetation and stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

VULNERABILITY: High
Daggett County in prime wildfire territory. Current drought conditions have exacerbated the fire problem. In 2002, the Mustang Wildfire started by sparks from a flat tire on a recreational trailer almost consumed Dutch John. This fire qualified under the Fire Management Assistance Grant Program and cost over 3 million dollars in state funding to suppress. Watersheds damaged as a result of the fire have resulted in erosion problems and post fire damage. The county contains an abundance of forested land susceptible to wildfires.

Generic Mitigation:

- Avoidance.
- Define, create, and maintain a defensible space.
- Plant drought and fire resistant vegetation.
- Ordinances.

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Daggett	N/A	67,693	204,401	189,792

Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Daggett	None	159/9,540,000	479/28,740,000

Cities of Daggett County

Town Name	Acres of Extreme	Acres of High	Acres of Moderate
Manila	None	None	93

Structures in Wildfire Area

Town	Households	Households	Households in

Name	in Extreme/Cost	in High/Cost	Moderate/Cost
Manila	None	None	72/4,320,000

*Excludes content value, which would result in, and increase of 50% to the values listed.

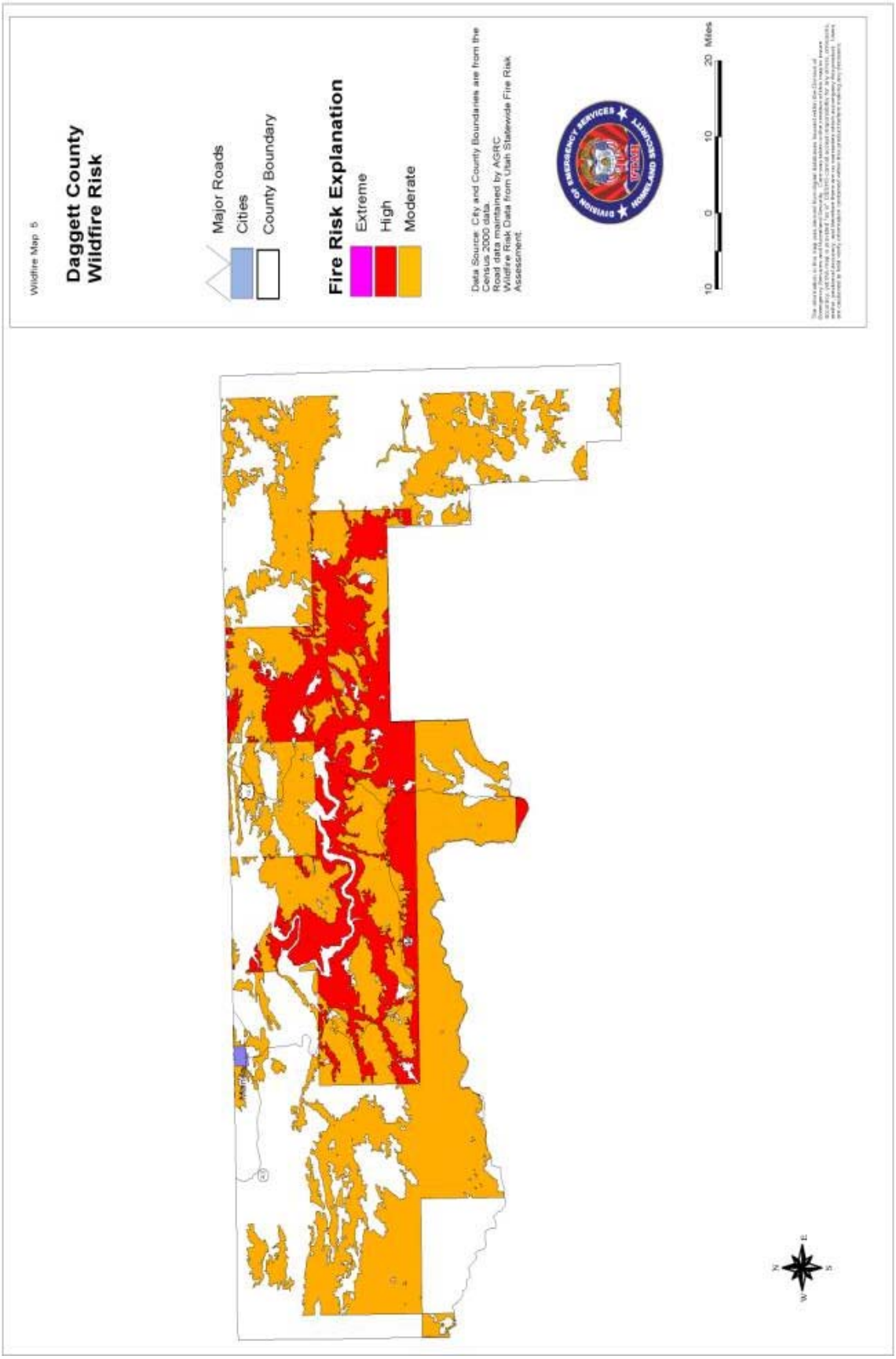
Transportation Roads, highways, and Rail Lines

Name	Miles	Estimated Cost
Local Neighborhood/local/Town street	218.1	436,200,000
State Route 43	1.18	2,847,930
State Route 44	21.31	51,431,685
US Highway 191	21	50,683,500

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Utilities

Name	Description	Estimated Cost
Flaming Gorge	Power Generation	50,000,000
Power lines	53.45 Miles	2,580,566
KV-230	4.25 Miles	205,190
Gas	6.41 Miles of Questar	1,547,309


Wildfire Map 5
Daggett County
Wildfire Risk
Major Roads
Cities
County Boundary
Fire Risk Explanation
Extreme
High
Moderate
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.
DIVISION OF EMERGENCY SERVICES AND HOMELAND SECURITY
10 0 10 20 Miles
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Mitigation Capabilities of Daggett County

This portion of the Plan assesses Daggett County's current capabilities to mitigate the effects of the natural hazards identified within the plan. The assessment includes an examination of the following local government capabilities:

1. Staff & Organizational Capability
2. Technical Capability
3. Development Trends
4. Fiscal Capability
5. Policy and Program Capabilities
6. Political Willpower

The capabilities assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for Daggett County to pursue under this Plan, but also ensures that those goals and objectives are realistically achievable under given local conditions.

1. Staff and Organizational Capability

Daggett County has **Very Limited** staff and organizational capability to implement hazard mitigation strategies. Daggett County is Utah's least populated county, containing only 753 people. While the County has a number of professional staff members to serve residents and carry out day-to-day administrative activities, much of the staff is part time or is tasked with numerous duties.

The County of Daggett does have an Emergency Manager who is responsible for the mitigation, preparedness, response and recovery operations that deal with both natural and man-made disaster events.

2. Technical Capability

Daggett County has **very limited** technical capability to implement hazard mitigation strategies.

Technical Expertise

Daggett County does have an, emergency manager to administer the County's hazard mitigation programs. The County does not have a licensed engineer or related technical expert on staff, and has in the past relied upon outside contractors/consultants to perform a majority of any required technical work.

Internet Access

Daggett County does provide its employees and citizens with high speed broadband Internet. Internet access opens up an enormous door for local officials to keep abreast of the latest information relative to their work and makes

receiving government services more affordable and convenient. It is believed that Internet access will help further the County's hazard mitigation awareness programs, but should be supplemented with more traditional (and less technical) means as well.

3. Development Trends
Daggett County is approximately 90% federal land. Out of the remaining 10% around 8% is used for agricultural purposes. This leaves approximately 2% of the land available for development. Therefore, future development in Daggett County will be minimal.

4. Fiscal capability
Daggett County has **very limited** fiscal capability to implement hazard mitigation strategies.

Under the Disaster Mitigation Act of 2000, FEMA has made special accommodations for "small and impoverished communities", who will be eligible for a 90% Federal share, 10% non-Federal cost split for projects funded through the Pre-Disaster Mitigation Grant Program. Daggett County is not yet classified as small and impoverished but it is thought they meet the requirements.

5. Policy and program capability

Emergency Operations Plan
Daggett County has developed and adopted an Emergency Operations Plan, which predetermines actions to be taken by government agencies and private organizations in response to an emergency or disaster event. The Plan was adopted April 12, 2000. For the most part, the Plan describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster. The Plan does not specifically address hazard mitigation, but it does identify the specific operations to be undertaken by the County to protect lives and property immediately before, during and immediately following an emergency. There are no foreseeable conflicts between this Hazard Mitigation Plan and Daggett County's Emergency Management Plan, primarily because they are each focused on two separate phases of emergency management (mitigation vs. preparedness and response).

Daggett County Emergency Management Program
Daggett County has an emergency management program headed by Shirley Slaugh. Very few counties in the country of similar size have been able to fund and sustain an emergency management program. The emergency management program is tasked with protecting the life safety of the residents of Daggett County, utilizing the four phases of emergency management, one of which is mitigation. Daggett is constantly looking for low or no cost mitigation and has accomplished much through partnerships. Daggett County emergency

management personnel have attended state sponsored mitigation training and provided support for this PDM planning effort.

Floodplain Management Plan
Daggett County does not currently participate in the National Flood Insurance Program. However, this Hazard Mitigation Plan recommends that Daggett County participate in the NFIP.

Storm water Management Plan
Daggett County Currently has no formal Storm water Management Plan.

County Ordinances
The Daggett County currently does not have any county ordinance that addresses natural disasters. However, the planning committee was in attendance at our Natural Disaster meetings and agreed to work on implementing and adopting new County Ordinances that are relevant to hazard mitigation.

6. Political Willpower
Most Daggett County residents are quite knowledgeable about the potential hazards that their community faces. Recent wildfires have increased the understanding and need for mitigation within the government structure of Daggett County.

The Uintah Basin Association of Governments used historical data to estimate to the best of their ability (with the data available at the time) the potential dollar losses if the County were to experience flooding and wildfires, the two most likely hazards to occur in the County. The estimated costs are as follows:

Potential flood losses:
At this time, data was insufficient to conduct a loss analysis for flood events in Daggett County. However, the current mapping projects being led by the county and by the state will result in better data that will assist in understanding potential losses due to flooding.

Potential wildfire losses:
At this time, data was insufficient to conduct a loss analysis for wildfire events in Daggett County. However, the current mapping projects being led by the county and by the state will result in better data that will assist in understanding potential losses due to wildfires. Wildfires pose little threat to the residential and commercial properties, as well as, the local school system located within Daggett County.

Daggett County

The Daggett County Local Emergency Prepardness Committee which consists of one County Commissioner, the Mayor of Manila, the County Emergency Managers, the TRI-County Health Department, the County Planning and Zoning, the Executive Assistant to the County Commissioners, and several local citizens in conjunction with the Uintah Basin Association of Governments held a 3 day round table discussion to review and analyze the risk assessment studies that were performed for the County. The goals listed were determined to be those goals that would have the greatest benefit in hazard reduction to the County. The goals, objectives and actions represent a long-term vision for hazard reduction or enhancement of mitigation capabilities. Listed below is our definition of goals and objectives. *Daggett County participated in the County Pre-Disaster Mitigation Planning Grant and their complete Mitigation Strategies Workbook can be found in Appendix N.*

Goals: General guidelines that explain what you want to achieve. They are usually long-term and represent global visions, such as "eliminate flood damage."

Objectives: Define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific, measurable, and have a defined completion date. Objectives are more specific, such as "adopt a zoning ordinance prohibiting new development in the floodplain."

The Local Emergency Prepardness Committee and the Uintah Basin AOG Mitigation Planner decided upon the following goals, objectives, action items, and priorities for each of the natural hazards. The priorities for each hazard are ranked in the following order: High, Medium, and Low. Each hazard is ranked by order of importance; however, this does not mean the ranking of each hazard will not potentially change over time.

Mitigation Strategies

Dam Failure

Daggett County

GOAL 1: Reduce future flooding in Daggett County due to dam failure.

Medium Priority

Objective 1.1

- Use technology to aid in prevention of flood loss due to dam failure

Action 1.1.1:

- Digitize high hazard dam failure inundation maps

Time Frame: ongoing
Funding: state government
Estimated Cost: 500 dollars per dam
Staff: Utah Dam Safety Section, and AGRC

Action 1.1.2:

- Update Emergency Operations Plan to include GIS dam failure estimates

Time Frame: Next EOP update
Funding: County
Estimated Cost: Undetermined
Staff: County GIS and Emergency Manager

Action 1.1.3:

- Educate the local elected officials, developers, and citizens.

Time Frame: Within the next two years
Funding: County
Estimated Cost: Minimal
Staff: County employees

Action 1.1.4

- Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**

Time Frame: Ongoing
Funding: FEMA, State and Local
Estimated Cost: Unknown
Staff: State and Local

Action 1.1.5:

- Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to town stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Daggett County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.

Drought

Daggett County

GOAL 1: Reduce water loss within Daggett County.

High Priority

Objective 1.1

- Conserve culinary water by educating the public.

Action 1.1.1:

- The Local LEPC will hold meetings semi-annually to educate the public on the need to be water wise.

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: Use a newsletter to educate the public

Objective 1.2:

- Develop more water storage tanks within the County.

Action 1.1.2:

- Conduct a feasibility study.

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: unknown
Staff: Water surveyor and newsletter editor

Action 1.1.3:

- Install new wheel lines to improve efficiency of water.

Time Frame: Ongoing
Funding: Federal, and State funding
Estimated Cost: Unknown
Staff: NRCS, UACD, USU, Extension, ect.

Action 1.1.4:

- Implement and enforce water laws that prohibit the use of extensive amounts of water.

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: Unknown
Staff: Water surveyor and newsletter editor

Drought

Manila

GOAL 1: Reduce water loss within the Town of Manila.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: Town funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Manila Town Staff, Professional Services, and Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The Town should continue to maintain and implement a tiered water rate structure.

Earthquake

Daggett County

GOAL 1: Reduce potential confusion with the citizens of Daggett County by providing public awareness regarding possible earthquakes.
Problem Identification: Transportation and utilities services could be severely impacted.

Medium Priority

Objective 1.1

- Provide for emergency response and relief

Action 1.1.1:

- Identify and maintain critical transportation and utility services

Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: Town staff.
Background: Critical transportation systems

Objective 1.2

- Public Awareness

Action 1.1.2:

- Conduct a public awareness campaign.

Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown
Staff: Agency personnel and volunteers

Background: Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.

GOAL 2: Identify the number of seismically unsafe structures within the County.
Problem Identification: Unknown number of seismically unsafe structures around the county.

High Priority

Objective 1.2

- Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.

Action 1.1.2:

- Structural and non-structural earthquake hazard assessment.

Time Frame: ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Critical transportation systems

Flooding

Daggett County

GOAL 1: Reduce flood damage in Daggett County.
Problem Identification: Control flooding in residential areas of Daggett County, Including but not limited to the Town of Manila and the unincorporated Dutch John. Flooding occurs from heavy rains and fast moving thunderstorms. *For more information regarding Flooding in Daggett County see the Flood Hazard Identification Study in Appendix M.*

High Priority

Objective 1.1:

- Obtain Aerial photography with contours of each residential area in Daggett County.

Action 1.1.1:

- Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: Ongoing
Funding: Local, State and Federal grants
Estimated Cost: Unknown
Staff: State, Local, and possibly Federal
Background: Aerial Topography is needed for master storm drainage design.

Objective 1.2:

- Design master storm drainage plans for residential areas.

Action 1.1.2:

- Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.

Background: Engineers design master storm drainage plans for the residential areas.

Objective 1.3:

- Implement storm drainage plans throughout the residential areas of Daggett County.

Action 1.1.3:

- Provide information to the public on how the storm drainage plans will assist in preventing flood damage to the residents of Daggett County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the finals plans and what is required for facilities
Staff: County and contracted staff

Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Manila

GOAL 1: Reduce flooding in Manila related to the Sheep Creek Canal. The Majority of the Town of Manila's 401 homes sit down grade from the Sheep Creek
Problem Identification: This unlined earthen canal has failed before causing damage to the KOA camp ground on the Western edge of Manila.

High Priority

Objective 1.1:

- Use technology to aid in prevention of flood loss due to canal failure.

Action 1.1.1:

- Daggett County and the Town of Manila will form a partnership with the current owners of the Sheep Creek Canal. In doing so, this will enable them to work together in the lining or piping of portions of the canal as funding becomes available.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.2:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the populated areas in Daggett County.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and Town Employees, Local Volunteers

Action 1.1.3:

- Place a restrictive clause in the County and Town Ordinances that will prohibit any new development in the County floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.4:

- Place a restrictive clause in the County and Town Ordinances that will prohibit any undercutting of the canal.

Time Frame: Within the next year
Funding: FEMA, state and local
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.5:

- Educate the public on Canal maintaince and repair.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers
Background: Past and future flooding

Action 1.1.6:

- County and Town building inspectors and the planning committee will implement a maintenance and inspection schedule in coordination with the owners of the canal.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers
Background: Past and future flooding

Action 1.1.7:

- County and Town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.8:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.9:

- Implement a flood ordinance that will cover the County and Town with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time

Staff: County and Town Employees, Local Volunteers

Insect Infestation

Daggett County

GOAL 1: Reduce insect Infestation to the agricultural businesses'
Problem Identification: South and west sides of Daggett County are vulnerable to Mormon cricket and Cutworm infestations as well as some mosquito problems.

High Priority

Objective 1.1

- Reduce the impact of insects

Action 1.1.1:

- Spread insect bait and spray for mosquitoes

Time Frame: When required
Funding: Town and County funds, Mosquito abatement funds come from property tax
Estimated Cost: Approximately $3.00 per property owner per month
Staff: County Mosquito Abatement District

Objective 1.2:

- Reduce the severity of infestations

Action 1.1.2:

- The County has applied for a $6,000.00 grant to assist in purchasing 4 Mosquito magnets, propane tanks to run the magnets and to assist in salaries for the county employees to maintain the magnets.

Time Frame: Spring and summer of 2004
Funding: $6,000.00 in grants
Estimated Cost: $6,000.00
Staff: County employees

Background: Several agricultural fields surround Daggett County; these fields have been subjected to insect infestation especially during the recent years of drought.

Objective 1.3:

- Reduce the threat of West Nile Virus within Daggett County

Action 1.1.3:

- Educate the public on the importance of vaccinating their animals.

Time Frame: Spring and summer of 2004
Funding: State and local funding
Estimated Cost: $6,000.00
Staff: County employees

Background: Several of the Daggett County residents have horses that could be affected by the West Nile virus.

Manila

GOAL 1: Reduce grasshopper infestations within residential areas of the Town of Manila.
Problem Identification: Periodic Grasshopper infestations tend to be more sever on the edge of the developed town area and in the fields surrounding the town.

High Priority

Objective 1.1:

- Reduce the severity of infestations

Action 1.1.1:

- Conduct aerial spraying to reduce infestations.

Time Frame: As infestations occur
Funding: By private individuals in most cases
Estimated Cost: Varies, depending on acreage treated
Staff: Contractor

Background: Many agricultural fields surround Daggett County and the Town of Manila. These fields have been subjected to insect infestation especially during the recent years of drought.

Landslide

Daggett County

GOAL 1: Protect vehicle traffic from possible accidents due to the Carter Creek rockslides.
Problem Identification: There is a potential risk to pedestrians and vehicle traffic due to the Carter Creek rockslides, which are located in areas identified by the county as landslide risk areas.

High Priority

Objective 1.1

- Reduce potential landslide risk on highway 44 in areas of known landslide potential.

Action 1.1.1:

- Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Action 1.1.2:

- Coordinate with all government agencies' that would assist in sloping of the hillside near Carter Creek. The county will need to contact the following agency's on the possibility of implementing some kind of protective netting or fencing that would eliminate the rock's from tumbling down on to Highway 44.

Time Frame: Undetermined
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Action 1.1.3:

- The county's and town's planning committee will review and update the zoning ordinances within the County and Town to make sure that individuals are not constructing new homes near potential landslide areas.

Time Frame: Undetermined
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Hold monthly planning and zoning meetings within the town and county.

Severe Weather

Daggett County

GOAL 1: Reduce structural damage to both residential and commercial buildings due to Severe Weather.
Problem Identification: Daggett experiences occasional, damaging high winds and snowstorms.

High Priority

Objective 1.1

- Reduce damage to structures through strict adherence to building codes

Action 1.1.1:

- Ensure that 80 MPH wind load requirement is met by builders

Time Frame: Ongoing
Funding: Fees from Building permits
Estimated Cost: Minimal
Staff: Building Inspector

Background: Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events

Manila

GOAL 1: Provide protection for the citizens from possible power line failure.
Problem Identification: Power lines are at risk from seasonal high winds.

High Priority

Objective 1.1

- Reduce service disruptions and damage to power lines

Action 1.1.1:

- Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.

Time Frame: Ongoing
Funding: Possible Grants
Estimated Cost: To be determined
Staff: County and town employees

Background: Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.

Wildfire

Daggett County

GOAL 1: To develop mitigation strategies that will improve the protection of the citizens of Daggett County from wildfires.
Problem Identification: Continuing non-compliance with existing building codes and fire codes.

High Priority

Objective 1.1

- Increase compliance with existing building and fire codes.

Action 1.1.1:

- Develop and enforce current local, state and national codes

Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies

Background: Implement and enforce rules, regulations and codes

Manila

GOAL 1: Reduce the threat of wildfires within the Town of Manila.
Problem Identification: Specific areas of the county are susceptible to wildland fire danger.

High Priority

Objective 1.1

- Educate homeowners on how to reduce risk of wildfire damage

Action 1.1.1:

- The local LEPC will provide semi-annual training for the citizens of Daggett County and the Town of Manila.

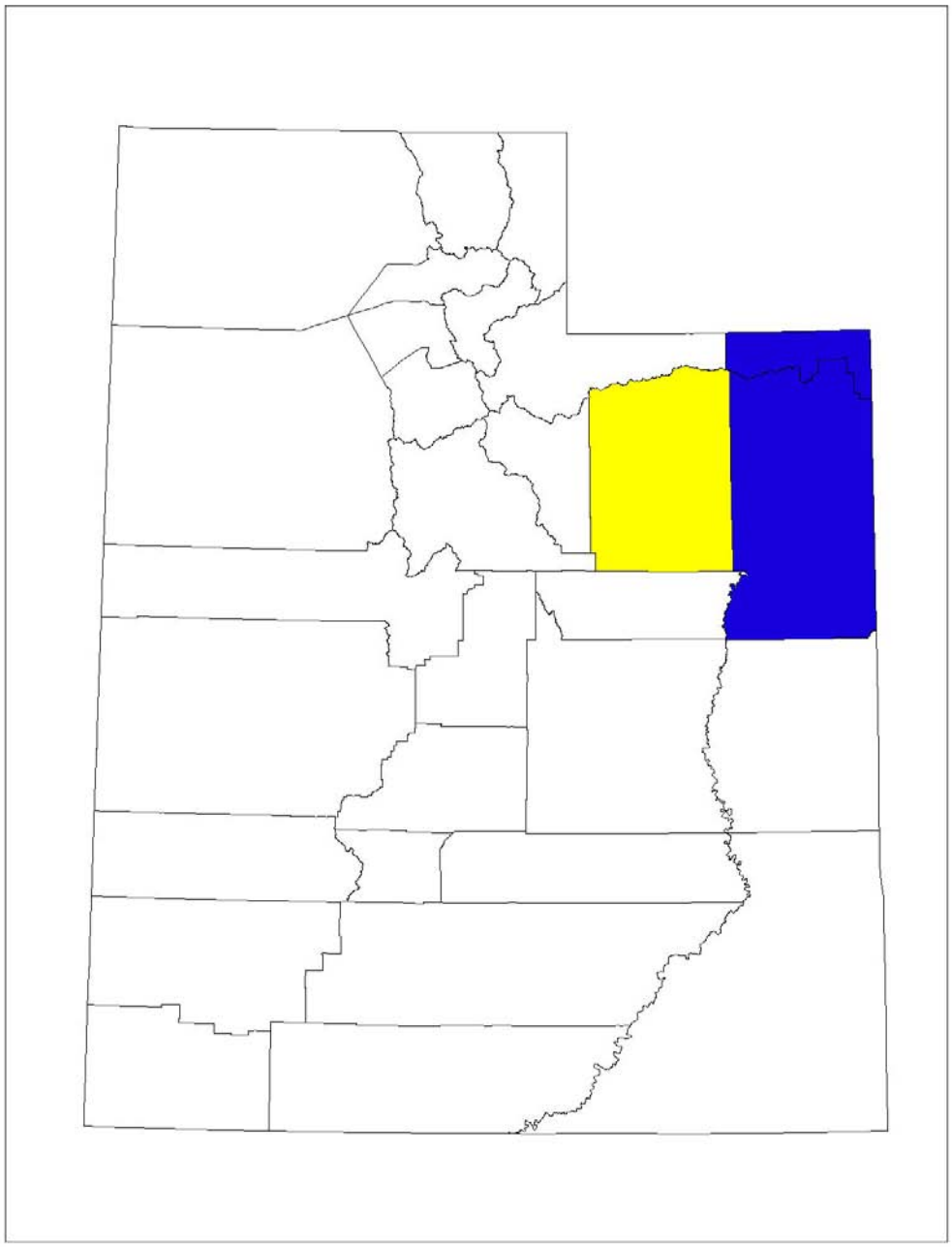
Time Frame: Starting 2004
Funding: State and local
Estimated Cost: Minimal
Staff: County

Background: Educate the public on how to reduce the risk of wildfires.

Annex 3- Duchesne County

Duchesne County Annex

Figure 1: Tri-county map



DUCHESNE COUNTY

Past Hazard Events in Duchesne County

Understanding the past is often the key to discovering what the future holds; this is especially true when planning for natural disasters. The fact that cities within Duchesne County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 1 provides a brief history of Duchesne County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 1 Duchesne County Natural Disaster History

Hazard	Date	Location	Critical Facility or area impacted	Comments
Flood	September 13, 1940	Duchesne	Damage in Indian Canyon and roads flooded	No loss of life
Flood	August 7, 1941	Mountain Home	Destroyed bridges washed out road over Kofford wash and caused damage in Rock Creek	No loss of life
Flood	August 7, 1945	Strawberry Creek area	Damage to roads, ranches, and irrigation diversions near Strawberry Creek	No loss of life
Flood	August 1, 1953	Sowers Canyon	Damage to farm house and 200 acres	No loss of life

Hazard	Date	Location	Critical Facility or area impacted	Comments
Flood	August 5, 1957	Tabiona/Hanna	Damage to homes, roads, farms, and crops	Farm Creek
Flood	September 2, 1960	Hanna	Flood homes and damaged approximately 100 acres of farmland	No loss of life
Flood	August 11, 1969	Duchesne	Damage to town due to flooding	Source Yellowstone river, Strawberry river, Duchesne River, and Reed Creek

Duchesne County identified six natural hazards they wanted addressed in the Duchesne County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire.

In identifying these hazards the PDM planning committee relied on technical experts, public input, research of past events and plan, and risk assessments completed by the county emergency manager for their Pre-Disaster Mitigation Plan.

The Duchesne County Disaster Mitigation Planning committee consisted of one County Commissioner, the Mayor of Duchesne, the Mayor of Altamont, the Mayor of Tabiona, the Roosevelt City Manager, the Mayor of Myton, the County Emergency Manager and the Uintah Basin Association of Governments planning Coordinator.

The Disaster Mitigation Plan for Duchesne County identifies critical facilities located in the County *(See Appendix B).* A critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the County, or fulfills important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in the County were not located in the natural hazard area. *The Uintah Basin Association of Governments did not map the location of the critical facilities in Duchesne County. Through GIS analysis no critical facilities were found in hazard areas.*

NATURAL HAZARD: DAM FAILURE

FEMA Hazard Profile for Dam Failure

Frequency		**Highly likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire county		
Seasonal Pattern	Spring		
Duration	Several months to over one year		
Speed of Onset	Range from 35 minutes to three hours		

A Word About Dams

Dams are a critical support function for water managers in the State and also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 117 dams within Uintah Basin of these 20 have received an high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams

annually, moderate hazard dams biannually, and low-hazard dams every five years. *For a description of dam failure and possible causes dams failure in Duchesne County see the Flood Hazard Identification Study in Appendix M.*

VULNERABLIITY: High
Low-lying areas down stream from dams are at risk. Under lying geologic conditions in the planning area create difficulties during dam construction. Dams in similar geologic setting in the state have failed in the past; Trial Lake Dam is an example. The aged fractured rock of the Uinta Mountain range contains numerous passages for water through the dams. During dam building these fractures require extensive engineering and grouting.

Description of Hazard

The following high hazard dams exist within Duchesne County according to the Utah Division of Dam Safety database.

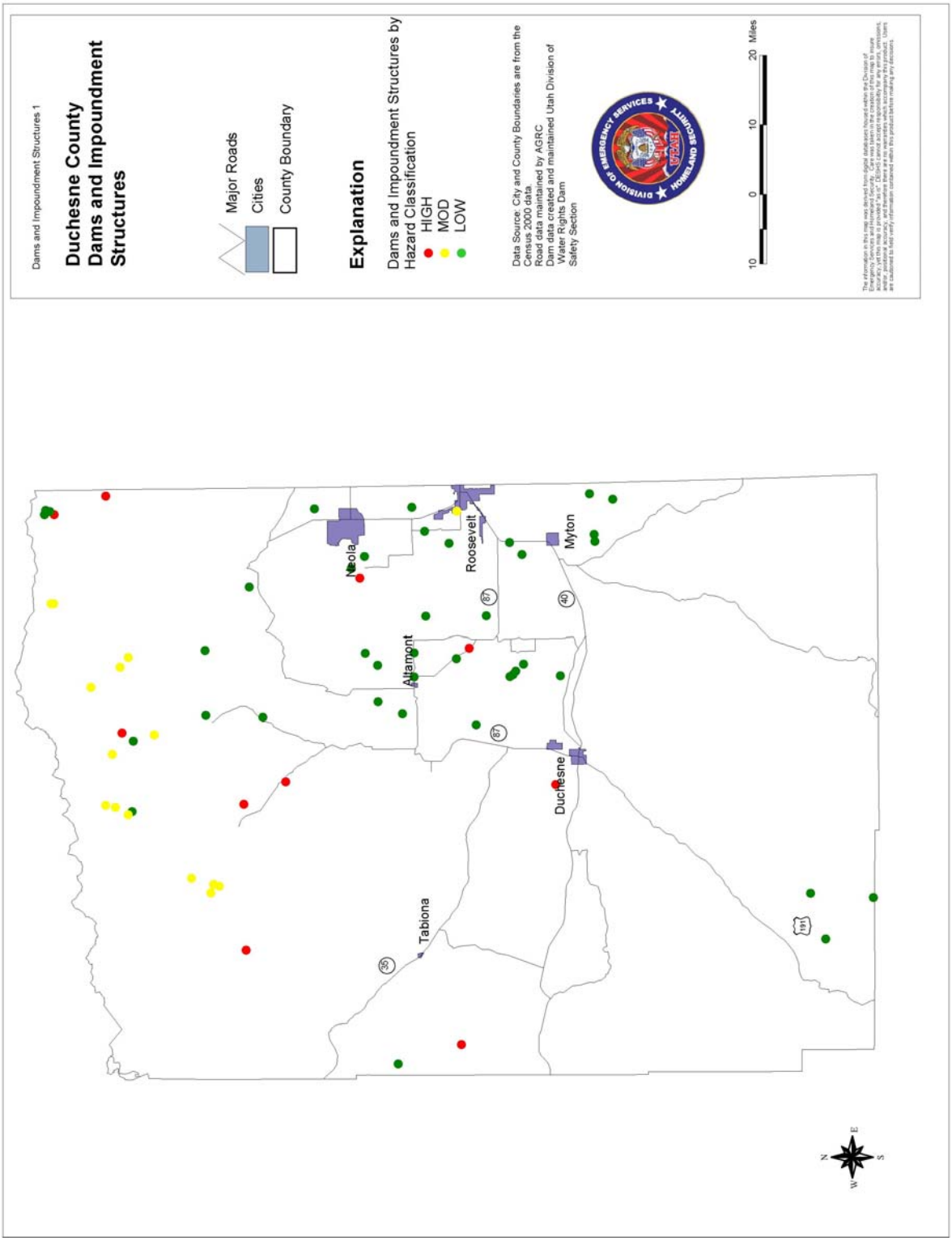
- Cliff Lake
- Browns Draw
- Starvation
- Twin Pots
- Moon Lake
- East Timothy
- Red Creek
- Chepeta Lake
- Stillwater
- Big Sand Wash

The map on page 7 illustrates the location of each dam.
Low lying areas down stream of these dams are particularly at risk, if a dam were to fail. *For a description of dam failure and possible causes see the dams failure section in Appendix A.*

Generic Mitigation:

- Proper mapping of flood plains, including mapping of dam breach flood potential.
- Knowledge must be made public so that emergency managers are aware and the public is aware when they buy and sell property.
- Updated Emergency Action Plans (EAP) and integration with GIS Systems.
- Maintaining proper flood plain and wetland geometry and vegetation will help route floods.
- Flood plain usage should be compatible with flood plain needs.
- More debris dams would help with floods and debris, and mud, and maintaining a flood control pool in existing dams would be beneficial.
- Protection of roads and bridges.

- General infrastructure protection.
- More authority to order releases and better forecasting would help in snowmelt floods and runoff.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.


Dams and Impoundment Structures 1
Duchesne County
Dams and Impoundment
Structures
Major Roads
Cities
County Boundary
Explanation
Dams and Impoundment Structures by
Hazard Classification
HIGH
MOD
LOW
Data Source: City and County Boundaries are from the
Census 2000 data
Road data maintained by AGRC
Dam data created and maintained Utah Division of
Water Rights Dam
Safety Section
DIVISION OF EMERGENCY SERVICES
HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Neola
Roosevelt
Myton
Altamont
Duchesne
Tabiona
40
87
35
191
N
E
S
W

NATURAL HAZARD: EARTHQUAKE

FEMA Hazard Profile for Earthquake

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity	**X**	Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire county		
Seasonal Pattern	Near fault zones County Wide		
Duration	Hours		
Speed of Onset	Minimal or no warning		

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. This shaking can cause buildings and bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, and fires. Buildings with foundations resting on unconsolidated landfill, old waterways, or other unstable soil are most at risk. Buildings or trailers and manufactured homes not tied to a reinforced foundation anchored to the ground are also at risk since they can be shaken off their mountings during an earthquake. Earthquakes can occur at any time of year. Source: http://www.fema.gov/hazards/earthquakes/
For a description of earthquakes and possible causes see the earthquake section in Appendix A.

Duchesne County contains the Towanta Flat Graben and the Duchesne Pleasant Valley Fault system. The Duchesne Pleasant valley system is a poorly understood system with fault traces running east and west. This east west orientation is at odds with contemporary tectonic stress regimes so it has not been determined if this fault could produce a large magnitude earthquake or not. Research indicates the Towanta Flat fault last moved in the mid to late Quaternary period. Duchesne County is an area of limited seismic hazard due to

the long recurrence intervals along the Towanta Flat and Pleasant Valley Fault zones. Duchesne being zoned for little or no seismic activity is warranted.

VULNERABILITY: Low

The map on page 10 shows the national Peak Ground Acceleration (PGA) values for the United States with a 10% chance of being exceeded over 50 years. This is a common earthquake measurement that shows three things: the geographic area affected (all colored areas on the map), the probability of an earthquake of each given level of severity (10% chance in 50 years), and the severity (the PGA is indicated by color). ***2. Locate your planning area on the map.***

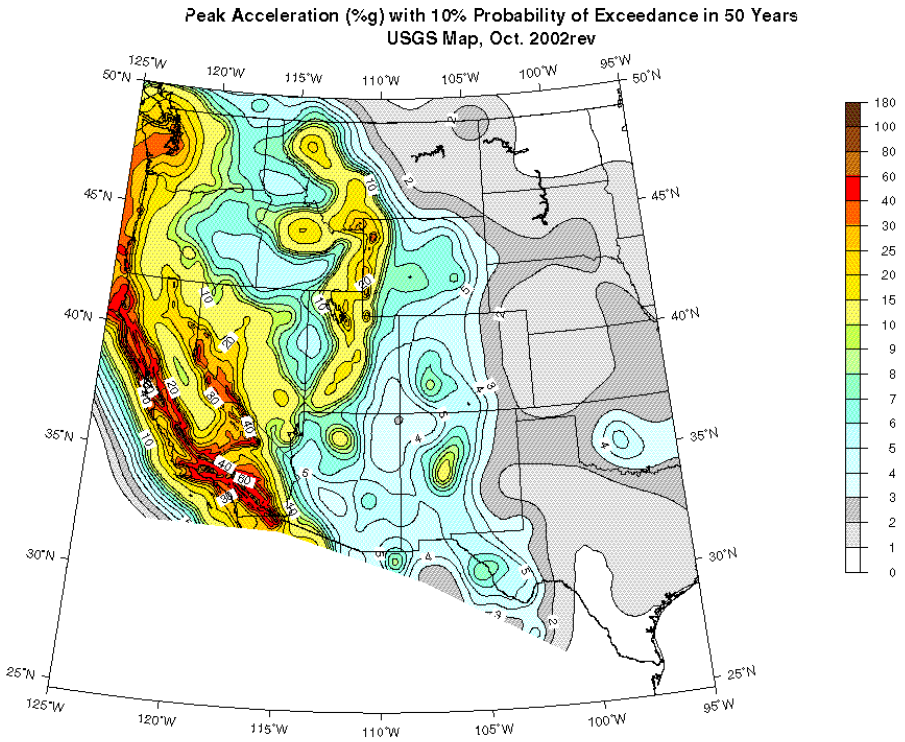
You can also generate maps based on zip codes or longitude and latitude by following the directions on the Website. ***3. Determine your Peak Ground Acceleration.***
Determine the PGA zone(s) in which your planning area is located. This is done by identifying the color associated with your planning area and correlating it with the color key located on the map. Large planning areas may be located in more than one zone.

Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (g) (980 cm/sec/sec). For example, In an earthquake with an acceleration of the ground surface of 244 cm/sec/sec, the PGA or rate in change of motion is 25% g where:

%g= Ground Surface Acceleration/ Rate of Acceleration due to Gravity

%g= 244 cm/sec/sec/980 cm/sec/sec

%g= 25%


Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
180
100
80
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40
30
25
20
15
10
9
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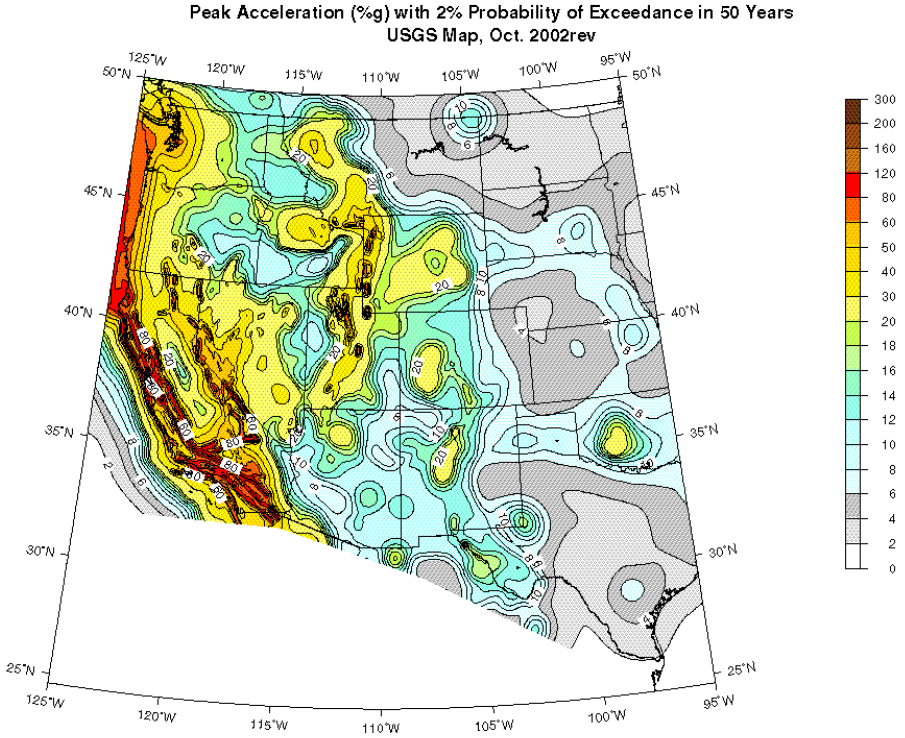
7
6
5
4
3
2
1
0


Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
300
200
160
120
80
60
50
40
30
20
18
16
14
12
10
8
6
4
2
0

POTENTIAL AFFECT:

A potential earthquake could affect water, oil and gas produced for the Uintah Basin as well as the Wasatch Front. An earthquake could affect transportation and dams. Many homes in Duchesne County were not built to meet earthquake standards. *The map on page 14 and 15 identify Epicenters and Quaternary Faults and gives an explanation for each in Duchesne County.*

HAZUS MH Vulnerability Assessment

Table 1.1 Casualties

Casualties	Nighttime –Minor	33
	Nighttime –Major	1
	Nighttime -Fatalities	1
	Daytime –Minor	31
	Daytime –Major	1
	Daytime- Fatalities	2
	Commute –Minor	28
	Commute –Major	1
	Commute-Fatalities	1

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table1.2 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 1.2 –Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	1,011
Commercial	9
Industrial	3
Totals	1,023

Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	1
Schools	16	0	0	2
EOCs	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	2	0	0	0

Debris Removal –Table 1.4 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.

A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of one yard.

Table 1.4 –Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	0.04
Loads (25 tons per load)	2,000

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 1.5 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

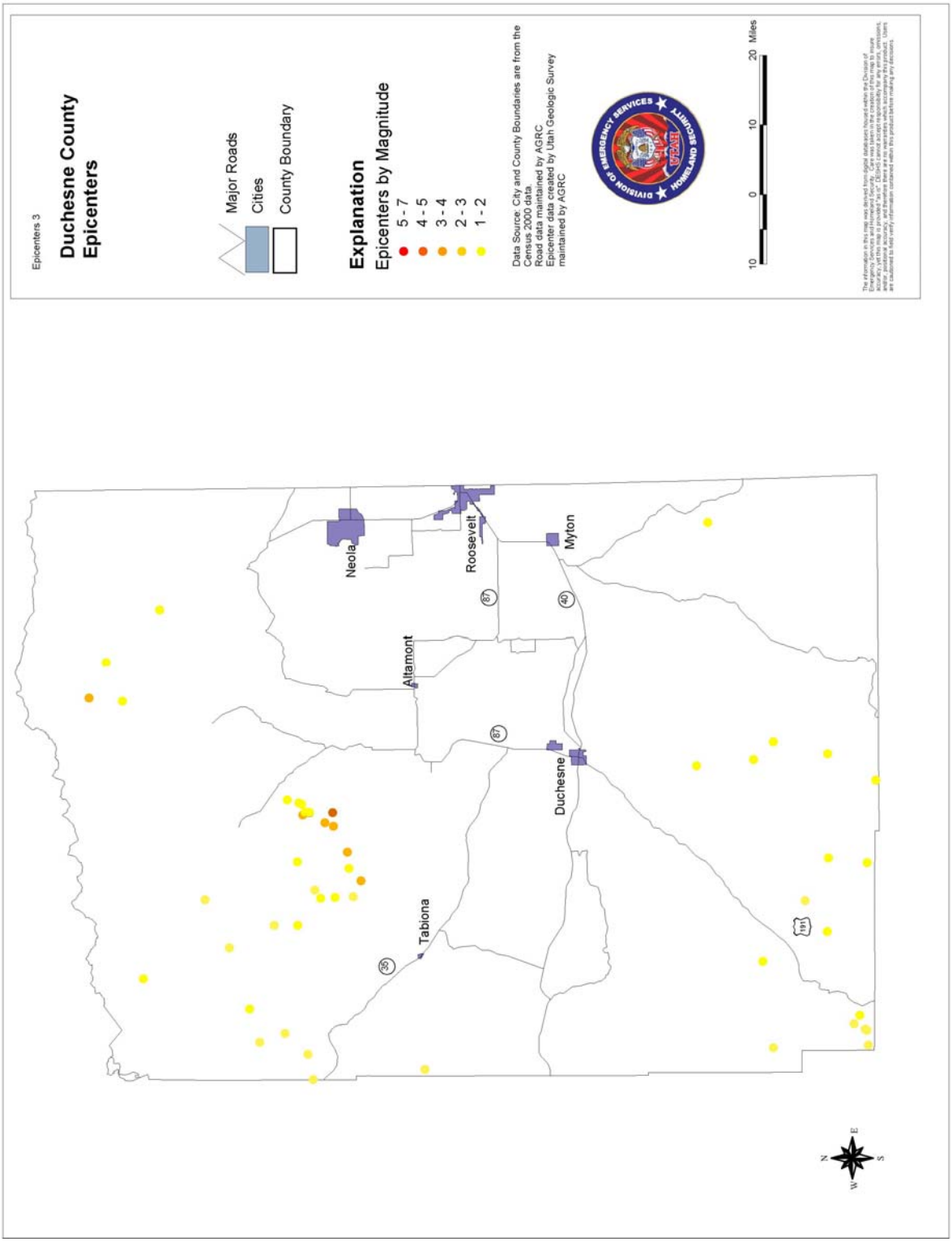
Table 1.5 –Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. *The complete HAZUS MH run for Duchesne County is available in appendix H.*

Generic Mitigation:

- Avoidance
- Build all homes and building's to meet the standards and code of earthquakes. County adopts building codes on all new construction.
- Educate the public on potential hazards.
- Working with local LEPC on exercising plans in existence.
- Educate local school systems to utilize LEPC.


Epicenters 3
Duchesne County
Epicenters
Major Roads
Cities
County Boundary
Explanation
Epicenters by Magnitude
5 - 7
4 - 5
3 - 4
2 - 3
1 - 2
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Neola
Roosevelt
Myton
Altamont
Duchesne
Tabiona
87
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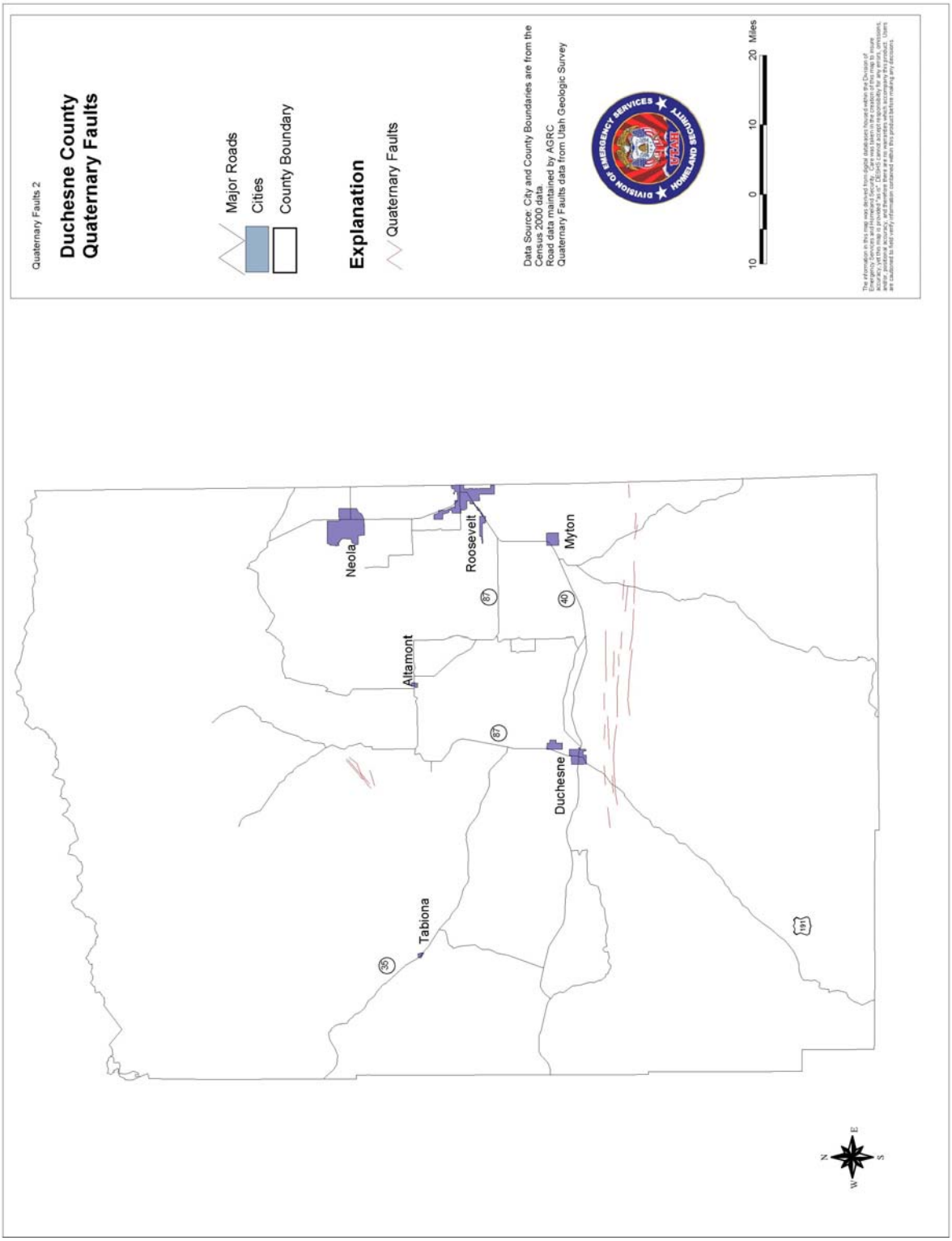

Quaternary Faults 2
Duchesne County
Quaternary Faults
Major Roads
Cities
County Boundary
Explanation
Quaternary Faults
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey
DIVISION OF EMERGENCY SERVICES AND HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Neola
Roosevelt
Myton
Altamont
Duchesne
Tabiona
40
87
35
191
N
E
S
W

NATURAL HAZARD: FLOODING

FEMA Hazard Profile for Flooding

Frequency		**Highly likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity		Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
	X	Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Flooding would affect all communities in the county that are in and along the flood plains		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring thaws		
Duration	Rainstorms can last for hours and possibly days. Spring run-off can last weeks		
Speed of Onset	Six to twelve hours		

Floods are the most common and widespread of all natural disasters except fire. Most communities in the United States have experienced some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws.

A flood, as defined by the National Flood Insurance Program is: "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from:

- Overflow of inland or tidal waters.
- Unusual and rapid accumulation or runoff of surface waters from any source, or
- A mudflow.

[The] collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood." *For a description of flooding and possible causes see the flooding section in Appendix A.*

Floods can be slow, or fast rising but generally develop over a period of days. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in mitigation steps now, such as, engaging in floodplain management activities, constructing barriers, such as levees, and purchasing flood insurance will help reduce the amount of structural damage to your home and financial loss from building and crop damage should a flood or flash flood occur.
Source: http://www.fema.gov/hazards/floods/

For more information regarding Flooding in Duchesne County see the Flood Hazard Identification Study in Appendix M.

VULNERABILITY: High
Flood plain maps were analyzed during completion of this plan. These maps were all quite dated and not geo-referenced preventing us from performing a GIS based vulnerability analysis. The Flood Hazard Identification Study completed by the Army Corps of Engineers can be found in Appendix M. This study assessed vulnerability and suggested potential mitigation projects.

Generic Mitigation:

- Avoidance
- Revise and up-date building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.
- Manufactured homes need to be installed properly and inspected.
- Enforce zoning
- Protection of roads and bridges.
- Protection of drinking water supply systems.
- Education of local officials, developers, and citizens.
- Better flood routing through communities.
- Development of improved mitigation techniques.

NATURAL HAZARD: INSECT INFESTATION

FEMA Hazard Profile for Insect Infestation

Frequency	**X**	**Highly likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	Catastrophic	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Duchesne County		
Seasonal Pattern	Spring, summer, and fall		
Duration	Not applicable		
Speed of Onset	Not applicable		

Agriculture has historically dominated the economic life of Duchesne County. The county remains a significant producer of crops and livestock. Duchesne County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation. Damage to the economic base and to the health of the citizens is also a direct result of insect infestation. Insects most notable are grasshoppers, Mormon Crickets, Bark Beetles, and mosquitoes. Currently the West Nile Virus spread by mosquitoes is a serious threat to humans and animals in Duchesne County.

Generic Mitigation:

- Avoidance
- Spread insect bait and spray for mosquitoes
- Vaccinate

NATURAL HAZARD: LANDSLIDE

FEMA Hazard Profile for Landslide

Frequency		**Highly likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity		**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
	X	**Limited**	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Dye Dugway, Indian Canyon, Ravola Dougway, and Wolf Creek Pass in Duchesne County.		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring snow thaws.		
Duration	Depending upon conditions.		
Speed of Onset	Not applicable.		

VULNERABILITY: Low
A large amount of landslides exist in Duchesne County, these landslides primarily occur on federal lands would mainly affect roads and utility distribution lines. The City of Neola has mapped landslides within its city boarders. These slides could impact a large number of structures and people.

Additionally some areas of known landslides are near city boundaries. If and when cities annex additional land they should take into account landslides.

AFFECT:
In 1983, the Dye Dugway moved and peeled off the side. Damages were approximately $50,000. Other areas that incur landslides are Indian Canyon, Ravola Dugway, and Wolf Creek Pass.

Overall Summary of Impacts
The Uintah Basin Association of Governments identified and mapped possible landslide threats to Duchesne County that would have a potential risk to pedestrians, vehicle traffic, and residential areas.
The map on page 22 illustrates Landslides and gives an explanation for Landslides in Duchesne County.

In Duchesne County there are several areas namely Indian Canyon, Ravola Dugway, and Wolf Creek Pass that could have a potential risk to pedestrians and vehicle traffic due to landslides. Based upon the information we had available at that time we were unable to come up with any hard value figures that these landslides would have on Duchesne County.

In Duchesne County there are approximately 253 residential structures at potential risk from landslide. Based upon figures provided by the Duchesne County Assessors Office, the market value of those structures is estimated to be $20,240,000. *For a description of Landslides and possible causes see the Landslides section in Appendix A.*

Structure Loss and Value as a Percentage of Total Acreage.

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost
Duchesne County	82,560	253/$20,240,000
Duchesne	1	.373/$29,840
Neola	182	7.6/$611,520

*Includes value of land.

Vulnerable Transportation Within Duchesne County

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	95.95	191,900,000
State Route 87	.268	646,818
State Route 40	.448	1,081,248

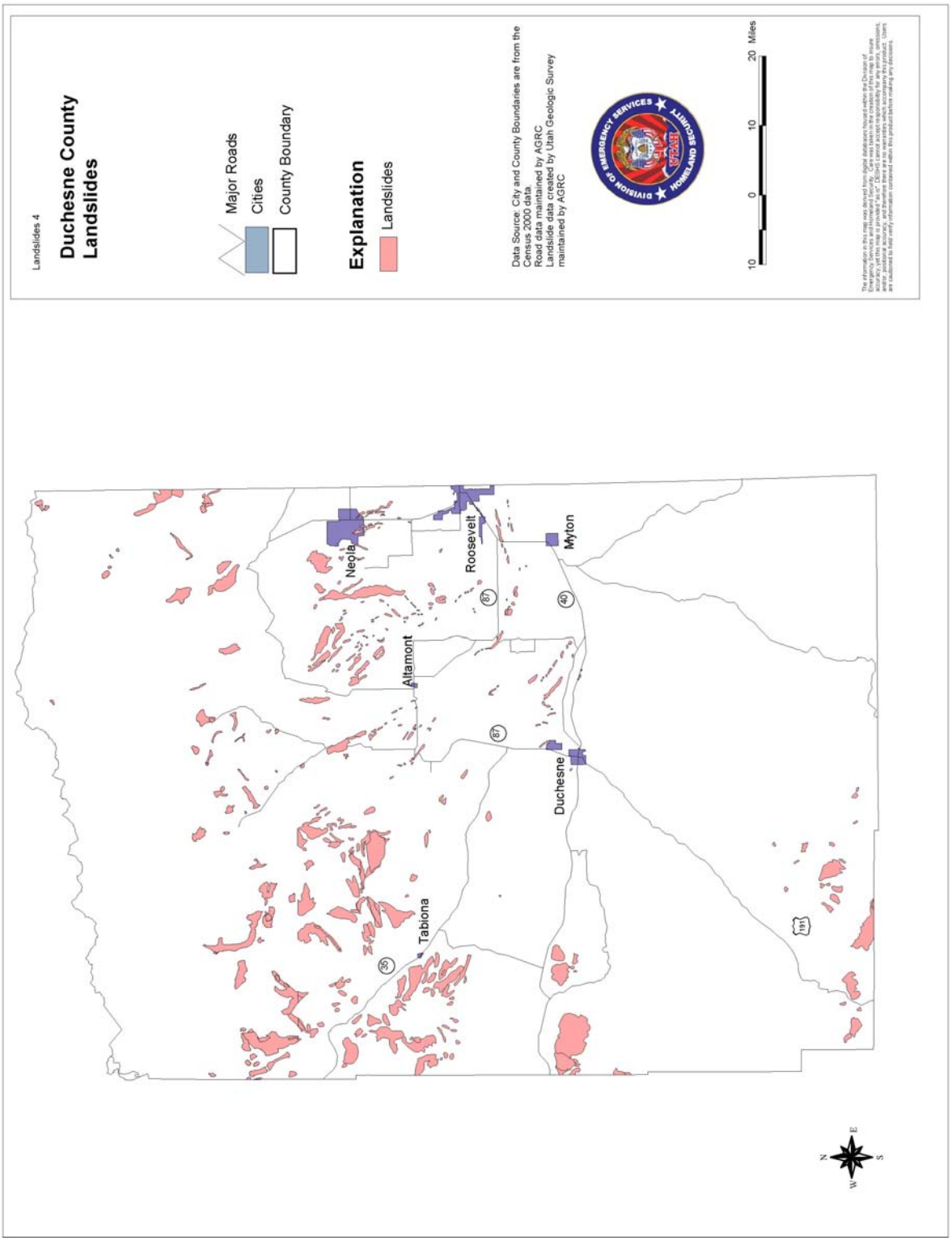
Table data represents total length of roads, which overlay historically active landslides.

Vulnerable Utilities Within Duchesne County

Name	Description	Estimated Cost
KV-138 Lines	1.929 miles	93,132
Other power lines	9.27 miles	447,555
Gas lines	1.62 miles Questar	391,051

Generic Mitigation:

- Avoidance
- Recognize landslide areas
- Zoning Ordinances
- Install surface drains
- Remove materials from the head of the landslide
- Install a pipeline for run-off.
- Seed hillsides to prevent landslides
- Re-grade


Landslides 4
Duchesne County
Landslides
Major Roads
Cities
County Boundary
Explanation
Landslides
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES & HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Neola
Roosevelt
Myton
Altamont
Duchesne
Tabiona
40
87
191
N
E
S
W

NATURAL HAZARD: WILDFIRE

FEMA Hazard Profile for Wildfire

Frequency	**X**	**Highly likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Duchesne County		
Seasonal Pattern	June through October		
Duration	Minutes to days and months		
Speed of Onset	Minimal or no warning		

There are three different classes of wild land fires. A **surface fire** is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A **ground fire** is usually started by lightning and burns on or below the forest floor. **Crown fires** spread rapidly by wind and move quickly by jumping along the tops of trees.

Wild land fires are usually signaled by dense smoke that fills the area for miles around.
Source: http://www.fema.gov/hazards/fires/

The map on page 26 illustrates fire risk and gives a wildfire explanation for Duchesne County.

A Word about Wildfires

Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk associated with alluvial fans is always of concern. Post fire revegetation and

stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

VULNERABILITY: High
Duchesne County and cities within the county are not as vulnerable to wildfire as other jurisdictions in the planning area, a risk is still exists. Some of the vegetative regimes within the county have short natural burn cycles; this is compounded by drought and non-native species of grass.

Generic Mitigation:

- The County cannot mitigate because the forest service won't allow counties to manage their land.
- Poor land management on BLM and forestlands.
- Obtain fire-fighting equipment to control wildfires in rough terrain.
- Provide wild land fire training.
- Obtain fire grant from FEMA for personnel equipment.
- Weed control.

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Duchesne	N/A	10,842	569,861	1,496,417

Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Duchesne	N/A	2.86/163,840	150.1/9,606,400

Duchesne County

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Duchesne City			659
Roosevelt City			87
Neola			552

Structures in Wildfire Area

City Name	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Duchesne City			245.8/15,731,200
Roosevelt City			40.5/2,592,000
Neola			23.18/1,483,520

*Excludes content value, which would result in, and increase of 50% to the values listed.

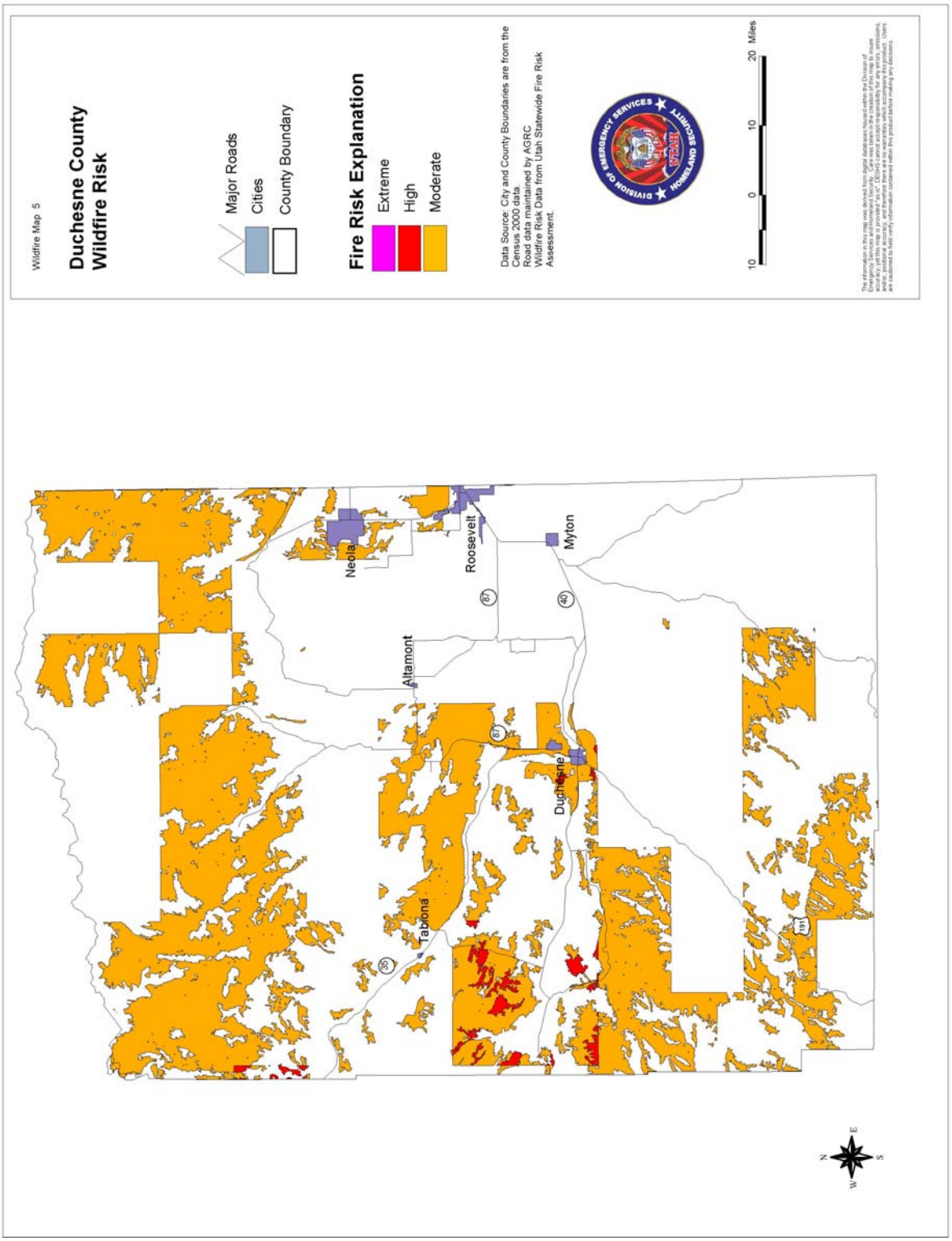
Transportation Roads, highways, and Rail Lines

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	618.918	1,237,836,000
State Route 35	1.1	2,654,850
State Route 87	13.07	31,544,445
State Route 121	.90	2,172,150
State Route 150	3.68	8,881,680
State Route 191	4.88	11,777,880
State Route 208	5.85	14,118,975
State Route 311	2.59	6,250,965

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Utilities

Name	Description	Estimated Cost
KV-138	6.01 miles	290,162
Uncoded Power lines	46.27 miles	2,233,915
Mono Lake Plant	Power Generation	10,000,000
Gas lines	9.37 miles of Questar	2,261,824


Wildfire Map 5
Duchesne County
Wildfire Risk
Major Roads
Cities
County Boundary
Fire Risk Explanation
Extreme
High
Moderate
Data Source: City and County Boundaries are from the Census 2000 data.
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.
DIVISION OF EMERGENCY SERVICES & HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Neola
Roosevelt
Myton
Altamont
Duchesne
Tabiona
40
87
191
N
E
S
W

Mitigation Capabilities of Duchesne County

This portion of the Plan assesses Duchesne County's current capacity to mitigate the effects of the natural hazards identified within the plan. The assessment includes an examination of the following local government capabilities:

1. Staff & Organizational Capability
2. Technical Capability
3. Development Trends
4. Fiscal Capability
5. Policy and Program Capabilities
6. Political Willpower

The capabilities assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for Duchesne County to pursue under this Plan, but also ensures that those goals and objectives are realistically achievable under given local conditions.

1. Staff and Organizational Capability

Duchesne County has **Very Limited** staff and organizational capability to implement hazard mitigation strategies. Duchesne County is Utah's 15th most populated county, containing only 14,759 people. While the County has a number of professional staff members to serve residents and carry out day-to-day administrative activities, much of the staff is part time or is tasked with numerous duties.

The County of Duchesne does have an Emergency Manager who is responsible for the mitigation, preparedness, response and recovery operations that deal with both natural and man-made disaster events.

2. Technical Capability

Duchesne County has **very limited** technical capability to implement hazard mitigation strategies.

Technical Expertise

Duchesne County does have an, emergency manager to administer the County's hazard mitigation programs. The County does not have a licensed engineer or related technical expert on staff, and has in the past relied upon outside contractors/consultants to perform a majority of any required technical work.

Internet Access

Duchesne County does provide its employees and citizens with high speed broadband Internet. Internet access opens up an enormous door for local officials to keep abreast of the latest information relative to their work and makes receiving government services more affordable and convenient. It is believed that Internet access will help further the County's hazard mitigation awareness

programs, but should be supplemented with more traditional (and less technical) means as well.

3. Development Trends

Agriculture has historically dominated the economic life of Duchesne County. The county remains a significant producer of crops and livestock. However, during the second half of the 20th Century, the development of oil and gas reserves provided an important boost to the economy, and this industry remains a major contributor to growth. Other expanding industries include government and trade. Duchesne County includes part of the tribal lands of the Uintah-Ouray Indian Reservation. New retail and service developments on tribal lands help sustain the Native American population and add to the economic vitality of the area.
For the third consecutive quarter, nonfarm employment in Duchesne County reported a year-over decline. Second quarter data for 1999 showed a decrease of 4.2 percent. Slowdowns in oil and gas activity continue to stymie economic growth in the area. Duchesne County's unemployment rate jumped from 7.2 percent in second quarter 1998 to 8.4 percent in second quarter 1999, one of the highest rates in Utah.

Slower economic growth has slowed the demand for construction in Duchesne County. The total valuation of second quarter permit-authorized construction slipped from $6.8 million in 1998 $4.6 million in 1999. Residential construction continued to slow, as new dwelling unites fell from 88 to 73. The value of residential construction declined from $5.2 million to $3.4 million. Nonresidential building slowed from building slowed from $1.0 million in 1998 to $820,600 in 1999 as fewer nonresidential projects were authorized. Total additions, alternations, and repairs dropped 29.2 percent in valuation; however, renovations to commercial structure did improve slightly. *For more information regarding Duchesnes County's development trends see Appendix L.*

4. Fiscal Capability

Duchesne County has **very limited** fiscal capability to implement hazard mitigation strategies.

5. Policy and Program Capability

Emergency Operations Plan

Duchesne County has developed and adopted an Emergency Operations Plan, which predetermines actions to be taken by government agencies and private organizations in response to an emergency or disaster event. The Plan was last updated in 1997. For the most part, the Plan describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster.
The Plan does not specifically address hazard mitigation, but it does identify the specific operations to be undertaken by the County to protect lives and property immediately before, during and immediately following an emergency. There are

no foreseeable conflicts between this Hazard Mitigation Plan and Duchesne County's Emergency Management Plan, primarily because they are each focused on two separate phases of emergency management (mitigation vs. preparedness and response).

Emergency Management Program
Duchesne County has an emergency manager and active emergency management program. One of the four phases of emergency management is mitigation, and the county as implemented low or no cost mitigation.

Floodplain Management Plan
Although Duchesne County currently participates in the National Flood Plain Insurance Program they do not have a current Floodplain Management Plan. However, this Disaster Mitigation Plan recommends that Duchesne County work on updating and/or revising their Floodplain Management Plan.

Stormwater Management Plan
Duchesne County Currently has no formal Storm water Management Plan.

County Ordinances
The Duchesne County currently does not have any county ordinances that address natural disasters. However, a member of the planning committee was in attendance at our Natural Disaster meetings and agreed to work on implementing and adopting new County Ordinances that are relevant to hazard mitigation.

6. Political Willpower
Most Duchesne County residents are quite knowledgeable about the potential hazards that their community faces. Recent wildfires have increased the understanding and need for mitigation within the government structure of Duchesne County.

The Uintah Basin Association of Governments used historical data to estimate to the best of their ability (with the data available at the time) the potential dollar losses if the County were to experience flooding and wildfires, the two most likely hazards to occur in the County. The estimated costs are as follows:

Potential flood losses:

- Residential properties (including senior citizens home): Depending upon the location of the flood, losses could result into millions of dollars. *Approximately; 4 to 5 million dollars*
- Local Hospital: The local Hospital in Duchesne County is located in Roosevelt City, which currently does not have a flood plain map. However, it is not likely that potential floods would affect the hospital. Past floods that have occurred in Duchesne County have not affected the

Hospital. Minimal damages would occur if the Hospital were affected by potential flooding. *Approximately; $100,000.00*

- Schools: The Schools located in Duchesne City, are likely to be affected by a flood. The elementary school and the High School are located in the flood plain. *Approximately; 4 to 5 million dollars*
- Communication utility company: Due to the fact that the communications and the utility companies are not located in the flood plain minimal damages would result from a flood. *Approximately; $100,000.00*
- Waste water treatment plant: It is not likely that the wastewater treatment plant would have any damages due to flooding. *Approximately; $100,000.00*

Potential wildfire losses:

- Residential properties: Depending upon the location of the flood, losses could result into excess of millions of dollars. *Approximately; 4 to 5 million dollars*
- Hospital: The Duchesne County Hospital would have minimal damages if any that would result from potential wildfire losses. *Approximately; $100,000.00*
- Secondary School: Duchesne County does have a couple of school systems located on the outskirts of the County that could have potential damages due to wildfires. *Approximately; 1 to 2 million dollars*

Duchesne County

The Duchesne County Disaster Mitigation Planning committee, which consists of one County Commissioner, the Mayor of Duchesne, the Mayor of Altamont, the Mayor of Tabiona, the Roosevelt City Manager, the Mayor of Myton, the County Emergency Manager in conjunction with the Uintah Basin Association of Governments meet on several different occasions to review and analyze the risk assessment studies that were performed for the County. The goals listed were determined to be those goals that would have the greatest benefit in hazard reduction to the County. The goals, objectives and actions represent a long-term vision for hazard reduction or enhancement of mitigation capabilities. Listed below is our definition of goals and objectives.

Goals: General guidelines that explain what you want to achieve. They are usually long-term and represent global visions, such as "eliminate flood damage."

Objectives: Define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific, measurable, and have a defined completion date. Objectives are more specific, such as "adopt a zoning ordinance prohibiting new development in the floodplain."

The Duchesne County Disaster Mitigation Planning Committee and the Uintah Basin AOG Mitigation Planner decided upon the following goals, objectives, action items, and priorities for each of the natural hazards. The priorities for each hazard are ranked in the following order: High, Medium, and Low. Each hazard is ranked by order of importance; however, this does not mean the ranking of each hazard will not potentially change over time.

Mitigation Strategies

Dam Failure

Duchesne County

GOAL 1: Help reduce future flooding in Duchesne County due to dam failure.
Problem Identification: Reduce down stream loss in Duchesne County due to dam failure.

High Priority

Objective 1.1

- Use technology to aid in prevention of flood loss due to dam failure

Action 1.1.1:

- Digitize high hazard dam failure inundation maps

  Time Frame: ongoing
  Funding: state government
  Estimated Cost: 500 dollars per dam
  Staff: Utah Dam Safety Section, and AGRC

Action 1.1.2:

- Update Emergency Operations Plan to include GIS dam failure estimates

  Time Frame: Next EOP update
  Funding: County
  Estimated Cost: Undetermined
  Staff: County GIS and Emergency Manager

Action 1.1.3:

- Educate the local elected officials, developers, and citizens.

  Time Frame: Within the next two years
  Funding: County
  Estimated Cost: Minimal
  Staff: County employees

Action 1.1.4

- Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**

  Time Frame: Ongoing
  Funding: FEMA, State and Local
  Estimated Cost: Unknown
  Staff: State and Local

Action 1.1.5:

- Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.

  Time Frame: Ongoing
  Funding: Town and County funds
  Estimated Cost: minimal
  Staff: Water surveyor and newsletter editor

Background: Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to down stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Duchesne County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.

Drought

Duchesne County

GOAL 1: Reduce water loss within Duchesne County due to drought.
Problem Identification: Current, past and future drought issues within Duchesne County.

High Priority

Objective 1.1

- Conserve culinary water by educating the public

Action 1.1.1:

- Educate the public on the need to be water wise

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: Use a newsletter to educate the public

Objective 1.2:
- Develop more water storage tanks within the County

Action 1.1.2:
- Conduct a feasibility study

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Action 1.1.3:
- Install new wheel lines to improve the water efficiency.

Time Frame: Ongoing
Funding: Federal, and State funding
Estimated Cost: Unknown
Staff: NRCS, UACD, USU, Extension, ect.

Action 1.1.4:
- Implement and enforce water laws that prohibit the use of extensive amounts of water.

Time Frame: Ongoing
Funding: County funds
Estimated Cost: Unknown
Staff: Water surveyor and newsletter editor

Drought

Altamont Town

GOAL 1: Reduce water loss within the town of Altamont.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: Town funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Altamont Town Staff, Professional Services, and Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The Town should continue to maintain and implement a tiered water rate structure.

Duchesne City

GOAL 1: Reduce water loss within Duchesne City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined

Staff: City Staff, Professional Services, and Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The City should continue to maintain and implement a tiered water rate structure.

Myton City

GOAL 1: Reduce water loss within Myton City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Myton City Staff, Professional Services, and Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds

Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The City should continue to maintain and implement a tiered water rate structure.

Roosevelt City

GOAL 1: Reduce water loss within Roosevelt City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Roosevelt City staff, Professional Services, Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The City should continue to maintain and implement a tiered water rate structure.

Tabiona Town

GOAL 1: Reduce water loss within the town of Tabiona.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: Town funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Tabiona Town Staff, Professional Services, and Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: Town and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The Town should continue to maintain and implement a tiered water rate structure.

Earthquake

Duchesne County

GOAL1: Provide public awareness regarding earthquakes.
Problem Identification: Transportation and utilities services could be severely impacted.

High Priority

Objective 1.1

- Provide for emergency response and relief.

Action 1.1.1:

- Identify and maintain critical transportation and utility services.

Time Frame: ongoing
Funding: Local governments and possible grants

Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: Town staff.

Background: Critical transportation systems

Objective 1.2
- Public Awareness

Action 1.1.2:
- Conduct a public awareness campaign.

Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown
Staff: Agency personnel and volunteers

Background: Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.

Duchesne County

Goal 2: Identify the number of seismically unsafe structures within the County.
Problem Identification: Unknown number of seismically unsafe structures around the county.

High Priority

Objective 1.1
- Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.

Action 1.1.1:
- Structural and non-structural earthquake hazard assessment.

Time Frame: ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Critical transportation systems

Flooding

Duchesne County

GOAL 1: Reduce flood damage in Duchesne County.
Problem Identification: Control flooding in residential areas of Duchesne County, Including but not limited to the Town of Altamont, Duchesne City, Roosevelt City, and the town of Tabiona. Flooding occurs from heavy rains and fast moving thunderstorms. *For more information regarding Flooding in Duchesne County see the Flood Hazard Identification Study in Appendix M.*

High Priority

Objective 1.1:
- Obtain Aerial photography with contours of each residential area in Duchesne County.

Action 1.1.1:
- Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: Ongoing
Funding: Local, State and Federal grants
Estimated Cost: Unknown
Staff: State, Local, and possibly Federal

Background: Aerial Topography is needed for master storm drainage design.

Objective 1.2:
- Design master storm drainage plans for residential areas.

Action 1.1.2:
- Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.

Background: Engineers design master storm drainage plans for the residential areas.

Objective 1.3:
- Implement storm drainage plans throughout the residential areas of Duchesne County.

Action 1.1.3:

- Implement storm drainage plans throughout the residential areas of Duchesne County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the finals plans and what is required for facilities
Staff: County and contracted staff

Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Altamont Town

GOAL 1: Reduce flooding in the town of Altamont.
Problem Identification: Control flooding in the Town of Altamont. Flooding occurs from heavy rains and fast moving thunderstorms.

High Priority

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the town of Altamont.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and Town Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the Town Ordinances that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.3:

- Town building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away..

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.4:

- Town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and Town with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time

Staff: County and Town Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Background: Past and future flooding

Duchesne City

High Priority

GOAL 1: Reduce flooding in Duchesne City.
Problem Identification: Control flooding in Duchesne City. Flooding occurs from heavy rains and fast moving thunderstorms.

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Duchesne City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:

- County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.4:

- County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Myton City

High Priority

GOAL 1: Reduce flooding in Myton City.
Problem Identification: Control flooding in Myton City. Flooding occurs from heavy rains and fast moving thunderstorms.

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Myton City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:

- County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.4:

- County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Roosevelt City

High Priority

GOAL 1: Reduce flooding in Roosevelt City.

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Roosevelt City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the County and City Ordinances that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:

- County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.4:

- County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time

Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Tabiona Town

High Priority

GOAL 1: Reduce flooding in the Town of Tabiona.

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the town of Tabiona.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and town Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the County and Town Ordinances that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers
Background: Past and future flooding

Action 1.1.3:

- County and town building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away..

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.4:

- County and town building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.

Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and Town with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Insect Infestation

Duchesne County

GOAL 1: Reduce insect infestation
Problem Identification: Duchesne County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation.

Priority High

Objective 1.1

- Reduce the impact of insects

Action 1.1.1:

- Spread insect bait and spray for mosquitoes

Time Frame: When required
Funding: Town and County funds, Mosquito abatement funds come from property tax
Estimated Cost: Approximately $3.00 per property owner per month
Staff: County Mosquito Abatement District

Objective 1.2:

- Reduce the severity of infestations

Action 1.1.2:

- Apply for grants to purchase Mosquito magnets and propane tanks to run the magnets.

Time Frame: Spring and summer of 2004
Funding: $6,000.00 in grants
Estimated Cost: $6,000.00
Staff: County employees

Background: Several agricultural fields surround Duchesne County; these fields have been subjected to insect infestation especially during the recent years of drought.

Objective 1.3:

- Reduce the threat of West Nile Virus within Duchesne County

Action 1.1.3:

- Educate the public on the importance of vaccinating their animals.

Time Frame: Spring and summer of 2004
Funding: State and local funding
Estimated Cost: minimal
Staff: County employees

Background: Several of the Duchesne County residents have horses that could be affected by the west nile virus.

Duchesne County

GOAL 1: Reduce grasshopper infestations.
Problem Identification: Periodic Grasshopper infestations more sever in the rural areas of Duchesne County.

High Priority

Objective 1.1:

- Reduce the severity of infestations

Action 1.1.1:

- Conduct aerial spraying to reduce infestations.

Time Frame: As infestations occur
Funding: By private individuals in most cases
Estimated Cost: Varies, depending on acreage treated
Staff: Contractor

Background: Many agricultural fields surround Duchesne County. These fields have been subjected to insect infestation especially during the recent years of drought.

Landslide

Duchesne County

GOAL 1: Protect residential areas from potential landslides.
Problem Identification: There is a potential risk to residential and commercial buildings due to rockslides, which are located in areas identified by the county as landslide risk areas.

High Priority

Objective 1.1

- Reduce potential landslides to residential and commercial areas.

Action 1.1.1:

- Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Action 1.1.2:

- The county's, city's and town's planning committee will review and update the zoning ordinances within the County to make sure that individuals are not constructing new homes near potential landslide areas.

Time Frame: Undetermined
Funding: Unknown
Estimated Cost: Unknown

Staff: Unknown

Background: Hold monthly planning and zoning meetings within the town and county.

Duchesne County

GOAL 2: Protect vehicle traffic from future accidents due to landslides.
Problem Identification: In Duchesne County there are several areas namely Indian Canyon, Ravola Dugway, and Wolf Creek Pass that could have a potential risk to pedestrians and vehicle traffic due to landslides.

High Priority

Objective 1.1

- Reduce potential landslides to residential and commercial areas.

Action 1.1.1:

- Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Severe Weather

Duchesne County

Goal 1: Reduce Structural damage to both residential and commercial buildings due to Severe Weather.
Problem Identification: Duchesne County experiences occasional, damaging high winds and snowstorms.

High Priority

Objective 1.1

- Reduce damage to structures through strict adherence to building codes

Action 1.1.1:

- Ensure that 80 MPH wind load requirement is met by builders

Time Frame: Ongoing
Funding: Fees from Building permits
Estimated Cost: Minimal
Staff: Building Inspector

Background: Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events

Duchesne County

Goal 2: Provide protection for citizens regarding power line failure.
Problem Identification: Power lines are at risk from seasonal high winds.

Priority High

Objective 1.1

- Reduce service disruptions and damage to power lines

Action 1.1.1:

- Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.

Time Frame: Ongoing
Funding: Possible Grants
Estimated Cost: To be determined
Staff: County and town employees

Background: Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.

Wildfire

Duchesne County

Goal: Reduce the threat of wildfires within Duchesne County.
Problem Identification: Continuing non-compliance with existing building codes and fire codes.

High Priority

Objective 1.1

- Increase compliance with existing building and fire codes.

Action:

- Develop and enforce current local, state and national codes

Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Duchesne County

Goal 1: Reduce wildfire danger within the County.
Problem Identification: Specific areas of the county are susceptible to wildland fire danger.

Objective 1.2

- Educate homeowners on how to reduce risk of wildfire damage

Action 1.1.2:

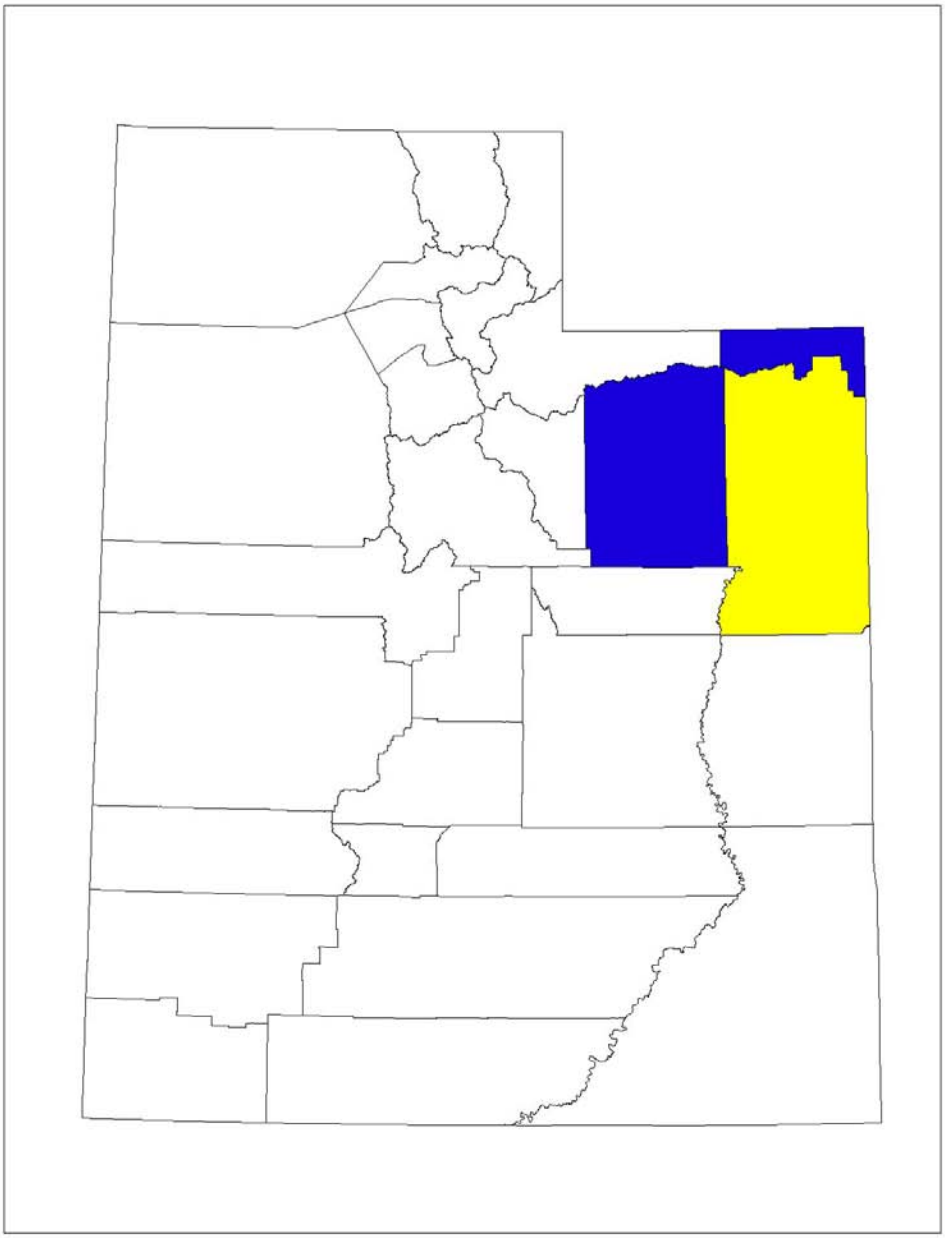
- The local LEPC will provide semi-annual training for the citizens of Duchesne County.

Time Frame: Starting 2004
Funding: State and local
Estimated Cost: Minimal
Staff: County
Background: Educate the public on how to reduce the risk of wildfires.

Annex 4-Uintah County

Uintah County Annex

Figure 1: Tri-county map



UINTAH COUNTY

Past Hazard Events in Uintah County

Understanding the past is often the key to discovering what the future holds; this is especially true when planning for natural disasters. The fact that cities within Uintah County have experienced, for example, flooding in the past means flooding can occur in the future. While over time some of this has been mitigated for the low frequency of occurrence often results in hazards with little or no mitigation. Table 1 provides a brief history of Uintah County natural disasters. This table includes only sizable events found during our research, and may not represent the total history.

Table 1 Uintah County Natural Disaster History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flash flood	September 1, 1909	Ashley River near Vernal	1 Death	Man crossing Ashley Creek with a wagon
Flash flood	July 4, 1925	Five Mile Canyon near Vernal	1 Death	Child swept from automobile
Flood	August 9, 1941	Vernal/Jensen	Approximately $75,000.00 to crops was caused by heavy rain and hail. Red Wash bridge damaged	No loss of life
Flood	August 25, 1955	Lapoint	$3,000.00 in damage to bridges and roads	No loss of life
Flood	July 30, 1956	Jensen	$25,000 damage to farmlands and crops	No loss of life
Flood	June 10, 1965	Maeser/Ouray	Damage to homes, crops, and waterlines	Source: Ashley Creek, Dry Fork, The Green, White, and Duchesne rivers

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood	1983	County Wide	Limited	Source
Wildfire	July 23, 1988	Green River Fire	Unknown	No loss of life
Wildfire	September 17, 1992	Diamond Mountain Bonus	Unknown	No loss of life
Wildfire	August 16, 1996	Diamond Rim #2	Unknown	No loss of life
Wildfire	June 25, 1999	Walsh Knolls	1096 Acres	No loss of life
Wildfire	June 27, 1999	WhiteRocks	Unknown	No loss of life
Wildfire	March 26, 2000	Max Assist	Unknown	No loss of life
Wildfire	May 29, 2000	Sweetwater Complex	3700 Acres	No loss of life
Wildfire	July 28, 2000	Pot Creek	Unknown	No loss of life

Uintah County identified six natural hazards they wanted addressed in the Uintah County portion of this multi-jurisdictional plan. Through input of the planning committee the following hazards were identified:

- Dam Failure
- Earthquakes
- Flooding
- Insect Infestation
- Landslides
- Wildfire.

In identifying these hazards the Uintah County PDM planning committee relied on technical experts, public input, research of past events and completed plans, and risk assessments completed by the county emergency manager for there Pre-Disaster Mitigation Plan.

The Uintah County Disaster Mitigation Planning committee consisted of one County Commissioner, the County Emergency Manager, the Vernal City Planner, the Naples City Manager, and Ballard City and the Uintah Basin Association of Governments planning coordinator.

The Disaster Mitigation Plan for Uintah County identifies critical facilities located in the County *(See Appendix B).* A critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the County, or fulfills important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in the County were not located in the natural hazard area. *The Uintah Basin Association of Governments did not map the location of the critical facilities in Uintah County. Through GIS analysis no critical facilities were found in the hazard area.*

NATURAL HAZARD: DAM FAILURE

FEMA Hazard Profile for Dam Failure

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire county		
Seasonal Pattern	Spring		
Duration	Several months to over one year		
Speed of Onset	Range from 35 minutes to three hours		

A Word About Dams

Dams are a critical support function for water managers in the State and also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 117 dams within Uintah Basin of these 20 have received an high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years. *For a description of dam failure and possible causes dams failure in Uintah County see the Flood Hazard Identification Study in Appendix M.*

VULNERABLIITY: High
Low-lying areas down stream from dams are at risk. Under lying geologic conditions in the planning area create difficulties during dam construction. Dams in similar geologic setting in the state have failed in the past; Trial Lake Dam is an example. The aged fractured rock of the Uinta Mountain range contains numerous passages for water through the dams. During dam building these fractures require extensive engineering and grouting.
Description of Hazard

The following high hazard dams exist within Uintah County according to the Utah Division of Dam Safety database.

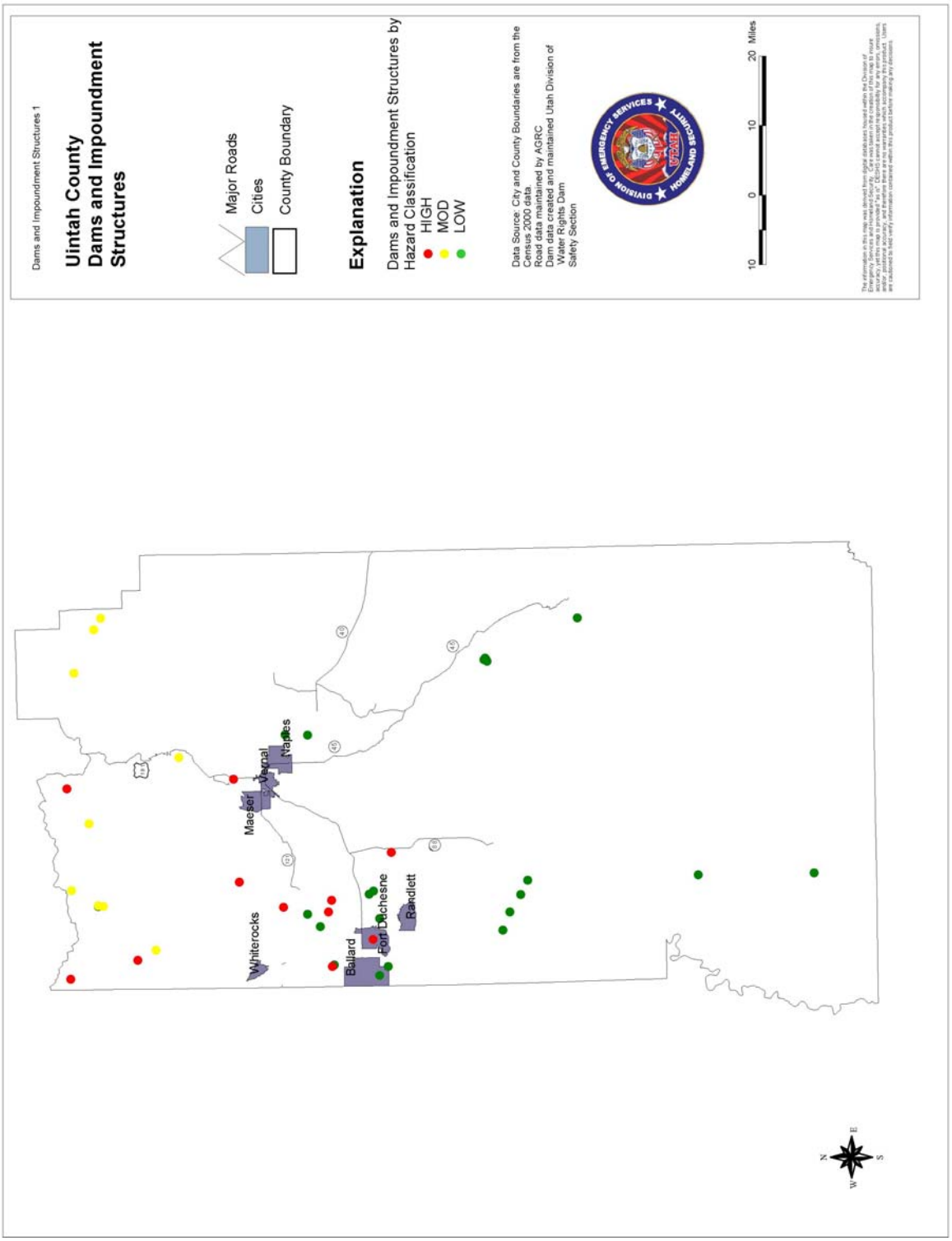
- Brough
- Whiterocks
- East Park
- Paradise Park
- Bullock Draw
- Lapoint
- Montes Creek
- Cottonwood
- Steineker
- Red Fleet

The map on page 7 illustrates the location of each dam.

Low lying areas down stream of these dams are particularly at risk, if a dam were to fail. *For a description of dam failure and possible causes see the dams failure section in Appendix A.*

Generic Mitigation:

- Proper mapping of flood plains, including mapping of dam breach flood potential.
- Knowledge must be made public so that emergency managers are aware and the public is aware when they buy and sell property.
- Updated Emergency Action Plans (EAP) and integration with GIS Systems.
- Maintaining proper flood plain and wetland geometry and vegetation will help route floods.
- Flood plain usage should be compatible with flood plain needs.
- More debris dams would help with floods and debris, and mud, and maintaining a flood control pool in existing dams would be beneficial.
- Protection of roads and bridges.
- General infrastructure protection.
- More authority to order releases and better forecasting would help in snowmelt floods and runoff.
- Gather hazard and risk data/information.
- Development of improved mitigation techniques.
- Education of local officials, developers, and citizens.


Dams and Impoundment Structures 1
Uintah County
Dams and Impoundment
Structures
Major Roads
Cities
County Boundary
Explanation
Dams and Impoundment Structures by
Hazard Classification
HIGH
MOD
LOW
Data Source: City and County Boundaries are from the
Census 2000 data
Road data maintained by AGRC
Dam data created and maintained Utah Division of
Water Rights Dam
Safety Section
DIVISION OF EMERGENCY SERVICES
HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Maeser
Vernal
Naples
Whiterocks
Ballard
Fort Duchesne
Randlett
N
W
E
S

NATURAL HAZARD: EARTHQUAKE

FEMA Hazard Profile for Earthquake

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Entire county		
Seasonal Pattern	Near fault lines located in the County		
Duration	Months and possibly years		
Speed of Onset	Minimal or no warning		

An earthquake is a sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the Earth's surface. This shaking can cause buildings and bridges to collapse; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill, old waterways, or other unstable soil are most at risk. Buildings or trailers and manufactured homes not tied to a reinforced foundation anchored to the ground are also at risk since they can be shaken off their mountings during an earthquake. Earthquakes can occur at any time of year.
Source: http://www.fema.gov/hazards/earthquakes/

For a description of earthquakes and possible causes see the earthquake section in Appendix A.

The Diamond Gulch Fault in Uintah County is the only source area for a large magnitude earthquake. Uintah County is similar to the other counties within the

Uintah Basin and has a low seismic hazard, as it is uncertain if the Diamond Gulch Fault has moved during the quaternary period.

VULNERABILITY: Low

The map on page 10 shows the national Peak Ground Acceleration (PGA) values for the United States with a 10% chance of being exceeded over 50 years. This is a common earthquake measurement that shows three things: the geographic area affected (all colored areas on the map), the probability of an earthquake of each given level of severity (10% chance in 50 years), and the severity (the PGA is indicated by color). ***2. Locate your planning area on the map.***

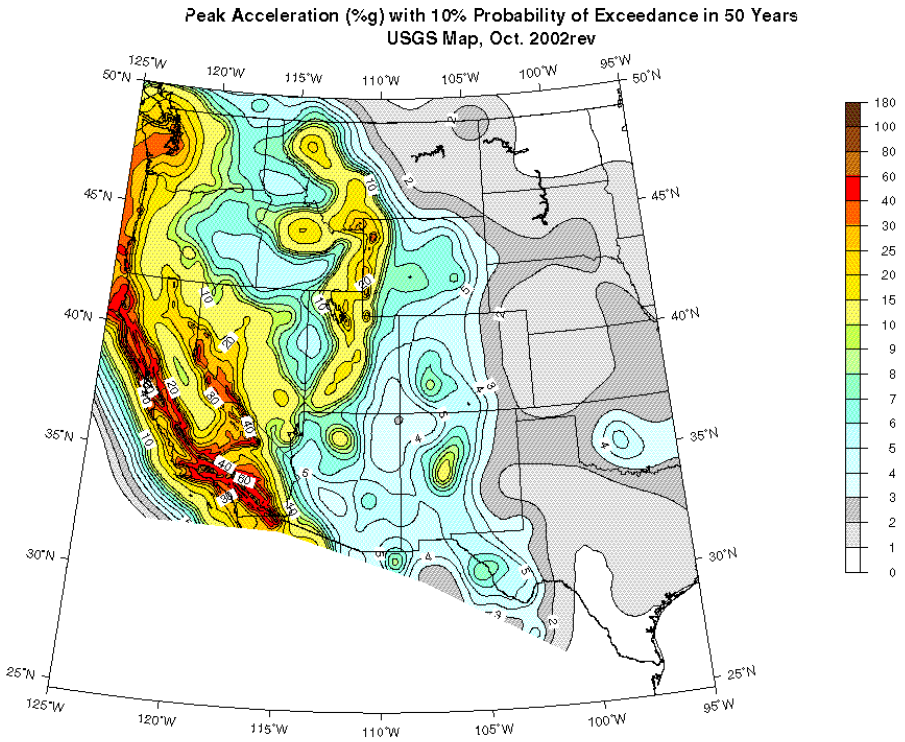
You can also generate maps based on zip codes or longitude and latitude by following the directions on the Website. ***3. Determine your Peak Ground Acceleration.***
Determine the PGA zone(s) in which your planning area is located. This is done by identifying the color associated with your planning area and correlating it with the color key located on the map. Large planning areas may be located in more than one zone.

Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (g) (980 cm/sec/sec). For example, in an earthquake with an acceleration of the ground surface of 244 cm/sec/sec, the PGA or rate in change of motion is 25% g where:

%g= Ground Surface Acceleration/ Rate of Acceleration due to Gravity

%g= 244 cm/sec/sec/980 cm/sec/sec

%g= 25%


Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
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1
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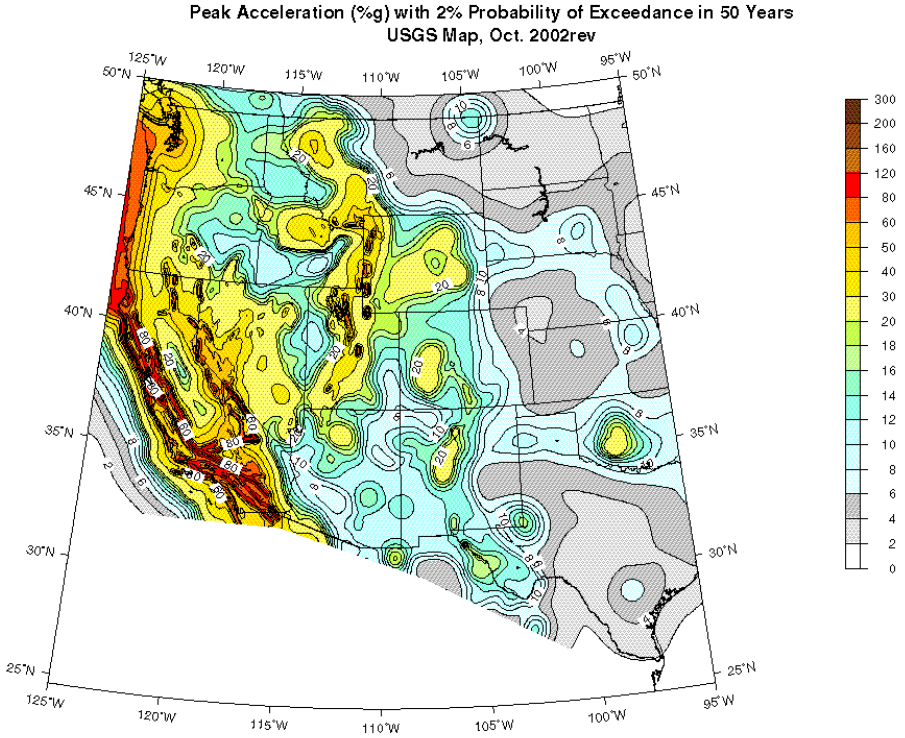

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
300
200
160
120
80
60
50
40
30
20
18
16
14
12
10
8
6
4
2
0

AFFECT:

The Diamond Gulch Fault in Uintah County is the only source area for a large magnitude earthquake. Uintah County is similar to the other counties within the Uintah Basin and has a low seismic hazard, as it is uncertain if the Diamond Gulch Fault has moved during the quaternary period.

POTENTIAL AFFECT:

A potential earthquake could affect water, oil and gas produced for the Uintah Basin as well as the Wasatch Front. An earthquake could affect transportation and dams. Many homes in Uintah County were not built to meet earthquake standards. *The map on page 14 and 15 identify Epicenters and Quaternary Faults and gives an explanation for each in Uintah County.*

HAZUS MH Vulnerability Assessment

Table 1.1 Casualties

Casualties	Nighttime –Minor	57
	Nighttime –Major	1
	Nighttime -Fatalities	2
	Daytime –Minor	52
	Daytime –Major	1
	Daytime- Fatalities	2
	Commute –Minor	48
	Commute –Major	1
	Commute-Fatalities	2

Buildings/Structures

Building Damage by Count -- Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table1.2 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage.

Table 1.2 –Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	731
Commercial	29
Industrial	10
Totals	770

Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	0	0	1
Schools	10	0	0	0
EOCs	1	0	0	1
Police Stations	3	0	0	0
Fire Stations	2	0	0	0

Debris Removal –Table 1.4 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour.

A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of one yard.

Table 1.4 –Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	0.04
Loads (25 tons per load)	2,000

Fire Following --The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 1.5 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 1.5 –Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	8
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. *The complete HAZUS MH run is available in Appendix H.*

Generic Mitigation:

- Build all homes and building's to meet the standards and code of earthquakes. County adopts building codes on all new construction.
- Educate the public on potential hazards.
- Working with local LEPC on exercising plans in existence.
- Educate local school systems to utilize LEPC.

Generic Ground Shaking Mitigation

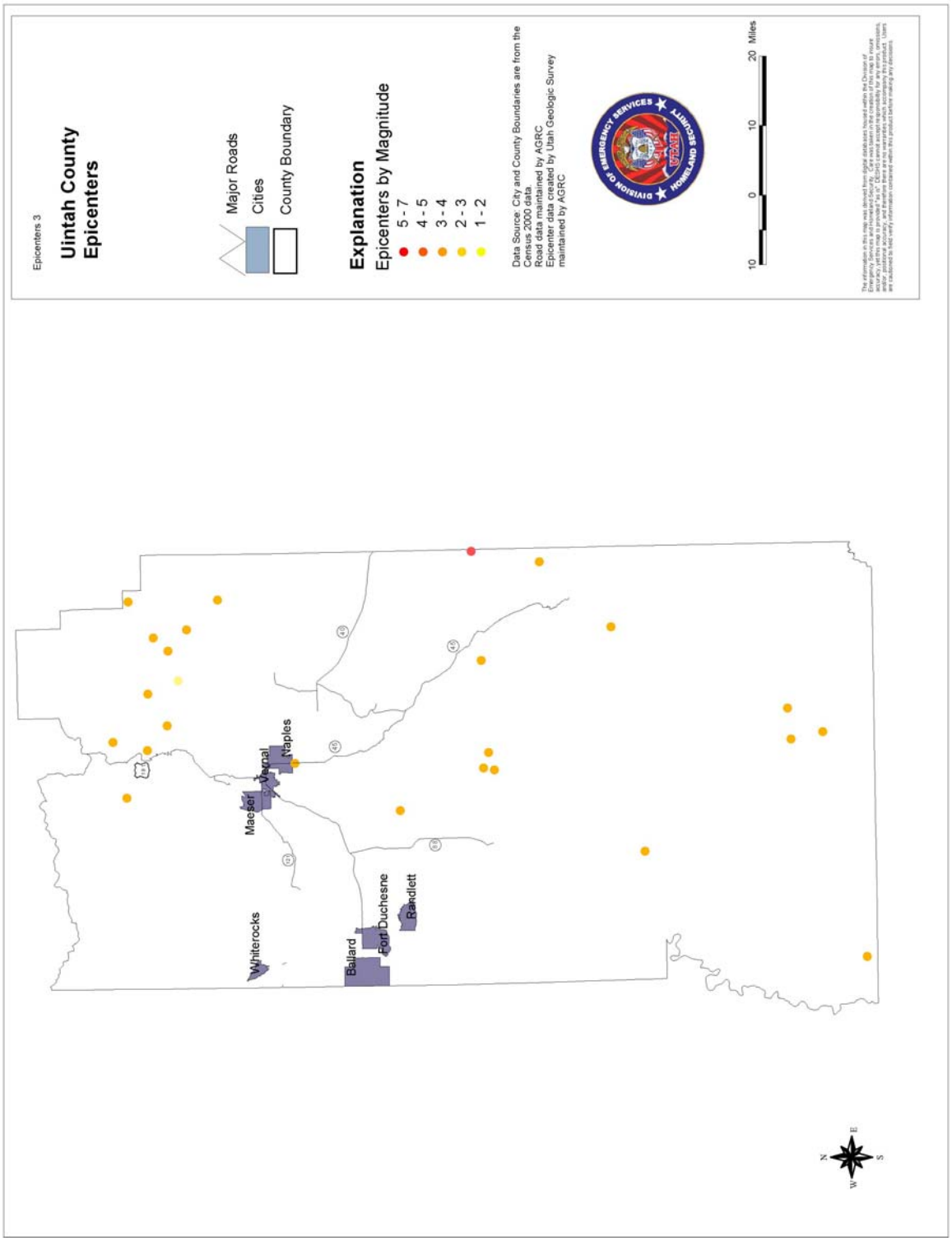
- Understand peak horizontal acceleration and recurrence interval.
- Design appropriately.
- Zoning ordinances and building codes.

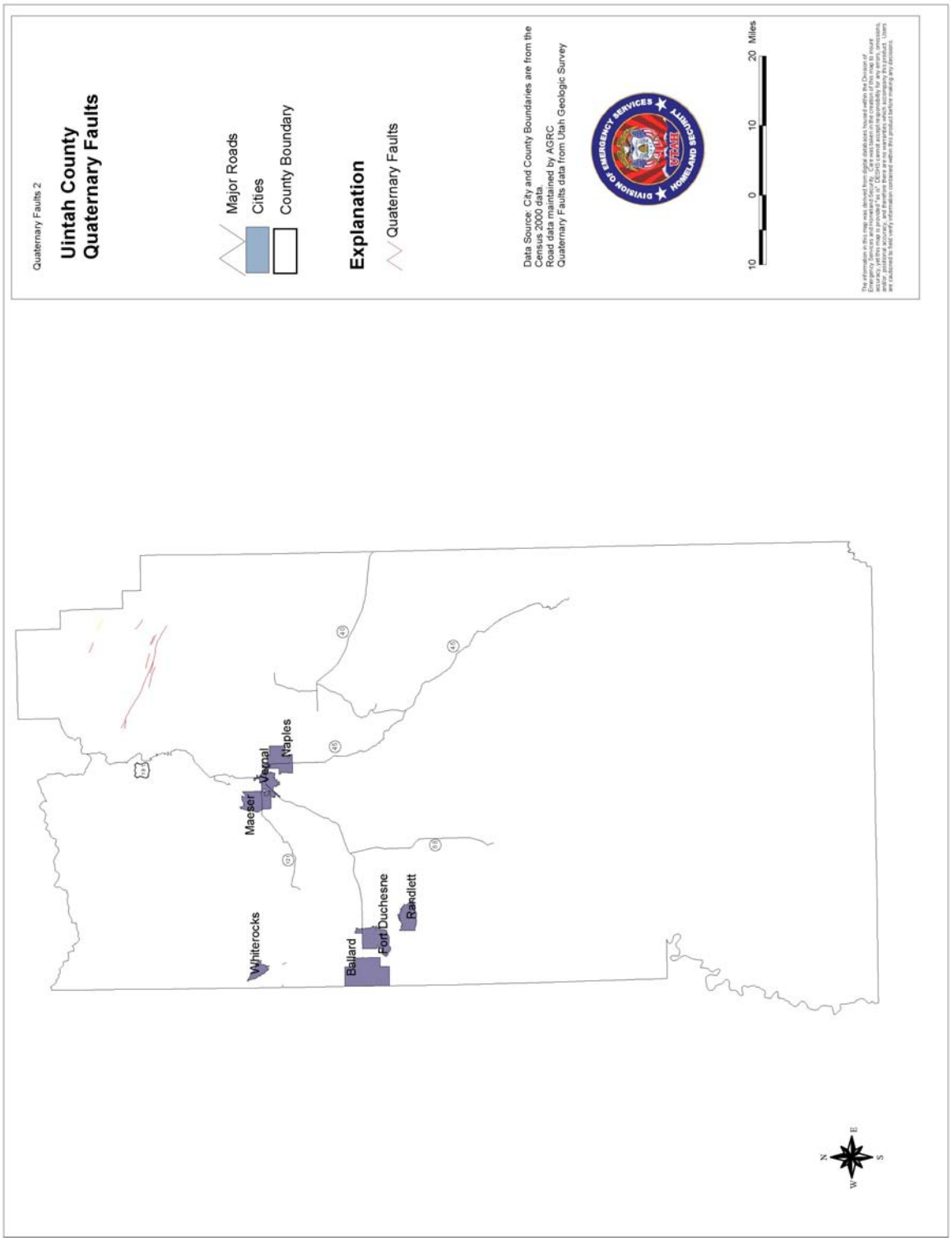
Generic Liquefaction Mitigation

- Move soil out.
- Densify soils in place.
- Remove ground water.
- Structural design.

Generic Surface Fault Rupture Mitigation

- Avoidance
- Zoning ordinances


Epicenters 3
Uintah County
Epicenters
Major Roads
Cities
County Boundary
Explanation
Epicenters by Magnitude
5 - 7
4 - 5
3 - 4
2 - 3
1 - 2
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Epicenter data created by Utah Geologic Survey maintained by AGRC
10 0 10 20 Miles
Naples
Vernal
Maeser
Whiterocks
Ballard
Fort Duchesne
Randlett
N
E
S
W


Quaternary Faults 2
Uintah County
Quaternary Faults
Major Roads
Cities
County Boundary
Explanation
Quaternary Faults
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Quaternary Faults data from Utah Geologic Survey
DIVISION OF EMERGENCY SERVICES & HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Naples
Vernal
Maeser
Whiterocks
Ballard
Fort Duchesne
Randlett
N
W
E
S

NATURAL HAZARD: FLOODING

FEMA Hazard Profile for Flooding

Frequency		**Highly Likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity		**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
	X	**Critical**	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Flooding would affect all communities in the county that are in and along the flood plains		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring thaws		
Duration	Rainstorms can last for hours and possibly days. Spring run-off can last weeks		
Speed of Onset	Six to twelve hours		

Floods are the most common and widespread of all natural disasters except fire. Most communities in the United States have experienced some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws.

A flood, as defined by the National Flood Insurance Program is: "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from:

- Overflow of inland or tidal waters.
- Unusual and rapid accumulation or runoff of surface waters from any source, or
- A mudflow.

[The] collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood." *For a description of floods and possible causes see the floods section in Appendix A.*

Floods can be slow, or fast rising but generally develop over a period of days. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in mitigation steps now, such as, engaging in floodplain management activities, constructing barriers, such as levees, and purchasing flood insurance will help reduce the amount of structural damage to your home and financial loss from building and crop damage should a flood or flash flood occur. Source: http://www.fema.gov/hazards/floods/

VULNERABILITY: High
Low lying particularly those along the river course are vulnerable to flooding. Flood plain maps were looked at during the completion of this plan but these maps are not geo-referenced prohibiting full GIS analysis. Unfortunately the flood model in HAZUS is too computationally intensive to complete a vulnerability assessment at this time.

AFFECT:
Naples City had some structural damage due to microbursts. Uintah County has had four to five flash floods in the last twenty years with little damage. However, some bridges were lost costing Uintah County approximately $200,000.00 and Vernal City around, $2,000.00. *For more information regarding Flooding in Uintah County see the Flood Hazard Identification Study in Appendix M.*

Generic Mitigation:

- Avoidance
- Revise and up-date building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.
- Manufactured homes need to be installed properly and inspected.
- Enforce zoning.
- Flood insurance awareness, emphasis, and marketing.
- Curtail development in flood-prone areas.
- Greater reservoir capacities.
- Gather hazard and risk data/information.
- Protection of drinking water supply.
- Education of local officials, developers, and citizens.
- Better flood routing through communities.
- Funding by a storm water tax in cooperation with Federal and State programs.

NATURAL HAZARD: INSECT INFESTATION

FEMA Hazard Profile for Insect Infestation

Frequency	**X**	**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Uintah County.		
Seasonal Pattern	Spring, summer, and fall		
Duration	Months		
Speed of Onset	Minimal or no warning		

Agriculture has historically dominated the economic life of Uintah County. The county remains a significant producer of crops and livestock.
Uintah County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation. Damage to the economic base and to the health of the citizens is also a direct result of insect infestation. Insects most notable are grasshoppers, Mormon Crickets, Bark Beetles, and mosquitoes. Currently the West Nile Virus spread by mosquitoes is a serious threat to humans and animals in Uintah County.

Generic Mitigation:

- Avoidance
- Spread insect bait and spray for mosquitoes
- Vaccinate

NATURAL HAZARD: LANDSLIDE

FEMA Hazard Profile for Landslide

Frequency		**Highly Likely**	**Near 100% probability in next year**
		Likely	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
	X	**Unlikely**	**Less than 1% probability in next 100 years**
Severity		**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
	X	**Critical**	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Uintah County		
Seasonal Pattern	After spring rains, heavy thunderstorms, or spring snow thaws.		
Duration	Depending upon conditions.		
Speed of Onset	Not applicable.		

VULNERABILITY: Low

The Uintah Basin Association of Governments identified and mapped possible landslide threats to Uintah County that would have a potential risk to pedestrians, vehicle traffic, and residential areas. *The map on page 21 illustrates Landslides and gives an explanation for Landslides in Uintah County.*

In Uintah County there are several areas namely, Blue Mountain, Diamond Mountain, Dry Fork Canyon, and the Book Cliffs that could have a potential risk to pedestrians and vehicle traffic due to landslides. Based upon the information we had available at that time we were unable to come up with any hard value figures that these landslides would have on Uintah County.

In Uintah County there are approximately 66 residential structures at potential risk from landslide. Based upon figures provided by the Uintah County Assessors Office, the market value of those structures is estimated to be $5,280,000.00.

For a description of Landslides and possible causes see the Landslides section in Appendix A.

Structure Loss and Value as a Percentage of Total Acreage.

City Name	Acres of Historically Active Landslides 1847 to Present	Households Vulnerable to Landslide/Cost
Uintah County	20,982.9	66/5,280,000

*Includes value of land.
Data set indicates no active landslides exist within the jurisdictions of Uintah County.

Transportation

Name	Miles	Estimated Cost
Local Neighborhood/local/city street	23	46,000,000

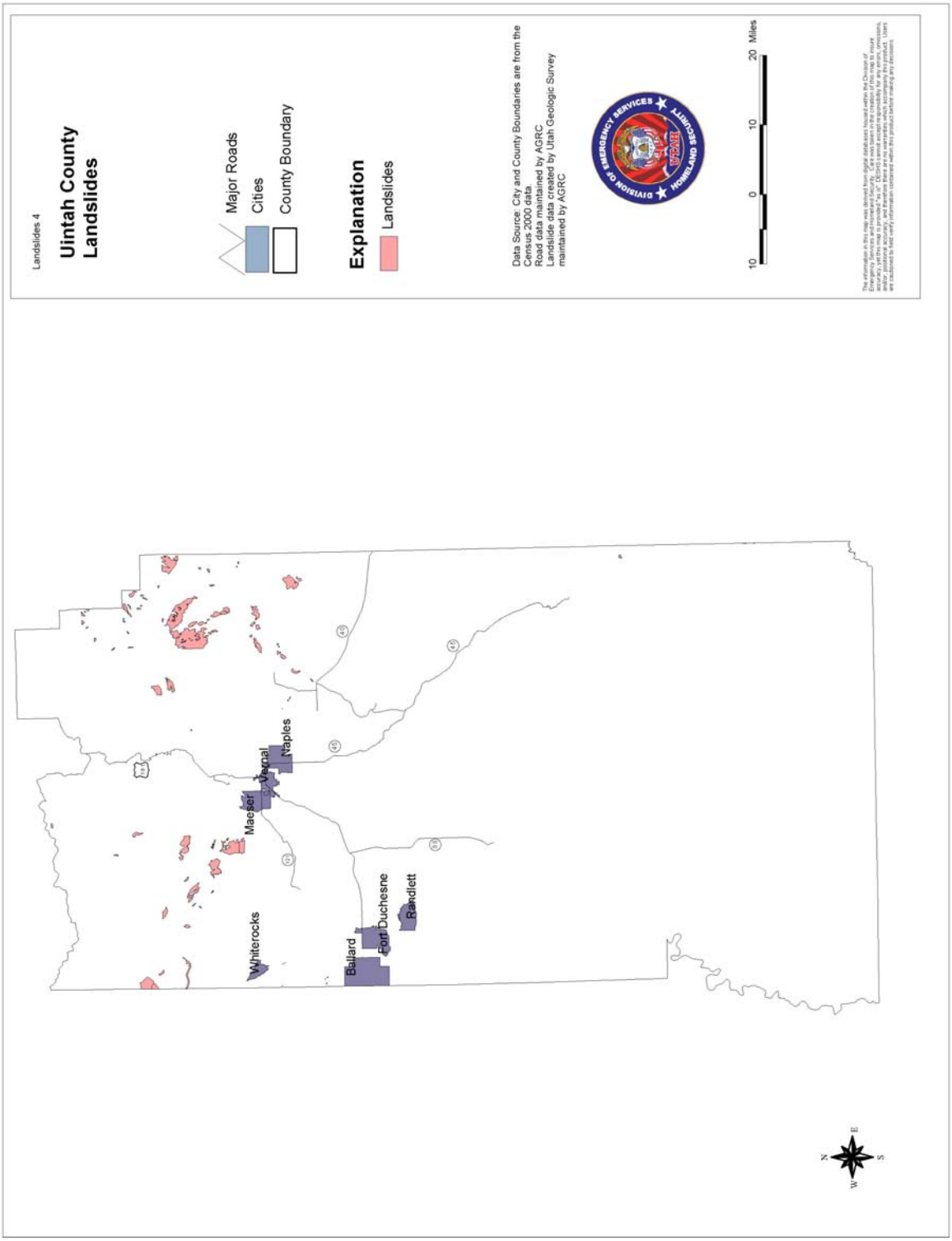
Table data represents total length of roads and rail lines, which overlay historically active landslides.

Utilities

Name	Description	Estimated Cost
Questar Gas Pipeline	1 mile	241,390
Uncoded Power Lines	.032 mile	1,544

<u>Generic Mitigation:</u>

- Install a pipeline for run-off.
- Seed hillsides to prevent landslides.


Landslides 4
Uintah County
Landslides
Major Roads
Cities
County Boundary
Explanation
Landslides
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Landslide data created by Utah Geologic Survey maintained by AGRC
DIVISION OF EMERGENCY SERVICES & HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Naples
Vernal
Maeser
Whiterocks
Ballard
Fort Duchesne
Randlett
N
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E
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NATURAL HAZARD: WILDFIRE

FEMA Hazard Profile for Wildfire

Frequency		**Highly Likely**	**Near 100% probability in next year**
	X	**Likely**	**Between 10 and 100% probability in next year, of at least one chance in 10 years**
		Possible	**Between 1 and 10% probability in next year, of at least one chance in next 100 years**
		Unlikely	**Less than 1% probability in next 100 years**
Severity	**X**	**Catastrophic**	**More than 50%** (of the jurisdiction that can be affected)
		Critical	**25 to 50%** (of the jurisdiction that can be affected)
		Limited	**10 to 25%** (of the jurisdiction that can be affected)
		Negligible	**Less than 10%** (of the jurisdiction that can be affected)
Location	Uintah County.		
Seasonal Pattern	June through October.		
Duration	Minutes to days and months.		
Speed of Onset	Not applicable.		

There are three different classes of wild land fires. A **surface fire** is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A **ground fire** is usually started by lightning and burns on or below the forest floor. **Crown fires** spread rapidly by wind and move quickly by jumping along the tops of trees.

Wild land fires are usually signaled by dense smoke that fills the area for miles around. Source: http://www.fema.gov/hazards/fires/
The map on page 25 illustrates fire risk and gives a wildfire explanation for Uintah County.

A Word about Wildfires

Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk

associated with alluvial fans is always of concern. Post fire revegetation and stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

VULNERABILITY: High
The current drought has resulted in a high death rate among certain vegetative communities. Although vegetation in Utah has evolved in to meet climate demands the cumulative affect of years of drought have resulted in a high vegetation mortality rates. This has resulted in an abundance of fuel should a wildfire start. Structures build in the unincorporated county surrounded by native vegetation are at a higher risk in Uintah County than those structures build in the cities. It is suggested that all property owners in interface areas initiate defensible space practices.

Generic Mitigation:

- The County cannot mitigate because the forest service won't allow counties to manage their land.
- Poor land management on BLM and forestlands.
- Obtain fire-fighting equipment to control wildfires in rough terrain.
- Provide wild land fire training.
- Obtain fire grant from FEMA for personnel equipment.
- Weed control.

County Name	Acres of Extreme	Acres of High	Acres of Moderate	Acres of Low/Very Low
Uintah County	N/A	74,927	631,257	2,177,549

Unincorporated County

County	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Uintah County		235/15,040,000	1,982/126,848,000

Uintah County

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Ballard			4,355.83
Naples			206.721
Fort Duchesne			2,474.9
Maeser		6.04	10.209

Structures in Wildfire Area

City Name	Households in Extreme/Cost	Households in High/Cost	Households in Moderate/Cost
Ballard			95/6,080,000
Naples			20.5/1,312,000
Fort Duchesne			91.5/5,856,000
City Name	**Households in Extreme/Cost**	**Households in High/Cost**	**Households in Moderate/Cost**
Maeser		1.4/89,600	2.3/147,200

*Excludes content value, which would result in, and increase of 50% to the values listed.

Transportation

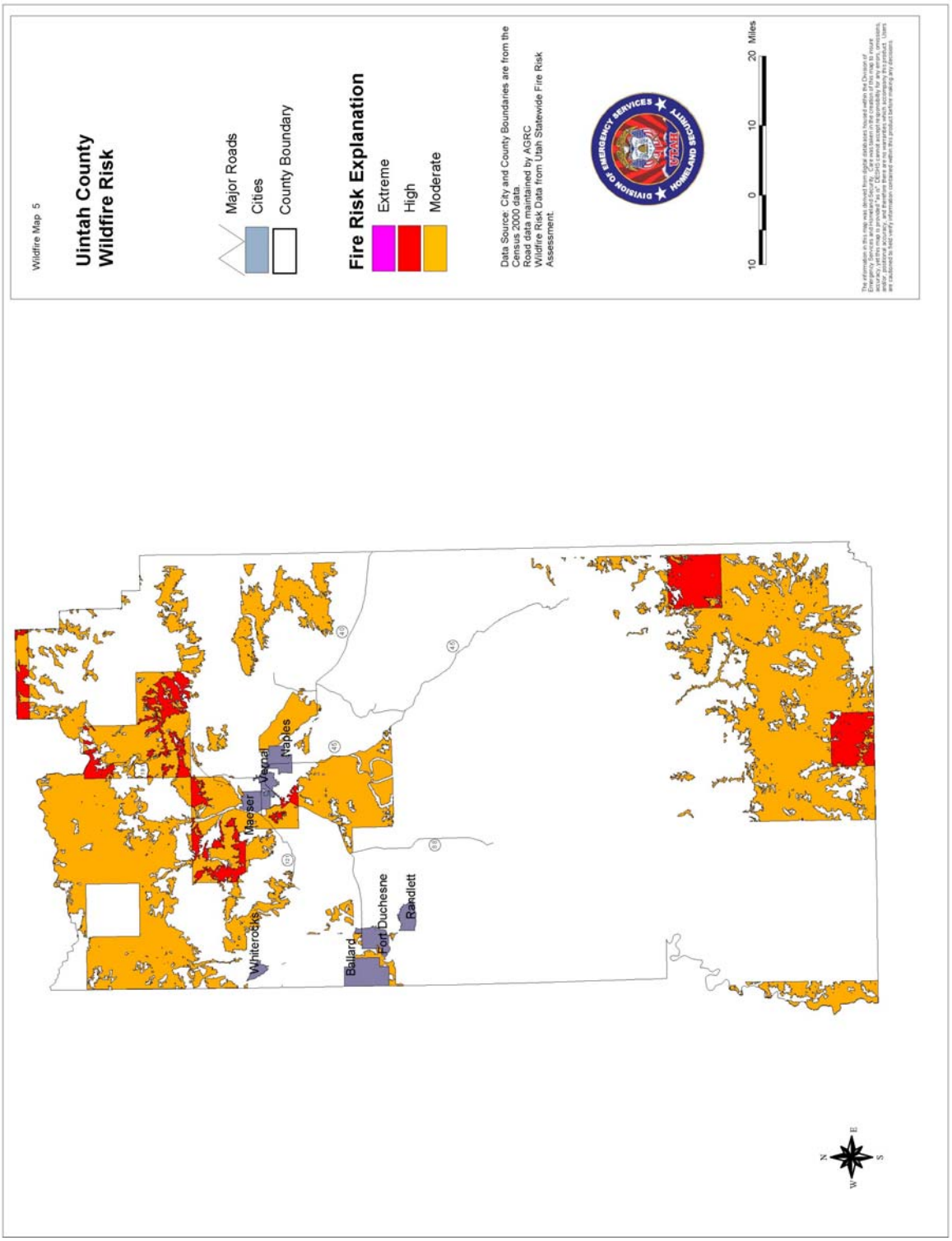
Name	Miles	Estimated Cost
Local Neighborhood/local/city street	918.7	1,837,400,000
US Highway 40	11.7	28,237,950
US Highway 191	15.2	36,685,200
State Route 121	2.4	5,792,400
State Route 301	2.2	5,309,700
State Route 45	3.8	9,171,300

Table data includes road lengths within areas determined to have an extreme, high, or moderate risk to wildfire as determined by the Utah Statewide Fire Risk Assessment.

Utilities

Name	Description	Estimated Cost
Maeser	Power Generation	10,000,000
Chevron Resources	Power Generation	10,000,000
Uncoded Power lines	108.3 miles	5,228,724
KV-12.5 or less	4.5 miles	217,260
KV – 69	6.7 miles	323,476

KV – 138	4 miles	193,120
Questar Gas Pipeline	20.2 miles	4,876,078


Wildfire Map 5
Uintah County
Wildfire Risk
Major Roads
Cities
County Boundary
Fire Risk Explanation
Extreme
High
Moderate
Data Source: City and County Boundaries are from the Census 2000 data
Road data maintained by AGRC
Wildfire Risk Data from Utah Statewide Fire Risk Assessment.
DIVISION OF EMERGENCY SERVICES
HOMELAND SECURITY
UTAH
10 0 10 20 Miles
Naples
Vernal
Maeser
Whiterocks
Ballard
Fort Duchesne
Randlett
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Mitigation Capabilities of Uintah County

This portion of the Plan assesses Uintah County's current capacity to mitigate the effects of the natural hazards identified within the plan. The assessment includes an examination of the following local government capabilities:

1. Staff & Organizational Capability
2. Technical Capability
3. Development Trends
4. Fiscal Capability
5. Policy and Program Capabilities
6. Political Willpower

The capabilities assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for Uintah County to pursue under this Plan, but also ensures that those goals and objectives are realistically achievable under given local conditions.

1. Staff and Organizational Capability

Uintah County has **Very Limited** staff and organizational capability to implement hazard mitigation strategies. Uintah County is Utah's 11 most populated county, containing 25,224 people. While the County has a number of professional staff members to serve residents and carry out day-to-day administrative activities, much of the staff is part time or is tasked with numerous duties.

The County of Uintah does have an Emergency Manager who is responsible for the mitigation, preparedness, response and recovery operations that deal with both natural and man-made disaster events.

2. Technical Capability

Uintah County has **very limited** technical capability to implement hazard mitigation strategies.

Technical Expertise

Uintah County does have an, emergency manager/building inspector to administer the County's hazard mitigation programs. The County does not have a licensed engineer or related technical expert on staff, and has in the past relied upon outside contractors/consultants to perform a majority of any required technical work.

Geographic Information Systems (GIS)

GIS systems can best be described as a set of tools (hardware, software and people) used to collect, manage, analyze and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations. Uintah County currently has GIS capability,

and it has been identified as a needed enhancement for both the Planning Department and the Building Inspections office to further hazard mitigation goals.

Internet Access
Uintah County does provide its employees and citizens with high speed broadband Internet. Internet access opens up an enormous door for local officials to keep abreast of the latest information relative to their work and makes receiving government services more affordable and convenient. It is believed that Internet access will help further the County's hazard mitigation awareness programs, but should be supplemented with more traditional (and less technical) means as well.

3. Development Trends
Uintah County's economy has always relied on agriculture and mining to sustain its growth. The area has benefited from the development of several geologic deposits, such as gilsonite, oil shale, tar sand and oil, which have shaped its economic growth. While mining and agriculture remain significant to the economy, other industries such as government services, trade and the Ute Indian Tribe, are developing. These new industries help stabilize and diversify the economy.

Nonagricultural employment in Uintah County rose 2.3 percent to 8,745 by adding nearly 200 jobs between the second quarter of 1998 and the second quarter of 1999. Increased construction activity and service employment sustained economic growth. Uintah County's unemployment rate rose to 6.3 percent in 1998 to 6.4 percent for the comparable period of 1999.

Construction employment jumped 50.8 percent by adding 190 positions. All of the growth was in heavy construction for water, sewer, pipeline and communications systems. Residential, nonresidential, and special trade contractors reported slight growth. **Services** added 170 positions, and 8.4 percent year-over growth. Home health care, offices and clinics of doctors, video rental stores, temporary help agencies, residential care facilities, and tribal organizations reported growth, while jobs for equipment rental declined.
Government jobs increased 4.6 percent by adding 81 positions. Increases were reported for federal, state and local government, although local government positions dominated growth. Federal jobs related to land and wildlife management increased moderately, while state employment reported slight increases in several areas. Local positions rose for roadwork, recreation and education, but contracted for environmental and transportation services. **Manufacturing** employment experienced an increase of 17 jobs both durable and nondurable goods manufacturing added positions. Wood kitchen cabinet manufacturing, construction machinery, and publishing accounted for the growth. Oil and gas equipment reported a decline. **Finance, Insurance** and **Real Estate** year-over data indicate a net increase of one position. Real estate and insurance agents expanded, while banking/lending positions declined.

4. Fiscal Capability
Uintah County has **very limited** fiscal capability to implement hazard mitigation strategies.

5. Policy and Program Capability

Emergency Operations Plan
Uintah County has developed and adopted an Emergency Operations Plan, which predetermines actions to be taken by government agencies and private organizations in response to an emergency or disaster event. The Plan was adopted June 1986. For the most part, the Plan describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster.

The Plan does not specifically address hazard mitigation, but it does identify the specific operations to be undertaken by the County to protect lives and property immediately before, during and immediately following an emergency. There are no foreseeable conflicts between this Hazard Mitigation Plan and Uintah County's Emergency Management Plan, primarily because they are each focused on two separate phases of emergency management (mitigation vs. preparedness and response).

Emergency Management Program
Uintah County has an emergency management program, which participates in the state EMPG program. The emergency management program is tasked with protection of life and property in Uintah County and mitigation is a big part of this task.

Floodplain Management Plan
Although Uintah County currently participates in the National Flood Plain Insurance Program they do not have a current Floodplain Management Plan. However, this Disaster Mitigation Plan recommends that Uintah County work on updating and/or revising their Floodplain Management Plan.

Stormwater Management Plan
Uintah County Currently has no formal Storm water Management Plan.
County Ordinances
The Uintah County currently does not have any county ordinances that address natural disasters. However, a member of the planning committee was in attendance at our Natural Disaster meetings and agreed to work on implementing and adopting new County Ordinances that are relevant to hazard mitigation.

6. Political Willpower
Most Uintah County residents are quite knowledgeable about the potential hazards that their community faces. Recent wildfires have increased the understanding and need for mitigation within the government structure of Uintah County.

The Uintah Basin Association of Governments used historical data to estimate to the best of their ability (with the data available at the time) the potential dollar losses if the County were to experience flooding and wildfires, the two most likely hazards to occur in the County. The estimated costs are as follows:

Potential flood losses:

- Residential properties (including senior citizens home): Depending upon the location of the flood, losses could result into millions of dollars. *Approximately; 3 to 4 million dollars*
- Local Hospital: The local Hospital in Uintah County is not in the flood plain, and would, therefore not likely be affected by a flood. *Approximately; $100,000.00*
- Schools: The Schools located in Uintah County, are not likely be affected by a flood. None of the schools are located in the flood plain. *Approximately; $100,000.00*
- Communication utility company: Due to the fact that the communications and the utility companies are not located in the flood plain minimal damages would result from a flood. *Approximately; $100,000.00*
- Waste water treatment plant: Due to the fact that the waste water treatment plant are not located in the flood plain minimal damages would result from a flood. *Approximately; $100,000.00*

Potential wildfire losses:

- Residential properties: Depending upon the location of the flood, losses could result into excess of millions of dollars. *Approximately; 4 to 5 million dollars*
- Hospital: The Uintah County Hospital would have minimal damages if any that would result from potential wildfire losses. *Approximately; $100,000.00*
- Secondary School: Uintah County does have two school systems located on the outskirts of City that could have potential damages due to wildfires. *Approximately; 1 to 2 million dollars*

Uintah County

The Uintah County Disaster Mitigation Planning committee, which consists of one County Commissioner, the County Emergency Manager, the Vernal City Planner, the Naples City Manager, and Ballard City in conjunction with the Uintah Basin Association of Governments meet on several different occasions to review and analyze the risk assessment studies that were performed for the County. The goals listed were determined to be those goals that would have the greatest benefit in hazard reduction to the County. The goals, objectives and actions represent a long-term vision for hazard reduction or enhancement of mitigation capabilities. Listed below is our definition of goals and objectives.

Goals: General guidelines that explain what you want to achieve. They are usually long-term and represent global visions, such as "eliminate flood damage."

Objectives: Define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific, measurable, and have a defined completion date. Objectives are more specific, such as "adopt a zoning ordinance prohibiting new development in the floodplain."

The Uintah County Disaster Mitigation Planning Committee and the Uintah Basin AOG Mitigation Planner decided upon the following goals, objectives, action items, and priorities for each of the natural hazards. The priorities for each hazard are ranked in the following order: High, Medium, and Low. Each hazard is ranked by order of importance; however, this does not mean the ranking of each hazard will not potentially change over time.

Mitigation Strategies

Dam Failure

Uintah County

GOAL 1: Help reduce future flooding in Uintah County due to dam failure.
Problem Identification: Reduce down stream loss in Uintah County due to dam failure.

High Priority

Objective 1.1

- Use technology to aid in prevention of flood loss due to dam failure

Action 1.1.1:

- Digitize high hazard dam failure inundation maps

  Time Frame: ongoing
  Funding: state government
  Estimated Cost: 500 dollars per dam
  Staff: Utah Dam Safety Section, and AGRC

Action 1.1.2:

- Update Emergency Operations Plan to include GIS dam failure estimates

  Time Frame: Next EOP update
  Funding: County
  Estimated Cost: Undetermined
  Staff: County GIS and Emergency Manager

Action 1.1.3:

- Educate the local elected officials, developers, and citizens.

  Time Frame: Within the next two years
  Funding: County
  Estimated Cost: Minimal
  Staff: County employees

Action 1.1.4

- Updated Emergency Action Plans (EAP) and integration with GIS Systems**.**

  Time Frame: Ongoing
  Funding: FEMA, State and Local
  Estimated Cost: Unknown
  Staff: State and Local

Action 1.1.5:

- Implementation of more debris dams would assist in controlling floods, reducing the amount of debris and mud that come through. Maintenance of flood control pools in existing dams would also be very beneficial.

  Time Frame: Ongoing
  Funding: Town and County funds
  Estimated Cost: minimal
  Staff: Water surveyor and newsletter editor

Background: Numerous technological advancements have been made which will help reduce the likely hood of dam failure and reduce the risk to down stream populations should a dam fail. These techniques will only reduce the risk if they are properly understood and implemented. The above mitigation recommendations when implemented will represent a first step into this new technology for Duchesne County. The county understands there are additional technologic steps that can be taken such as increase number of telemeter snow and stream gauges. Look for these advances in future revisions to the mitigation plan.

Drought

Uintah County

GOAL 1: Reduce water loss within Uintah County due to drought.
Problem Identification: Current, past and future drought issues within Uintah County.

High Priority

Objective 1.1

- Conserve culinary water by educating the public

Action 1.1.1:

- Educate the public on the need to be water wise

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: Use a newsletter to educate the public

Objective 1.2:

- Develop more water storage tanks within the County

Action 1.1.2:

- Conduct a feasibility study

Time Frame: Ongoing
Funding: County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Action 1.1.3:

- Install new wheel lines to improve the water efficiency.

Time Frame: Ongoing
Funding: Federal, and State funding
Estimated Cost: Unknown
Staff: NRCS, UACD, USU, Extension, ect.

Action 1.1.4:

- Implement and enforce water laws that prohibit the use of extensive amounts of water.

Time Frame: Ongoing
Funding: County funds
Estimated Cost: Unknown
Staff: Water surveyor and newsletter editor

Drought

Ballard City

GOAL 1: Reduce water loss within Ballard City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Ballard City staff, Professional Services, Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The city should continue to maintain and implement a tiered water rate structure.

Naples City

GOAL 1: Reduce water loss within Naples City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Naples City staff, Professional Services, Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The City should continue to maintain and implement a tiered water rate structure.

Vernal City

GOAL 1: Reduce water loss within Vernal City.
Problem Identification: Cyclical periods of drought place a strain on availability of community culinary water and irrigation water resources.

High Priority

Objective 1.1

- Meet current and future water needs of community. Conserve culinary water by educating the public

Action 1.1.1:

- Develop additional water storage tanks as well as implement conservation plans.

Time Frame: Ongoing
Funding: City funds, State and Federal Government loans and/or grants
Estimated Cost: To be determined
Staff: Vernal City staff, Professional Services, Contractors

Objective 1.2

- Conserve culinary water by conservation

Action 1.1.2:

- Maintain and enforce rate policies that encourage water conservation

Time Frame: Ongoing
Funding: City and County funds
Estimated Cost: minimal
Staff: Water surveyor and newsletter editor

Background: The City should continue to maintain and implement a tiered water rate structure.

Earthquake

Uintah County

GOAL1: Provide public awareness regarding earthquakes.
Problem Identification: Transportation and utilities services could be severely impacted.

High Priority

Objective 1.1

- Provide for emergency response and relief.

Action 1.1.1:

- Identify and maintain critical transportation and utility services.

Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown- Determined by the extent of damage anticipated.
Staff: Town staff.

Background: Critical transportation systems

Objective 1.2

- Public Awareness

Action 1.1.2:

- Conduct a public awareness campaign.

Time Frame: ongoing
Funding: Local governments and possible grants
Estimated Cost: Unknown
Staff: Agency personnel and volunteers

Background: Contact DESHS earthquake program specialist. Enhance earthquake instructions in school.

Uintah County

GOAL 2: Identify the number of seismically unsafe structures within the County.
Problem Identification: Unknown number of seismically unsafe structures around the county.

High Priority

Objective 1.1

- Have a study done to determine seismic resistance of structures within the county i.e. Elementary and high schools, public buildings, high traffic areas, ECT.

Action 1.1.1:

- Structural and non-structural earthquake hazard assessment.

Time Frame: ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Critical transportation systems

Flooding

Uintah County

GOAL 1: Reduce flood damage in Uintah County.
Problem Identification: Control flooding in residential areas of Uintah County, Including but not limited to Ballard City, Naples City, and Vernal City. Flooding occurs from heavy rains and fast moving thunderstorms. *For more information regarding Flooding in Uintah County see the Flood Hazard Identification Study in Appendix M.*

High Priority

Objective 1.1:

- Obtain Aerial photography with contours of each residential area in Uintah County.

Action 1.1.1:

- Set horizontal and vertical survey control and order aerial photography with contours for each residential area in the county.

Time Frame: Ongoing
Funding: Local, State and Federal grants
Estimated Cost: Unknown
Staff: State, Local, and possibly Federal

Background: Aerial Topography is needed for master storm drainage design.

Objective 1.2:

- Design master storm drainage plans for residential areas.

Action 1.1.2:

- Design master storm drainage plans to handle storm water runoff through residential areas.

Time Frame: 3 months to 2 years, (depending on number of areas worked on)
Funding: Grants
Estimated Cost: $10,000.00 per residential area, depending on size
Staff: County Staff and contracted staff.

Background: Engineers design master storm drainage plans for the residential areas.

Objective 1.3:

- Implement storm drainage plans throughout the residential areas of Uintah County.

Action 1.1.3:

- Implement storm drainage plans throughout the residential areas of Uintah County.

Time Frame: 2 years or as soon as the storm drainage plans are finished.
Funding: State and Federal grants
Estimated Cost: unknown, will depend on the finals plans and what is required for facilities
Staff: County and contracted staff

Background: Construct storm drainage facilities and require all new developments to meet county storm drainage plans.

Ballard City

GOAL 1: Reduce flooding in Ballard City.
Problem Identification: Control flooding in Ballard City. Flooding occurs from heavy rains and fast moving thunderstorms.

High Priority

Objective 1.1:
- Use technology to aid in prevention of flood loss.

Action 1.1.1:
- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for Ballard City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:
- Place a restrictive clause in the City Ordinances that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:
- City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.4:
- City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and Town Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Background: Past and future flooding

Naples City

High Priority

GOAL 1: Reduce flooding in Naples City.
Problem Identification: Control flooding in Naples City. Flooding occurs from heavy rains and fast moving thunderstorms.

Objective 1.1:
- Use technology to aid in prevention of flood loss.

Action 1.1.1:
- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Naples City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:
- Place a restrictive clause in the City Ordinance that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:
- County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away..

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.4:
- County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.

Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Vernal City

High Priority

GOAL 1: Reduce flooding in Vernal City.

Objective 1.1:

- Use technology to aid in prevention of flood loss.

Action 1.1.1:

- Put in an application to the Army Corps. Of Engineers for updated and revised flood plain maps for the Vernal City.

Time Frame: Within the next two years
Funding: FEMA, state and local.
Estimated Cost: Unknown
Staff: County and City Employees, Local Volunteers

Action 1.1.2:

- Place a restrictive clause in the County and City Ordinances that will prohibit any new development in the floodplain.

Time Frame: Within the next year
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.3:

- County and City building inspectors and the planning committee will revise and update building ordinances for new construction that takes place to help eliminate bridges and buildings from being washed away..

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.4:

- County and City building inspectors and planning committee will make sure that the Zoning Ordinance is up-dated or revised every 5 to 6 years.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.5:

- The County Emergency Managers will research grant opportunities for potential funding.

Time Frame: Ongoing
Funding: FEMA, state and local.

Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.6:

- Implement a flood ordinance that will cover the County and City with flood insurance.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.7:

- Implement a zoning ordinance to ensure that manufactured homes are being installed properly and inspected.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Action 1.1.8:

- Enforce Zoning laws.

Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown at this time
Staff: County and City Employees, Local Volunteers

Insect Infestation

Uintah County

GOAL 1: Reduce insect infestation
Problem Identification: Uintah County has experienced losses in agriculture, livestock, and wildlife as a result of insect infestation.

Priority High

Objective 1.1

- Reduce the impact of insects

Action 1.1.1:

- Spread insect bait and spray for mosquitoes

Time Frame: When required
Funding: County funds, Mosquito abatement funds come from property tax
Estimated Cost: Approximately $3.00 per property owner per month
Staff: County Mosquito Abatement District

Objective 1.2:

- Reduce the severity of infestations

Action 1.1.2:

- Apply for grants to purchase Mosquito magnets and propane tanks to run the magnets.

Time Frame: Spring and summer of 2004
Funding: $6,000.00 in grants
Estimated Cost: $6,000.00
Staff: County employees

Background: Several agricultural fields surround Uintah County; these fields have been subjected to insect infestation especially during the recent years of drought.

Objective 1.3:

- Reduce the threat of West Nile Virus within Uintah County

Action 1.1.3:

- Educate the public on the importance of vaccinating their animals.

Time Frame: Spring and summer of 2004
Funding: State and local funding
Estimated Cost: minimal
Staff: County employees

Background: Several of the Uintah County residents have horses that could be affected by the West Nile virus.

Uintah County

GOAL 1: Reduce grasshopper infestations.
Problem Identification: Periodic Grasshopper infestations more sever in the rural areas of Uintah County.

High Priority

Objective 1.1:

- Reduce the severity of infestations

Action 1.1.1:

- Conduct aerial spraying to reduce infestations.

Time Frame: As infestations occur
Funding: By private individuals in most cases
Estimated Cost: Varies, depending on acreage treated
Staff: Contractor

Background: Many agricultural fields surround Uintah County. These fields have been subjected to insect infestation especially during the recent years of drought.

Landslide

Uintah County

GOAL 1: Protect residential areas from potential landslides.
Problem Identification: There is a potential risk to residential and commercial buildings due to rockslides, which are located in areas identified by the county as landslide risk areas.

High Priority

Objective 1.1

- Reduce potential landslides to residential and commercial areas.

Action 1.1.1:

- Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Action 1.1.2:

- The county's, city's and town's planning committee will review and update the zoning ordinances within the County to make sure that individuals are not constructing new homes near potential landslide areas.

Time Frame: Undetermined
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown

Background: Hold monthly planning and zoning meetings within the town and county.

Uintah County

GOAL 2: Protect vehicle traffic from future accidents due to landslides.
Problem Identification: In Uintah County there are several areas namely, Blue Mountain, Diamond Mountain, and Dry Fork Canyon that could have a potential risk to pedestrians and vehicle traffic due to landslides.

High Priority

Objective 1.1

- Reduce potential landslides to residential and commercial areas.

Action 1.1.1:

- Assess the probability of landslides and identify specific structures at risk

Time Frame: Undetermined
Funding: Property owner
Estimated Cost: Unknown
Staff: Unknown

Background: Soil surveys and other engineering surveys are needed.

Severe Weather

Uintah County

GOAL 1: Reduce Structural damage to both residential and commercial buildings due to Severe Weather.
Problem Identification: Uintah County experiences occasional, damaging high winds and snowstorms.

High Priority

Objective 1.1

- Reduce damage to structures through strict adherence to building codes

Action 1.1.1:

- Ensure that 80 MPH wind load requirement is met by builders

Time Frame: Ongoing
Funding: Fees from Building permits

Estimated Cost: Minimal
Staff: Building Inspector

Background: Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events

Uintah County

GOAL 2: Provide protection for citizens regarding power line failure.
Problem Identification: Power lines are at risk from seasonal high winds.

High Priority

Objective 1.1

- Reduce service disruptions and damage to power lines

Action 1.1.1:

- Provide adequate clearances for power lines and conduct ongoing line maintenance. Maintain outage plan.

Time Frame: Ongoing
Funding: Possible Grants
Estimated Cost: To be determined
Staff: County and town employees

Background: Extreme winds have occurred, utilities disruption has occurred in past years due to damage to power poles and transmission lines by high winds.

Wildfire

Uintah County

GOAL 1: Reduce the threat of wildfires within Uintah County.
Problem Identification: Continuing non-compliance with existing building codes and fire codes.

High Priority

Objective 1.1

- Increase compliance with existing building and fire codes.

Action:

- Develop and enforce current local, state and national codes

Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown

Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Uintah County

GOAL 1: Reduce wildfire danger within the County.
Problem Identification: Specific areas of the county are susceptible to wildland fire danger.

Objective 1.2

- Educate homeowners on how to reduce risk of wildfire damage

Action 1.1.2:

- The local LEPC will provide semi-annual training for the citizens of Uintah County.

Time Frame: Starting 2004
Funding: State and local
Estimated Cost: Minimal
Staff: County
Background: Educate the public on how to reduce the risk of wildfires.

Plan Maintenance Procedures

Monitoring, Evaluating and Updating the Plan

Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for Uintah Basin are kept current and that local mitigation efforts are being carried out. The Plan has therefore been designed to be user-friendly in terms of monitoring implementation and preparing regular progress reports.

Annual Reporting Procedures

The Plan shall be reviewed annually, as required by the Executive Council, or as situations dictate such as following a disaster declaration. Each year the UBAOG Community Development Department Staff will review the plan and ensure the following:

1. The Executive Director and the Executive Council will receive an annual report and/or presentation on the implementation status of the Plan at the January Executive Council Meeting.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the Plan.

3. The report will recommend, as appropriate, any required changes or amendments to the Plan.

If the UBAOG Executive Council determines that a modification of the Plan is warranted, the Council may initiate a Plan amendment.

Revisions and Updates

Periodic revisions and updates of the Plan are required to ensure that the goals and objectives for the Uintah Basin are kept current. More importantly, revisions may be necessary to ensure the Plan is in full compliance with Federal regulations and State statutes. This portion of the Plan outlines the procedures for completing such revisions and updates. Plan maintenance and significant revision is contingent upon availability of funding.

Five (5) Year Plan Review

The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the Uintah Basin, which would affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the Plan.

The Pre-Disaster Hazard Mitigation Plan Ad-Hoc Committee, with a potential membership representing every jurisdiction in the UBAOG, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the Plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review should become summarized in the annual report prepared for this Plan under the direction of the Community Development Director. The annual report will include an evaluation of the effectiveness and appropriateness of the Plan, and will recommend, as appropriate, any required changes or amendments to the Plan.

If the Executive Council determines that the recommendations warrant modification to the Plan, the Council may either initiate a Plan amendment as described below, or, if conditions justify, may direct the UBAOG Community Development Department to undertake a complete update of the Plan.

Plan Amendments

An amendment to the Plan should be initiated only by the Executive Council, either at its own initiative or upon the recommendation of the Executive Director, Community Development Director or Mayor of an affected community.

Upon initiation of an amendment to the Plan, UBAOG will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full Ad-Hoc committee may be reconstituted. At a minimum, the information will be made available through public notice in a newspaper of general circulation and on the Uintah Basin or DES Website. Information will also be forwarded to the Utah Department of Public Safety, Division of Emergency Services and Homeland Security. This information will be sent out in order to seek input on the proposed Plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Executive Director (or his/her designee) for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Executive Director (or his/her designee) will review the proposed amendment along with comments received from other parties and submit a recommendation to the Executive Council within sixty (60) days.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the Plan; and/or

3. There has been a change in information, data or assumptions from those on which the Plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, the Executive Council will hold a public hearing. The Executive Council will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Executive Council will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Refer the amendment request back to the Executive Director for further consideration.

4. Defer the amendment request for further consideration and/or hearing.

5. Reject the amendment request.

Implementation through Existing Programs

Implementation

Each jurisdiction included in the Uintah Basin Association of Governments Pre-Disaster Hazard Mitigation Plan has a current Capital Improvements Plan (CIP). The Capital Improvement Planning that occurs in the future will contribute and be a reflection of the goals in the Hazard Mitigation Plan. It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to include within the Capital Improvements Plan action items that have been

outlined within the Mitigation Plan and ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Many mitigation strategies can be implemented through existing federal, state, and county programs and administered by the county emergency manager. Examples include the National Flood Insurance Program, Fire Wise, Living With Fire Committee, and Storm Ready.

Prioritization

For this plan projects were prioritized using that STAPLEE method and given a rating of high, medium or low. These rating take into account the following evaluation criteria: social, technical, administrative, political, legal, and funding. Emphasis was given to funding which is a fundamental consideration in any hazard mitigation project. Benefit cost analysis was not formally conducted on any of the projects suggested in the mitigation strategies. With few exceptions, none of the projects in the plan were developed far enough to derive a meaningful benefit to cost ratio. Should funding become available the extent by which benefits are maximized with regard to cost, would play a significant roll in determining which, projects get funded and which do not.

Administrative

Project administration is purely a function of project size for the jurisdictions within the planning area. The jurisdictions have self-funded or received state and federal funding for numerous projects in the past. The larger the project the more administration would be needed. Local jurisdictions or counties with current staff could administer small projects. Larger projects would still by managed “in-house” but would require additional staff be hired.

Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. Uintah Basin jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the Plan identifies the primary Federal and State grant programs for Uintah Basin jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program

Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants fro post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

STATE PROGRAMS

The state of Utah maintains a philosophy of local responsibility for hazard mitigation. State agencies still provide an integrated network of support, services, and resources for hazard mitigation activities. As demonstrated during past disasters, these agencies are well organized in their delivery and coordination of services. The following is a review of State departments with disaster responsibilities describing their existing and planned mitigation programs.

An evaluation of the laws, regulations, authorities, policies, and programs used in Utah to mitigate hazards demonstrate that they work exceptionally well, as evidenced by the massive amount of mitigation accomplished in Utah, the few numbers of disasters, and the limited nature of those emergencies that do occur. According to the Utah SHMT, the only changes that could be considered by the Legislature might be ones that parallel the Federal Disaster Mitigation Act of 2000, which would integrate pre-disaster mitigation considerations into the code of various state agencies.

Utah Division of Emergency Services and Homeland Security (DESHS)

The capabilities of DESHS Hazard Mitigation Program include:

- Prepare, implement, and maintain programs and plans to provide for preventions and minimization of injury and damage caused by disasters.
- Identify areas particularly vulnerable to disasters.
- Coordinate hazard mitigation and other preventive and preparedness measures designed to eliminate or reduce disasters.
- Assist local officials in designing local emergency actions plans.
- Coordinate federal, state, and local emergency activities.
- Coordinate emergency operations plans with emergency pans of the federal governments.

Through the State Hazard Mitigation Program, the following occurs:

- Provides a state coordinator for hazard mitigation, the State Hazard Mitigation Officer.
- Provides a central location of the coordination of state hazard mitigation activities.
- Provides coordination for the Federal Pre-Disaster Mitigation Program.
- Provide for coordination of Project Impact.
- Provide coordination for Comprehensive Multi-hazard Mitigation Plan development, implementation, and monitoring.
- Provide for interagency coordination
- Provide development of procedures for grant administration and project evaluation.
- Provide State Hazard Mitigation Team assistance to local governments.

- Provide for development of specific hazard mitigation plans, such as drought and wildfire.
- Provide for local hazard and risk analysis.
- Provide for development of SHMT mitigation recommendations following disasters.

Utah Department of Agriculture

The Utah Department of Agriculture administers programs serving the state's large agricultural sector. The department's response role during and after a disaster period has been to coordinate damage reports for funding needs and provides loan and recovery program information and assistance to disaster victims. This service is provided for flood, drought, insect infestation, fire, livestock disease, and frost.

Assistance During Drought Disasters

A damage reporting network coordinated through the existing County Emergency Board was established during the drought disaster of 1996. Each county agent assembled damage reports in his area and transmitted them through a computer network based at Utah State University. The individual damage reports from each county were recapped in the Department of Agriculture and formed the basis of documentation for an appeal to the legislature for additional funds to mitigate the damage.

Loans Handbook

The department has prepared a handbook listing the types of loans available for flood damage to agriculture, the funding requirements, and applications procedures. This includes loans from both state and federal sources. There are three loan programs operated by the agriculture department, all of which can be used for flood damage:

1) Rural Rehabilitation Loan Program (federally funded and operated by the state)
2) Agriculture Resource Development Loan Program (state funded)
3) Emergency Loan Program (state funded)

Soil Conservation Program

The Department of Agriculture also administers the ongoing Soil Conservation Program. In each of the state's thirty-nine soil conservation districts, three unpaid, elected supervisors offer technical assistance and consultation on watershed protection. The state offers limited technical and planning assistance through a staff member. The program works cooperatively with the federal Soil Conservation Service, which provides most of the technical assistance. The ongoing program is not regulatory, but is directed towards improved water use and soil conservation.

Disaster Easements
Because of the similarity between past events, the department is now working on a permanent hazard mitigation concept known as “Disaster Easements”, which may have widespread agreements with irrigation companies, water districts, or water users’ associations for the purpose of routing flood water through local communities.

Monitoring Ground Water Quality
The Department also monitors the quality of groundwater, including individual wells and springs throughout the State.

Non-Point Source Pollution
The Department’s Non-Point Source Pollution Program focuses on flood prevention through reduction of erosion, vegetating streams, and restoring “natural stream structure”. The Department also monitors drought conditions, which are a precursor to wildfire.

Department of Community and Economic Development

Community Impact Board
The Utah Permanent Community Impact Fund Board provides loans and/or grants to state agencies and sub-divisions of the state, which may be socially or economically impacted by mineral resource development of federal lands.

Permanent Community Impact Fund
The Permanent Community Impact Fund provides loans and/or grants to state agencies and subdivisions of the state, which are or may be socially or economically impacted, directly or indirectly, by mineral resource development on federal lands.

Under the Federal Mineral Lease Act of 1920, leaseholders on public land make royalty payments to the federal government for the development and production of non-metalliferous minerals. In Utah, the primary source of these royalties is the commercial production of fossil fuels on federal land held by the U.S. Forest Service and the Bureau of Land Management. Since the enactment of the Minerals Lease Act of 1920, a portion of these royalty payments, called mineral lease payments, have been returned to the state in an effort to help mitigate the local impact of energy and mineral developments on federal lands.

Funding Options
The Board has the option of funding projects with loans and/or grants. The Board’s preferred financing mechanism is an interest-bearing loan.

Loan Requirements
In providing financial assistance in the form of a loan, the Board may purchase an applicant's bonds only if the bonds are accompanied by legal opinion of recognized municipal bond counsel to the effect that the bonds are legal and binding under applicable Utah Law.

The Board may purchase either a taxable or tax-exempt bond. The board may purchase taxable bonds if it determines, after evaluating all relevant circumstances, including the applicant's ability to pay, that the purchase of the taxable bonds is in the best interest of the state and the applicant.

Grants
Grants may be provided only when the other financing mechanisms cannot be utilized, where no reasonable method of repayment can be identified, or in emergency situations regarding public health and/or safety.

Community Development Block Grant
The Community Development Block Grant, or CDBG program, provides funding from the federal government's Department of Housing and Urban Development or HUD, to small cities and counties in the State of Utah.

Utah Division of State History

The Utah State Historical Society, Utah's Division of State History, was founded in 1897 on the 50th anniversary of the first settlement in the Salt Lake Valley by the Mormon Pioneers. The Society became a state agency in 1917, now housed in the historic Rio Grande Depot since 1980. The Division stimulates archaeological research, study; oversees the protection and orderly development of sites; collects and preserves specimens; administers site surveys; keeps excavation records; encourage and supports the preservation of historic and pre-historic sites and publishes antiquities records. The Division also issues archaeological permits and consults with agencies and individuals doing archaeological work.

Preserving and Sharing Utah's Past
The mission of the State Division of History is "preserving and sharing Utah's past for the present and the future".

State Historical Preservation Officer (SHPO)
The SHPO administers the Section 106 process (national Historic Preservation Act) in Utah. The SHPO also serves on the Utah State Hazard Mitigation Team, providing guidance on historical and cultural preservation regulations.

Historic properties include districts, buildings, structures, objects, landscapes, archeological sites, and traditional cultural properties that are included in, or

eligible for inclusion in, the National Register of Historic Places. These properties are not just “old buildings” or “well-known historic sites, but places important in local, state, or national history. Facilities as diverse as bridges and water treatment plants my, be considered historic.

Utah Geological Survey (UGS)

The Utah Geologic and Mineral Survey is the principal state agency concerned with geologic hazards. Through years of study, the UGS has developed considerable information on Utah’s geologic hazards. When geologic events occur or threaten to occur, the UGS is consulted by other state agencies, local governments, and private organizations for assistance in defining the threat from natural hazards. The UGS works in partnership with other agencies, such as DESHS, in relating the threats from natural hazard to the communities at risk.

Functions

The functions of the UGS include the following:

- Evaluation of individual geological hazards;
- Participation on local government and state agency technical teams;
- Prediction of the performance on individual slides once they began to move;
- Coordination and awareness of research efforts undertaken by other agencies;
- Provide information on status of individual geologic hazards;
- Reconnaissance reports on status of hazards statewide;
- Advise Division of Water Rights on geologic hazards associated with dam sites; and
- Provide geologic information for use during planning of remedial actions.

Laws/authorities/policies of the Utah Geological Survey for conducting mitigation

Utah Code Annotated

Chapter 73 Geological and Mineral Survey

Section 68-73-6 Objectives of Survey

(1) Determine and investigate areas of geologic and topographic hazards that could affect the safety of, or cause economic loss to, the citizens of this state; (f) assist local and state government agencies in their planning, zoning, and building regulations functions by publishing maps, delineating appropriately wide special earthquake risk areas, and, at the request of state agencies, review the citing of critical facilities:

Utah State Office of Education (USOE) Rule R277-455 Standards and Procedures for building plan review

R277-455-4 Criteria for Approval; to receive approval of a proposed building site, the local school district must certify that:

Staff of the Utah Geologic Survey have reviewed and recommended approval of the geologic hazards report provided by the school districts geo-technical consultant.

Division of Water Resources
The Divisions role of planning, funding and constructing water projects serves as both active and passive hazard mitigation against drought and flood situations throughout the state. The various State water plans contain brief summaries of flood threat and risk for each drainages.

The Division is one of seven agencies in the State Department of Natural Resources. The eight member Water Resources Board, appointed by the governor, administers three state water conservation and development funds. These include:

- Revolving Construction fund – This fund started in 1947 with 1 million legislative appropriation to help construct irrigation projects, wells and rural culinary water systems. Further appropriations have added to this fund.
- Conservation and Development Fund – This fund was created in 1978 wit the sale of 25 million in general obligations bonds. Money was added to this fund with bond sales in 1980 and 1983. The C & D Fund generally helps sponsors finance larger multi-purpose dams and water systems.
- Cities Water Loan Fund – Established with an initial legislative appropriation of 2 million dollars in 1974, and with continued appropriations, this fund provides financing to help construct new culinary water projects for cities, towns, improvement districts, and special service districts.

Construction Funds
In addition to overseeing these three construction funds, the Division also manages the State funds appropriated each year for renovation and reconstruction of unsafe dams. As the funding arm of the state for water resource projects the Division works closely with Water Rights, the Regulatory arm of the state charged with jurisdiction over all private and state owned dams.

Water Resource Planning
The Division is also charged with the general water resource planning for the state. The State Water Plan is a process that is coordinated to evaluate existing water resources in the state, determine water-related issues that should be confronted and recommend how and by whom issues can be resolved. The plan identifies programs and practices of state and federal

agencies, water user groups and environmental interests and describes the state's current, future, and long-term water related needs. The plan is continually updated using current hydrologic databases, river basin simulations, water supply and demand models and water related land use inventories. Revisions reflect the latest water conservation and development options concerning water rights, water transfers, population, zoning, and many other complex issues for the next 50 years in the state's major river basins.

Utah Division of Forestry, Fire, and State Lands

The Division of Forestry, Fire & State Lands utilizes the principles of stewardship and ecosystem management to assist non-federal landowners in management of their natural resources. The agency provides wildland fire protection for non-federal landowners commensurate with risk; and optimizes the benefits from ecosystem based, multiple-use management of resources held in the public trust. Wildfires are managed from six area offices 1) Bear River Office, 2) Northeast Area, 3)Wasatch Front Area, 4) Central Area, 5) Southwest Area, and 5) Southeast Area. The Division operates under the authority of the Utah Code Annotated 65-A-3-1 though 10.

<u>The Flame-n-Go's (pronounced Flamingoes)</u>

In 1978 the Division of Forestry, Fire, and State Lands and the Utah State Prison signed a cooperative agreement establishing Utah's first volunteer, inmate wildland fire hand-crew. The inmates named themselves the "Flame-N-Go's" and designed a logo that has become well known in the wildland fire fighting community.

All Flame-N-Go's are carefully screened for the program. They must complete rigorous training and sign a yearly contract committing themselves to preserving Utah's natural resources and building responsible lives.

The Flame-N-Go's are divided into three crews, each of which can respond to fires anywhere in the United States. A twenty-man type II hand line crew is the backbone of the group, responding to each assignment with all tools and equipment needed to do battle on the fire line. An Engine Strike Team, (five fire engines, outfitted with men and equipment) is ready to respond when needed as an Engine Strike Team or a Type II Hand line Crew. The Hotshot crew is trained to tackle the most dangerous fires in the most rugged terrain. All crews during peak fire season are on 24-hour call to respond within an hour's notice. These crews respond to an average of 50 fires per year and typically spend 45,000 hours fighting fires each season. At least one Division of Forestry, Fire, and State Lands supervisor and two Department of Corrections staff accompany each crew.

Each year, Flame-N-Go's are put through at least 80 hours of extensive training including classroom work and practical field exercises. Safety, individual, and team skills, and professionalism are stressed.

National Fire Plan
The Division administers the State responsibilities of the National fire Plan, a current emphasis of the U.S. Congress, which also addresses hazard and risk analysis and hazard mitigation.

Living With Fire Committee
The Division works in partnership with the U.S. Forest Service, Bureau of Land Management, and various other entities tasked with suppressing wildland fires on the "Living With Fire" program promoting wildland fire mitigation.

Utah Division of State Parks and Recreation
The goal of the Division of Parks and Recreation is to enhance the quality of life for residents and visitors of our state through parks, people, and programs. They are responsible for protecting, preserving, and managing many of Utah's natural and heritage resources.

Hazard and Risk Analyses
The Division develops hazard and risk analyses for the State Parks as part of the park resource management plans. The Utah Division of Emergency Services and Homeland Security produced one analysis for Snow Canyon State Park in Washington County.

Non-Motorized Trail Program
The Recreational Trails Act of 1991 charged Utah State Parks and Recreation with coordinating the development of a statewide network of non-motorized trails. The Non-Motorized Trail program makes state and federal funds available on a 50/50 matching basis to any federal, state, or local government agency, or special improvement district for the planning, acquisition, and development of recreational trails.

Grants from State Parks Boards
The council advises the Division of Parks and Recreation on non-motorized trail matters, reviews requests for matching grant fiscal assistance, rates and ranks proposed trail projects and along with State Park's staff provides recommendations for funding to the State Parks Board.

Riverway Enhancement Program
In 1986, the Utah Legislature passed a bill, which established the Riverway Enhancement Program. The program makes state funds available on a 50/50 matching basis to state agencies, counties, cities, towns, and/or special improvement districts for property acquisition and/or development for

recreation, flood control, conservation, and wildlife management, along rivers and streams that are impacted by high density populations or are prone to flooding. Public outdoor recreation should be the primary focus of the project.

Utah Division of Water Rights

The Division of Water Rights is the state agency that regulated appropriation and distribution of water in the State of Utah. It is an office of public record. The Utah State Engineer's Office was created in 1897. The State Engineer's Office is the chief water rights administrative officer. A complete "water code" was enacted in 1903 and was revised and reenacted in 1919. This law, with succeeding complete reenactments of State statutes, and as amended, is presently in force mostly as *Utah Code, Title 73*. In 1963, the name was changed from State Engineers office to the Division of Water Rights.

All water in Utah are public property. A water right is a right to the use of water based upon 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use.

Regulate Dams

The State engineer has the authority to regulate dams for the purpose of protecting public safety. Dams are classified according to hazard, size, and use. The dam inventory gives the identification, location, construction parameters, and the operation and maintenance history of the dams in Utah.

Stream Alterations Program

The Utah State Engineer's Office administers a Stream alterations program with the purpose of regulation activities affecting the bed or banks or natural streams. The State Engineer's working definition of a natural stream is any natural waterway in the state, which has flows of sufficient duration to develop a characteristic ecosystem distinguishing it from the surrounding environments. Any individual planning an activity that will affect a natural stream must first obtain a Stream Alterations Permit from this office.

Most proposals reviewed by the State, are covered by General Permit 40, which authorizes the state to have its Stream Alteration Permit fulfill the requirements of Section 404 of the Clean Water Act for most activities. General permit 40 does not apply in some instances and a U.S. Army Corps of Engineers Individual Permit is required. Projects requiring this additional permit include those involving wetlands, threatened or endangered species, properties listed on the National Historic Register, stream relocation, or the pushing of streambed material against a stream bank.

Dam Safety Program

The Dam Safety Section of the Division of Water Rights was established under Chapters 73-5a 101 thru 73-5a 702 including chapters 73-2-22 for Flood Control and the Chapter 63-30-10 Waiver of Immunity of the Utah Code

and Rules R655-10 thru R655-12-6A. The program basically has jurisdiction over all private and state owned dams in the state during design, construction, operation, and decommissioning. This involved periodic inspections according to hazard classifications, inventory maintenance, design, and construction approval and systematic upgrade of all the high hazard structures to current dam safety Minimum Standards and creation of Emergency Action Plans for High Hazard dams. Since 1991, detailed dam reviews have been undertaken by the staff and by private consulting firms. Since 1995, the State Legislature has provided 3-4 million dollars per year to finance 50 % of the instrumentation, investigations, and design and 80 to 90 % of the construction costs of retrofitting and upgrading deficient dams, starting with the worst dams in the most hazardous locations.

The impetus for this dam safety program has been in reaction to dam failures, both in Utah and in other states, including the Teton Dam in Idaho and the Trial Lake Dam in Summit County and the Quail Creek Dam near St. George Utah. Since the establishment of our Minimum Standards program we have fostered the repair of dozens of dams and have not had a catastrophic failure since.

Future recommendations include continuation of the funding for dam upgrades for all the high hazard dams, and then the moderate hazard dams, continued annual inspections for maintenance items and dangerous deficiencies, upgrading EAP, and hazard assessment to reflect downstream development. Inclusion of the scanned design drawings and inundation maps from the EAP studies is being considered for our web page for public information and emergency access. Possible expansion of the program to cover canals and dikes has been considered.

Utah Division of Wildlife Resources

It is the mission of the Utah Division of Wildlife Resources to serve people of Utah as trustee and guardian of the State's wildlife. Regulates hunting, fishing and trapping, and promotes recreational, educational, scientific and aesthetic enjoyment of wildlife.

Wildlife Habitats and Hazards

Wildlife species and/or their habitats are frequently exposed to hazards. These may be either natural or human influenced (i.e. drought, flood, fire, wind, snow, wetland drainage, water diversions, hazardous material spills, improper/illegal chemical use, earthquake, and other land or water construction/development). Impact resulting either directly or indirectly, from individuals or an accumulation of several hazards, may cause but not be limited to: decreased water supply, stream/lake channel/basin morphology change, riparian/upland vegetation loss or degradation, and impairment of water quality. These in turn have a varying influence, in the extreme causing death or at a minimum temporary stress, on wildlife populations and their

habitats. Hazards mentioned may affect a fairly large geographic area or be very localized in nature.

While the Division of Wildlife Resources (DNR) is charged with the management of wildlife, they do not have regulatory authority over water appropriations, water quality, development, or land management; except as allowed or occurring on properties they own. Therefore, when hazards occur, outside DWR property, DWR is limited to be a participating influence only through comments to the other regulatory agencies or individuals.

DWR management of wildlife is carried out largely through regulation of taking controlling, disturbance and/or possession of wildlife, and introduction of movement of species. However, there are numerous non-regulatory means (i.e. conservation agreements, memorandum of understanding, contract, lease agreements, cooperative agreements, and technical assistance) by which DWR interacts with other agencies, groups and individuals, to have an influence on wildlife and/or their habitat.

Hazard Areas of Commentary Interaction

While not being able to control/regulate many of the elements necessary for the benefit of wildlife; DWR provides technical comments for the maintenance, protection, and enhancement of wildlife and/or habitats for various value reasons. It is too extensive list all the areas of comment; however, the following are examples of fairly frequent concern:

- Steam Channel Alteration Permit Applications
- Water Rights Filings
- Energy and Mineral Exploration and Extraction Applications
- Federal Agency land management plans
- Waste Water Discharge Permit Applications
- Hydroelectric plant licensing or regimenting
- Urban and rural development project planning
- Utility transmission line style and locations
- Wetland alteration
- Federal land management planning
- Highway constructions

The Utah Division of Drinking Water

Division of Drinking Water's Mission Statement is to " protect the public against waterborne heath risks through assistance, educations, and oversight". The Division acts as the administrative arm of the Utah Drinking Water Board. It implements the rules, which they adopt. As such, it is engaged in a variety of activities related to the design and operation of Utah's public drinking water system. The Utah Drinking Water Board is an 11-person board appointed by the Governor. It is empowered by Title 19, Chapter 4 of the Utah Code to adopt rules

governing the design, operations, and maintenance of Utah's "public drinking water system".

Safe Drinking Water Act
There is a Federal Safe Drinking Water Act, which applies to all public drinking water systems in the country. The U.S. Environmental Protection Agency (EPA) has given Utah "primacy" for enforcing the federal act within its boundaries. To qualify for this Utah's laws and rules governing public drinking water systems must be at least as strict as the federal law.

Sanitary Surveys
The Division performs sanitary surveys on the water systems, which is a compliance action that identifies system deficiencies.

Emergency Response Plans
The Division of Drinking Water requires water utilities to prepare emergency response plans under the State Safe Drinking Water Act, Utah Code Section 19-4. The Division operates according to DDW Rules: R309 gives them authority to administer actions: R309-301 through R309-104 and R309-113, R309-150, R309-301, and R309-211.

Utah Division of Solid and Hazardous Waste
The Tier II Chemical Inventory report, required by the Federal Emergency Planning and community Right-to-Know Act, requires facilities to submit lists of hazardous chemicals present on site. These reports are computerized and the information is provided to local emergency planning committees, the general public, and others for contingency planning purposes. To implement the Federal law, the State operates under Utah State Code, Section 63-5-5. The Division of Solid and Hazardous Waste requires that hazardous waste treatment storage and disposal facilities prepare and emergency response plan as required by regulations authorized by the State Solid and Hazardous Waste Act, Utah Code Section 19-6.

Other Agency programs are regulatory in nature requiring proper use or disposal of hazardous substances or pollutants. For example the Division of Solid and Hazardous Waste regulates the disposal of hazardous waste, the Division of Radiation Control regulates the proper usage and disposal of radioactive materials. As such there is a threat mitigation nature to these programs.

Utah Division of Water Quality
The Utah Division of Water Quality protects, maintains, and enhances the quality of Utah's surface and underground water for appropriate beneficial uses; the Division of Water Quality regulates discharge of pollutants into surface water, and protects the public health through eliminating and preventing water related health hazards which can occur as a result of improper disposal of human,

animal, or industrial wastes while giving reasonable consideration to the economic impact.

Water Quality Fund and Wastewater Treatment Project Fund: The Division Manages the Water Quality Revolving Fund that can be used by local governments for water quality projects and a Wastewater Treatment Project Fund.

Abating Watershed Pollution: Federal and State regulations charge the Division with “preventing, controlling, and abating” watershed pollution. Other state and local agencies have similar responsibilities. The Watershed Approach forms partnerships with these groups to pool resources and increase the effectiveness of existing programs. For each watershed management unit, a watershed plan will be prepared. The watershed plan addresses management actions at several spatial scales ranging from those that encompass a watershed management unit to specific sites that are tailored to specific environmental conditions. Ground water hydrologic basins and eco-region areas encompassed within the units will also be delineated.

State Revolving Fund Program

In 1987, Congress replaced the Construction Grants Program, with the State Revolving Fund Program. Rather than provide direct grants to communities, the federal government provides each state with a series of grants, then each state contributes a 20 percent state match. Grants from the federal government are combined with state funds in the Water Quality Project Assistance Program (WQPAP) and are used to capitalize a perpetual source of funds to finance water quality construction control activities at below market interests rates. Projects eligible for WQPAP financing include such traditional activities as construction of wastewater treatment plants and sewers. The program also will finance non-traditional water quality-related activities such as agricultural runoff control, landfill closures, contaminated industrial property (Brownfield) remediation, stream bank restoration, and wellhead protection.

LOCAL

Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

NON-GOVERNMENTAL

Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private

sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this Plan.

Continued Public Involvement

Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. On a yearly basis the plan will be profiled at Uintah Basin's Annual Open House, which is held in the fall of every year. There are typically 250-300 local citizens who attend the Open House. The plan will also be available on the UBAOG website to provide additional opportunities for public participation and comment.

Uintah Basin Association of Governments staff has been designated by its Executive Council as the lead agency in preparing and submitting the Uintah Basin Pre-Disaster Hazard Mitigation Plan, which includes coverage for all incorporated cities and counties within the three county region, of Daggett, Duchesne, and Uintah. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The AOG will publicly advertise all hearings, requests for input and meetings directly related to the Pre-Disaster Hazard Mitigation Plan process. Executive Council meetings where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the AOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the Uintah Basin Standard. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Pre-Disaster Hazard Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the Hazard Mitigation Plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the Plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Hazard Mitigation Plan will be presented to the Uintah Basin Executive Council at its regularly scheduled monthly meeting for adoption and approval to submit the document to State authorities. Executive Council policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the Plan, the Plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Hazard Mitigation Plan as open and convenient as possible:

A. Participation: All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings: Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information: Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Hazard Mitigation Plan, and/or any other documents prepared for distribution by the Association of Governments that may be adopted as part of the plan by reference. The AOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance: Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings: The AOG will plan and hold public hearings according to the following priorities: 1- Hearings will be conveniently timed for people who might benefit most from Mitigation programs, 2- Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy), and 3- Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: a-identify and profile hazards, b-develop mitigation strategies, and c-review plan goals, performance, and future plans.

F. Comment Period: The AOG will sponsor a 30-day public comment period prior to final plan submission. The comment period will begin with a public hearing to open the 30-day solicitation of input. Comments may be made orally, or in writing, and as far as possible, will be included in the final Pre-Disaster Hazard Mitigation Plan according to the outlined participation rules.

References:

Utah State Water Plan Uintah Basin._ Utah Division of Water Resources, December 1999.

Hazard Definitions

Flooding

Flooding is a temporary overflow of water onto lands not normally inundated by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss, and interruption of business. Floods also increase the likelihood of hazard such as transportation accidents, contamination of water supplies, and health risk increase after a flooding event.

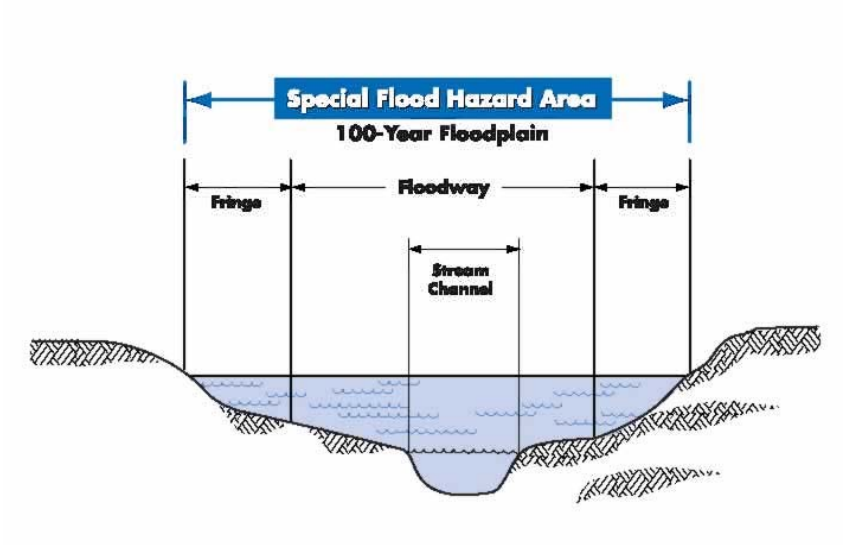
Several factors determine the severity of floods including rainfall intensity, duration and rapid snowmelt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having, impermeable surfaces such as large parking lots, paved roadways, or post burned areas with hydrophobic soils. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover.

Frequency of inundation depends on the climate, soil, and channel slope. In regions where substantial precipitation occurs during a particular season or in regions where annual flooding is due to spring melting of winter snow pack, areas at risk may be inundated nearly every year.

Conditions which my exacerbate floods:
Impermeable surfaces
Steeply sloped watersheds
Constrictions
Obstructions
Debris
Contamination
Soil saturation
Velocity

Explanation of Common Flood Terms

FIRM: Flood Insurance Rate Map



100-year flood: Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100 year-flood is also referred to as the base flood.

Base Flood: Is the standard that has been adopted for the NFIP. It is a national standard that represents a compromise between minor floods and the greatest flood likely to occur in a given area and provides a useful benchmark.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum (NGVD) or 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

Special Flood Hazard Area (SFHA): Is the shaded area on a FIRM that identifies an area that has a 1% chance of being flooded in any given year (100-year floodplain).

Floodway: Is the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising that water surface elevation by more than one foot.

Earthquakes

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks when they can no longer withstand the stresses, which build up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. When rocks break they produce seismic waves that are transmitted through the rock outward producing ground shaking. Earthquakes are unique multi-hazard events, with the potential to cause huge amounts of

damage and loss. Secondary effects of a sudden release of seismic energy (earthquake) include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, slope failure, and various types of flooding.

The Intermountain Seismic Belt

The Intermountain Seismic Belt (ISB), is a zone of pronounced earthquake activity up to 120 miles wide extending in a north south direction 800 miles from Montana to northern Arizona. The Utah portion of the ISB trends from the Tremonton Cache Valley area south through the center of the state, along the Wasatch Front, and the southwest through Richfield and Cedar City concluding in St. George. "The zone generally coincides with the boundary between the Basin and Range physiographic province to the west and the Middle Rocky Mountains and Colorado Plateau physiographic provinces to the east" (Eldredge 6).

Secondary Earthquake Threats

The major secondary effects of earthquakes include: ground shaking, surface fault rupture, liquefaction, tectonic subsidence, avalanches, rock fall, slope failure, and various types of flooding. Other sections discuss landslides, and flooding therefore they will not be discussed under secondary effects of earthquakes yet importance needs to be given to the fact that earthquakes can increase the likelihood of flooding and landslides.

Ground Shaking

Ground shaking causes the most impact during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated by earthquakes. Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves cause more damage to short stiff structures, where as low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity.

Local geologic conditions such as depth of sediment and sediment make up, affect earthquake waves. Deep valley sediments increase the frequency of seismic waves relative to bedrock. In general, ground shaking increases with increased thickness of sediments" (Eldredge 8). Findings in recent geologic research done by Ivan Wong indicate that earthquakes in Salt Lake County would produce higher PGA values than previously expected near faults and areas of near surface bedrock.

Surface Fault Rupture

During a large earthquake fault movement may propagate along a fault plain to the surface, resulting in surface rupture along the fault plain. The Wasatch fault is a normal (mountain building) fault with regards to movement, meaning the footwall of the fault moves upward and the hanging wall moves in a down direction. Thus faulting is on a vertical plain, which results in the formation of large fault scarps. Surface fault rupture along the Wasatch fault is expected for earthquakes with magnitudes of 6.5 or larger. The largest probable earthquake that could strike the Uintah Basin region is an earthquake with an estimated magnitude between 7.0 and 7.5; an earthquake of this magnitude, based on current research, would create "surface fault rupture with a displacement of between 16 to 20 feet in height with break segments 12 to 44 miles long" (Eldredge 10). In historic time surface fault rupture has only occurred once in Utah; the 1934 Hansel Valley earthquake with a magnitude 6.6 produced 1.6 feet of vertical offset.

Surface fault rupture presents several hazards, anything built on top of the fault or crossing the fault has a high potential of destroyed in the event of displacement. Foundations will be cracked, building torn apart, damage to roads, utility lines, pipelines, or any other utility line crossing the fault. It is almost impossible to design anything within reasonable cost parameters to withstand an estimated displacement of 16 to 20 feet.

Picture 1.1 Displacement in excavation near Rose Wagner Performing Arts Center.

Surface fault rupture doesn't occur on a single distinct plain; instead it occurs over a zone often several hundred feet wide known as the zone of deformation. This zone of deformation occurs mainly on the down thrown side of the main fault trace. Tectonic subsidence, caused by antithetic faults moving in the opposite direction of the main fault, slide down hill on the main fault scarp creating grabens (down dropped blocks) within the zone of deformation.

Liquefaction

Soil liquefaction occurs when water-saturated cohesion less sandy soils is subject to ground shaking. When liquefaction occurs soils behave more like a viscous liquid (quicksand) and lose they're bearing capacity and shear strength. Two conditions must be met in order for soils to liquefy: (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong

enough to cause susceptible soils to liquefy (lips). The loss of shear strength and bearing capacity due to liquefaction causes buildings to settle or tip and light buoyant structures such as buried storage tanks and empty swimming pools to float upward. Liquefaction can occur during earthquakes of magnitude 5.0 or greater.

Lateral Spread
Soils, once liquefied, can flow on slopes with angles of .5 to 5 percent this movement of liquefied soils is known as lateral spread. "The surficial soil layers break up and sections move independently, and are displaced laterally over a liquefied layer" (Eldredge 10). Liquefaction can cause damage in several ways, with lateral spreading being one of the most common. Displacement of three (3) or more feet may occur and be accompanied by ground cracking and vertical displacement. Lateral spreading causes roads, buildings, buried utilities, and any other buried or surface structure to be pulled apart.

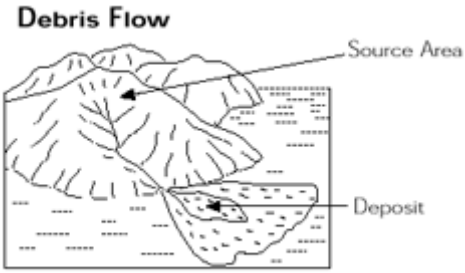
Various Flooding Issues Related to Earthquakes
Earthquakes could cause flooding due to the tilting of the valley floor, dam failure and seiches in lakes and reservoirs. Flooding can also result from the disruption of rivers and streams. Water tanks, pipelines, and aqueducts may be ruptured, or canals and streams altered by ground shaking, surface faulting, ground tilting, and land sliding.

Seiches
Standing bodies of water are susceptible to earthquake ground motion. Water in lakes and reservoirs may be set in motion and slosh from one end to the other, much like in a bathtub. This motion is called a seiche (pronounced “saysh”). A seiche may lead to dam failure or damage along shorelines.

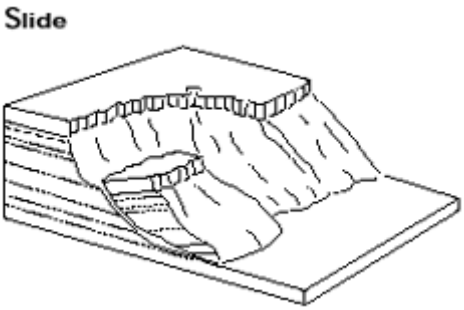
Landslides

Landslides are a “down slope movement of a mass of rock, earth, or debris”. Landslides, often referred to as mass wasting or slope failures, are one of the most common natural disasters. (Cruden 36). Slope failures can vary considerably in shape, rate of movement, extent, and effect on surrounding areas. Slope failures are classified by there types of movement, and types of material. The types of movement are classified as falls, slides, topples, and flows. “The types of material include rock, debris (coarse grained soil) and earth (fine grained soil)” (Eldredge 17). “Types of slope failures then are identified as rock falls, rock slides, debris flows, debris slides, and so on” (Eldredge 17). Slope failures occur because of either an increase in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). “Geology (rock type and structure), topography (slope gradient), water content, vegetative cover, and slope aspect are important factors of slope stability” (Eldredge 18).

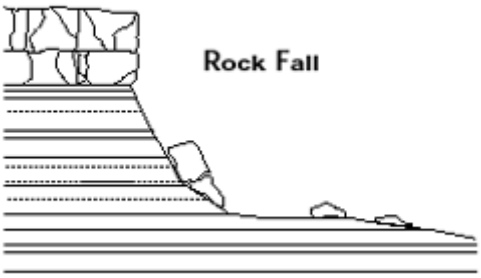
Three Common Types of Landslides in Utah



Debris flows consist of sediment-water mixtures that flow down a streambed or hillside, commonly depositing sediment at canyon mouths in fan like deposits know as alluvial fans.



Slides are down slope movements of soil or rock on slopes.



Rock falls consist of rock(s) falling from a cliff or cut slope and are very common in the canyon country of southern Utah.

Conditions That Make Slopes More Susceptible to Landslides

- Discontinuities: faults, joints, bedding surfaces.
- Massive Materials over soft materials.
- Orientations of dip slope: bedding plans that dip out of slope.
- Loose structure and roundness.
- Adding weight to the head of a slide area: rain, snow, landslides, mine waste piles, buildings, leaks from pipes, sewers, and canals, construction materials fill materials.
- Ground shaking: earthquakes or vibrations.
- Increase in lateral spread caused by mechanical weathering.
- Removal of lateral support.
- Human activities: cut and fill practices, quarries, mine pits, road cuts, lowering of reservoirs.
- Removing underlying support: under cutting of banks in a river.

- Increase in pore water pressure: snow melt, rain, and irrigation.
- Loss of cohesion.

Wildfire

Identifying Hazards

A wildfire is an uncontrolled fire spreading through vegetative fuel often exposing or consuming structures. Wildfires often begin unnoticed and spread quickly and are usually sighted by dense smoke. Wildfires are placed into two classifications Wildland and Urban-Wildland Interface. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. URWIN areas are divided into three subclasses.

- **Occluded**
  Occluded interface, are areas of wildlands within an urban area for example a park bordered by urban development such as homes.

- **Intermixed**
  Mixed or intermixed interface areas contain structures scattered throughout rural areas covered predominately by native flammable vegetation.

- **Classic**
  Classic interface areas are those areas where homes press against wildland vegetation along a broad front.

When discussing wildfires it is important to remember that fires are part of a natural process and are needed to maintain a healthy ecosystem. Three basic elements are needed for a fire to occur (1) a heat source (2) oxygen and (3) fuel. Major ignition sources for wildfire are lightning and human causes such as arson, recreational activities, burning debris, and carelessness with fireworks. On average, 65 percent of all wild fires started in Utah can be attributed to human activities. Once a wildfire has started, vegetation, topography and weather are all conditions having an affect wildfire behavior.

Severe Weather

For the purpose of this mitigation plan the term severe weather is used to represent downbursts, lightening, heavy snowstorms, blizzards, avalanches, hail, and tornados.

Downbursts
A downburst is a severe localized wind, blasting from a thunderstorm. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories by size. Microbursts, which cover and area less than 2.5 miles in diameter, and macrobursts, which cover an area with a diameter larger 2.5 miles.

Lightening
During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightening is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. When the potential between the positive and negative charges becomes to great, there is a discharge of electricity that we know as lightning.

Heavy Snowstorms
A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period. According to the official definition given by the U.S. Weather Service, the winds must exceed 35 miles per hour and the temperature must drop to 20° F or lower. All winter storms make driving extremely dangerous.

Blizzards
A blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting winds up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees Fahrenheit or colder and potentially life-threatening travel conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range.

Avalanches
Avalanches are a rapid down-slope movement of snow, ice, and debris. Snow avalanches are a significant mountain hazard in Utah, and nationally account for more deaths each year than earthquakes. Avalanches are the result of snow accumulation on a step slope and can be triggered by ground shaking, sound, or a person. Avalanches consist of a starting zone, a track, and a run-out zone. The starting zone is where the ice or snow breaks loose and starts to slide. The Track

is the grade or channel down which an avalanche travels. The run-out zone is where an avalanche stops and deposits the snow.

The two main factors affecting avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Additional factors that contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

Topography plays a vital role avalanche dynamics. Slope angles between 30 to 45 degrees are optimum for avalanches with 38 degrees being the bulls-eye. Slopes with and angle above 45 degrees continually sluff eliminating large accumulation. The risk of avalanches decreases on slope angles below 30 degrees.

Types of Avalanches Common in Utah:

Dry or slab avalanches: occur when a cohesive slab of snow fractures as a unit and slides on top of weaker snow, breaking apart as it slides. Slab avalanches occur when additional weight is added quickly to the snow pack, overloading a buried weaker layer. Dry snow avalanches usually travel between 60-80 miles per hour, reaching this speed within 5 seconds of the fracture, resulting in the deadliest form of snow avalanche.

Wet avalanches: occur when percolating water dissolves the bonds between the snow grains in a pre-existing snow pack, this decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour.

Hail Storms

Hailstones are large pieces of ice that fall from powerful thunderstorms. Hail forms when strong updrafts within the convection cell of a cumulonimbus cloud carries water droplets upward causing them to freeze. Once the droplet freezes, it collides with other liquid droplets that freeze on contact. These rise and fall cycles continue until the hailstone becomes too heavy and falls from the cloud.

Tornados

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornados often occur at the edge of an updraft or within the air coming down from a thunderstorm. Tornadoes can have wind speeds of 250 miles per hour or more, causing a damage zone of 50 miles in length and 1 mile wide. Most tornados have winds less than 112 miles per hour and zones of damage less than 100 feet wide

Waterspout
Waterspouts are simply tornadoes that form over warm water. This typically occurs in Utah during a cold fall or late winter storms.

Scale
Tornadoes are classified by wind damage using the Fujita Scale. The National Weather Service has used the Fujita Scale since 1973. This scale uses numbers from 0 through 5 with higher numbers assigned based on the amount and type of wind damage.

Fujita Scale

Category F0	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lowers limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobiles-size missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Drought

Drought is a normal recurrent feature of climate, although many, in Utah, erroneously consider it a rare and random event. It occurs in virtually all-climatic zones, while its characteristics vary significantly from one region to another. Droughts, simple put, are cumulative hazards, which result from long periods of below normal precipitation. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate.

The State or Utah, uses the Palmer Drought Severity Index or (PDSI) to quantify the existence of a drought. Using the PDSI, drought is expressed as a negative number. Much of the basis, used by the State, to determine drought years, or drought periods, comes from the PDSI. In addition, the PDSI is used by the State Climatologist, the National Geophysical Data Center of NOAA, and the National Drought Mitigation Center.

For the most part droughts no longer affect the availability of drinking water, thus it no longer places peoples lives at risk, and the same cannot be said for a individual's livelihood. Numerous water projects throughout the state have placed enough water in storage to insure drinking water. Prolonged droughts have a significant affect on agricultural and agribusinesses, within the state dependent on irrigation water. Droughts also stress wildlife, and heighten the risk of wildfire.

Dam Failure

Dam failures result from the failure of a man made water impoundment structure, which often results in catastrophic down grade flooding. Dam failures are caused by one or a combination of the following: "breach from flooding or overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, vegetation and rodents, poor construction, lack of maintenance and repair, misuse, improper operation, terrorism, or a combination of any of these" (Eldredge 46). The Utah State Engineer has been charged with regulating non-federal dams in the State dams since 1919. "In the late 1970's Utah started its own Dam Safety Section within the State of Utah Engineers Office to administer all non-federal dams in response to the Federal Dam Safety Act (PL-92-367)" (Eldredge 46).

The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, the size, height, volume, and incremental risk/damage assessments or dams are all variables used to assign dam hazard ratings in Dam Safety's classification system. Using the hazard ratings systems developed by the Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams

would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years.

Problem Soils

Problem soils and rock constitute a widespread geologic hazard in Utah, covering approximately 18 to 20 percent of the state, and underlie many urbanized areas. The nine types of problem soil and rock in Utah are:

- Expansive Soil
- Collapsible Soil
- Limestone and Karst Terrain
- Gypsiferous Soil
- Soil Subject to Piping
- Dunes
- Peat
- Mine Subsidence
- Sodium Sulfate

Expansive Soil and Rock

Clay minerals found in soils and rock expand and contract due to changes in moisture content. The most common clay mineral associated with expansive soils in Utah is montmorillonite, “which expands up to 2,000 times its original size, and can exert pressures up to 11,000 pounds per square foot” (Eldredge 30). The cracks created by the expansion and contraction process create a positive feed back mechanism that allows more water to enter during the next storm cycle. Problems associated with expansive materials are cracked foundations, heaving and cracking of road surfaces, failure of wastewater disposal systems, and broken water lines.

Collapsible Soil

Collapsible soil causes ground-surface subsidence when loose, dry, low density deposits decrease in volume when saturated for the first time since deposition. Frequently the water introduced into these soils is from human sources such as irrigation, water impoundment, lawn watering, and alterations to natural drainages, and/or wastewater disposal.

Limestone and Karst Terrain

Closed depressions, caverns, and streams that abruptly disappear underground are characteristics of karst terrain. Limestone, dolomite, and gypsum are all common in the Six County region and susceptible to dissolution by ground water and surface water thus forming karst terrain. Karst features affect surface and

subsurface drainage causing a collapse of the ground surface and often the contamination of ground water. The cavernous nature of the terrain allows surface or subsurface sources of pollution from landfills, waste water disposal systems, and buried gasoline tanks to enter the groundwater system.

Gypsiferous Soil
Gypsum is a primary component in some rocks, and the soils derived from them. Gypsiferous deposits, when wetted, are subject to settlement, causing sinkholes similar to those found in karst terrains. Weathered gypsum forms sulfuric acid and sulphate, which reacts with certain types of cement often weakening foundations. Gypsum is also a week material with a low bonding strength.

Piping
Piping is a type of subsurface erosion caused by ground water moving along a permeable layer in unconsolidated materials and exiting at a free face, which intersects the unconsolidated layer. The movement of underground water removes fine-grained particles (silts and clay) creating subsurface voids, which act like channels directing the movement of water. These channels increase in size, as more and more water is collected, until the walls and roof can no longer support the weight and collapse. Over time this process forms a gully, which further concentrates erosion.

Dunes
Dunes form when sand derived from weathered rock or an unconsolidated deposit is blown by the wind into mounds or ridges. Migrating dunes can bury roads, and structures, clog waste and storm water systems, and cause contamination of local ground water.

In Utah, three types of material commonly form dunes: silica, gypsum, and oolites.

Silica Dunes comprised mainly of silica, are typically found along the western side mountain ranges in western Utah.

Gypsum Dunes are principally derived from the evaporation of playas and are found in Great Salt Lake Desert and along the lee side of many playas in the basins west of Delta.

Oolitic Dunes are composed of calcium carbonate, which is generally precipitated around brine shrimp fecal pellets. Oolitic dunes form in shallow water areas of the Great Salt Lake and are reworked by wind during low water lake cycles.

Many inactive or vegetated dunes in Utah are being reactivated by development and motorized recreation. Once dunes are denuded of there vegetation they begin to migrate once again.

Mine Subsidence
Utah has a long history of mining and there are numerous mines within Utah. Mining removes rock and leaves voids that, if not supported, can collapse and cause subsidence of the ground surface and sinkholes. Subsidence can occur in both active and abandoned mines.

Peat
Peat consists of partially decomposed plant remains. Peat usually accumulated in areas of shallow ground water and near standing water where oxygen depletion limits organic decay. Hazards associated with peat can include subsidence when water is removed, oxidations, and compression and settlement under. Peat deposits are considered a localized hazard occurring primarily along the shores of the Great Salt Lake, Utah Lake, and low lying areas formerly occupied by Lake Bonneville. Mountainous areas commonly have localized small areas of peat, forming in head scarps created by landslides and behind glacial moraines. (Eldredge 33)

Sodium Sulfate
Sodium Sulfate is derived from the evaporation of playas and for the weathering of bedrock. “Soils with high concentrations of water-soluble sulfates exhibit an expansive phenomenon resembling that of expansive clays and frost heave.” (Eldredge 33)

Critical Facilities
Duchesne County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.	Replacement Value (Estimated)	Contents Value *
Critical Facilities											
Altamont Fire Dept	AGRC	X									
Duchesne Fire Dept	AGRC	X									
Ft. Duchesne Fire Dept	AGRC	X									
Fruitland Fire Dept	AGRC	X									
South Myton Fire Dept	AGRC	X									
Tabiona Fire Dept	AGRC	X									
Duchesne County Sheriff	AGRC	X									
Roosevelt Police Dept	AGRC	X									
Uintah Basin Medical Center	AGRC	X	X			X	X				
Roosevelt Fire Dept.	AGRC	X									
Neola Fire Dept.	AGRC	X									
Care Facilities											
Stewarts Care Center	AGRC	X	X				X				
Schools											
East School Duchesne	AGRC		X				X				
Duchesne District Office	AGRC		X				X				
Altamont School	AGRC		X				X				
Altamont High School	AGRC		X				X				
Duchesne High School	AGRC		X				X				
Duchesne School	AGRC		X				X				
Ioka School	AGRC		X				X				
Myton School	AGRC		X				X				
Neola School	AGRC		X				X				
Union High School	AGRC		X				X				
Roosevelt Middle School	AGRC		X				X				
Tabiona School	AGRC		X				X				
Con Amore Train Ctr	AGRC		X				X				
Hazardous Material Storage Sites											
Chevron Pipe Line Myton Station	RCRA						X				
Duchesne City Corp	RCRA						X				
Chevron Pipe Line Altamont Station	RCRA						X				

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.	Replacement Value (Estimated)	Contents Value *
Chevron Pipe Line Hanna Station	RCRA						X				
Chevron Pipe Line Bluebell Station	RCRA						X				
Pennzoil Company (Seagull)	RCRA						X				
Moon Lake Electric	RCRA						X				
NL Baroid Roosevelt Service Center	RCRA						X				
Altamont Gas Plant	RCRA						X				
Petro-Way INC #1	RCRA						X				
Desert Drain Oil	RCRA						X				
National Oilwell	RCRA						X				
Atkinson Storage Altamont	RCRA						X				
Rocket Sanitation	RCRA						X				
Koch Hydrocarbon Cedar Rim	RCRA						X				
Koch Services	RCRA						X				
Chevron USA Inc Duchesne Terminal	RCRA						X				
MI Drilling Fluids	RCRA						X				
GWEC Altonah Gas Plant	RCRA						X				
Darryl B Taylor Transportation	RCRA						X				
US Forest Service Stockmore Ranger station	RCRA						X				
Bluebell Recovery	RCRA						X				
Power Substations											
Moon Lake Plant	AGRC	X			X		X				
Pole Creek Plant	AGRC	X			X		X				
Roosevelt	AGRC	X			X		X				
Duchesene	AGRC	X			X		X				
Pleasant Valley Moon Lake REA	AGRC	X			X		X				
Upalco	AGRC	X			X		X				
Tabiona Chevron Pipeline Sub	AGRC	X			X		X				
Myton	AGRC	X			X		X				
Pariette	AGRC	X			X		X				
Companies Employing Greater than 50 People											
Flying J Outfitters	AGRC					X	X				
Uintah Basin Medical Ctr	AGRC					X	X				
Utah State University	AGRC					X	X				

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft	Replacement Value (Estimated)	Contents Value *
UBET Wireless	AGRC					X	X				
IGA Foodliner	AGRC					X	X				
Darryl Taylor Transportation	AGRC					X	X				
Sand Star Family Entertainment	AGRC					X	X				
Uintah Basin Medical Clinic	AGRC					X	X				
Stewart's Care & Rehab	AGRC					X	X				
Inland Production Co	AGRC					X	X				
UBTA Network & Internet SVC	AGRC					X	X				
Duchesne School District	AGRC					X	X				
Uintah Basin Applied Tech Ctr	AGRC					X	X				
Inland Production	AGRC					X	X				
Frontier Motel	AGRC					X	X				
Duchesne County Sheriff	AGRC					X	X				
Uinatah Basin Telephone	AGRC					X	X				
Stewart's Thriftway	AGRC					X	X				
Moon Lake Electric Assn Inc	AGRC					X	X				
Davis Jubilee IGA	AGRC					X	X				
Burdick Paving Corp	AGRC					X	X				
Basin Western Inc	AGRC					X	X				

Daggett County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.	Replacement Value (Estimated)	Contents Value *
Critical Facilities											
Daggett County Medical Center	AGRC	X	X			X	X				
Daggett County Fire Department	AGRC	X									
Manila Fire Department	AGRC	X									
Dagget Administration Building	AGRC	X									
Daggett County Sheriff Dep.	AGRC	X									
Schools											
Daggett County School District	AGRC		X				X				

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft	Replacement Value (Estimated)	Contents Value *
Manila High School	AGRC		X				X				
Hazardous Materials Storage Sites											
US Forest Service Lucerne Valley	RCRA			X			X				
US Bureau of Rec. Flaming Gorge Dam	RCRA			X			X				
Power Substations											
Flaming Gorge	AGRC	X			X		X				
USBR Flaming Gorge Plant	AGRC	X			X		X				
Companies Employing Greater Than 25 People											
Daggett County Health Dept.	AGRC					X	X				
US Post Office	AGRC					X	X				
US Forest Service Ranger Station	AGRC					X	X				
US Bureau of Reclamation	AGRC					X	X				
Daggett County Jail	AGRC					X	X				
Uintah Basin Public Health Dept	AGRC					X	X				
Utah State University	AGRC					X	X				

Uintah County

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft.	Replacement Value (Estimated)	Contents Value *
Critical Facilities											
Uintah County Admin Building	AGRC	X									
Avalon Fire Dept.	AGRC	X									
Jensen Fire Dept.	AGRC	X									
Vernal Fire Dept.	AGRC	X									
Ute Indian Tribe	AGRC	X									
Lapoint Fire Dept	AGRC	X									
Naples Fire Dept	AGRC	X									
Randlett Fire Dept	AGRC	X									
Vernal Fire Dept	AGRC	X									

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft	Replacement Value (Estimated)	Contents Value *
Ashley Valley Medical Center	AGRC	X	X			X	X				
Ft. Duchesne Fire Department	AGRC	X									
Vernal City Police Dept	AGRC	X									
BIA Police	AGRC	X									
Naples City Police Dept	AGRC	X									
Uintah County Sheriff's Dept	AGRC	X									
Health Dept	AGRC	X	X			X	X				
Care Facilities											
Vernal Care Center	AGRC	X	X				X				
Beehive Homes of Vernal	AGRC	X	X				X				
Schools											
Ft. Duchesne School	AGRC		X				X				
Lapoint School	AGRC		X				X				
Uintah County School Dist	AGRC		X				X				
Vernal School	AGRC		X				X				
Ute Indian Tribe School	AGRC		X				X				
Utah State University Branch	AGRC					X	X				
Applied Technology Center	AGRC						X				
Hazardous Material Storage Sites											
Vernal Avenue TCE Plume	RCRA						X				
American Gilsonite	RCRA						X				
Great Lake Timber Company	RCRA						X				
Ouray Utah Haz Waste Site	RCRA						X				
Murray's Disposal Service	RCRA						X				
US EPA Abandoned Waste Response	RCRA						X				
BIA Uintah & Ouray Agency	RCRA						X				
AMF Tuboscope	RCRA						X				
Dowell	RCRA						X				
Industrial Mechanisms	RCRA						X				
Chevron Resources	RCRA						X				
Wheeler Machinery	RCRA						X				
Schlumberger Well Services	RCRA						X				
Western Company	RCRA						X				
Dowell Schlumberger Inc	RCRA						X				
Nowcam Services	RCRA						X				
Baker Oil Tools	RCRA						X				
J & Sons Drum Cleaners	RCRA						X				

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft	Replacement Value (Estimated)	Contents Value *
Westrock Warehouse	RCRA						X				
PAMCO	RCRA						X				
Halliburton	RCRA						X				
Oil Field Rental	RCRA						X				
H and H Bico Rental	RCRA						X				
Chevron Service Station #73272	RCRA						X				
NATCO	RCRA						X				
Weatherford US	RCRA						X				
Smith Detroit Allison	RCRA						X				
Questar Pipeline	RCRA						X				
West Hazmat Trucking	RCRA						X				
NL Petroleum Service	RCRA						X				
AZ Grant International	RCRA						X				
Miller Packers Inc.	RCRA						X				
Pacificorp	RCRA						X				
Perry Motors Company	RCRA						X				
West End Laundromat	RCRA						X				
USFS Vernal Ranger District	RCRA						X				
Crop Air Inc	RCRA						X				
Colorado Interstate Gas	RCRA						X				
Bowen Tools Inc	RCRA						X				
Paraho Commercial Shale Oil	RCRA						X				
Pipe Renewal Service	RCRA						X				
Natural Gas Pipeline Co	RCRA						X				
Northwest Pipeline	RCRA						X				
Power Substations and Plants											
La Point Generating Station	AGRC	X			X						
USBR Vernal	AGRC	X			X						
Bonanza	AGRC	X			X						
Ashley	AGRC	X			X						
Naples	AGRC	X			X						
Maeser	AGRC	X			X						
Chevron Resources	AGRC	X			X						
Companies Employing Greater than 50 People											
Ashley Valley Medical Ctr	AGRC					X					
Wal-Mart Discount	AGRC					X					
JC Penny Co	AGRC					X					
S F Phosphates	AGRC					X					

Name or Description Of Asset	Sources Of Information	Critical Facility	Vulnerable Populations	Hazardous Material	Infrastructure	Economic Assets	Special Considerations	Historic/Other Considerations	Size of Building (sq. ft	Replacement Value (Estimated)	Contents Value *
Halliburton Energy	AGRC					X					
Smith's Food & Drug	AGRC					X					
J West	AGRC					X					
Deseret Generation Co-op	AGRC					X					
J West Oil Field	AGRC					X					
J West Transportation	AGRC					X					
Uintah Care Ctr	AGRC					X					
Colorado Outward Bound	AGRC					X					
Uintah School District	AGRC					X					
Bureau of Land Management	AGRC					X					
White Pine Ear Nose & Throat	AGRC					X					
Ute Head Start Program	AGRC					X					
Gold Cross Ambulance Svc	AGRC					X					
Davis Jubilee IGA	AGRC					X					
American Gilsonite	AGRC					X					
Ute Plaza Supermarket	AGRC					X					
Christensen's Departments Store	AGRC					X					
BJ Services Co	AGRC					X					
K Mart Discount Stores	AGRC					X					
Target Trucking Inc.	AGRC					X					
Bob's Big Boy Restaurant	AGRC					X					
LDS Church	AGRC					X					

RCRA - Hazardous Waste Sites in Utah, locations were determined from addresses furnished by the Utah Department of Environmental Quality.

AGRC – State Automated Geographic Reference Center, houses GIS data for the state of Utah.

Environmental Considerations

Natural disasters are naturally occurring phenomena. They play an integral part in maintaining balance in our world. Meteorological, geological, or hydrological processes have shaped Utah for millions of years and will continue to shape the valley for millions more years. These unique phenomena only cause disasters when they affect humans and their structure. Modern engineering has made it possible to prevent damage from natural hazards, however the economic and environmental costs can be rather high. Tampering with the natural systems also can create an imbalance in the natural environment. The effects of many of these imbalances are still unknown. It is better to live will a small amount of risk, respect the natural process where appropriate, than to construct mitigation at every chance. Nature provides it's own mitigation measures that need to be identified, protected and/or strengthened. To ensure that our environment is not harmed through mitigation measures all applicable city codes; county codes, state and federal laws pertaining to the environment must be followed. The majority of the proposed mitigation programs in this plan will be funded through federal programs, thus tied to federal funding.

"44 CFR 10.8(d)(2)(iii) excludes this rule from the preparation of an environmental assessment or environmental impact statement, where the rule relates to actions that qualify for categorical exclusions under 44 CFR 10.8(d)(2)(iii), such as the development of plans under this section" (44 Code).

The following acts will be taken into consideration and will be incorporated when needed while organizing and implementing the PDM plan; Clean Air Act, Clean Water Act, Endangered Species Act, Floodplain Management, National Historic Preservation Act.

Clean Air Act (CAA) 1970: The Clean Air Act is the comprehensive Federal Law that covers the entire country under the Environmental Policy Act (EPA) regulating air emissions from area, stationary, and mobile sources. This law sets limits or National Ambient Air Quality Standards (NAAQS) on how much of a pollutant can be in the air anywhere in the United States, this controls the emissions of air pollutants. These limits ensure that all Americans have the same basic health and environmental protections. Maximum pollutant standards were set and states may have stronger pollution controls on an individual basis, but not weaker pollution controls than those set for the whole country. Each state explains how it will do its job under the Clean Air Act by developing a mandated "state implementation plan" (SIP) that has to be approved by EPA. The 1977 amendment was to set new dates for areas of the country that failed to meet the initial deadlines for achieving NAAQS. The 1990 amendments addressed problems such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics. This act required that facilities with large amounts of certain hazardous chemicals to have special emergency planning requirement. Based

on a facilities potential threat or risk from chemical spills, fires, explosions, etc. a Risk Management Plan (RMP) is prepared that includes hazard identification, assessments, design and maintenance of a safe facility, necessary steps to prevent releases and ways to minimize the consequences from an accidental release (Clean Air).

Clean Water Act (CWA): The Federal Water Pollution Control Act Amendments of 1972 came about because of the growing awareness for controlling water pollution. As amended in 1977, this law became known as the Clean Water Act whose mission is to establish the basic structure for regulating discharges of pollutants into the waters of the United States, and to reduce and maintain the chemical, biological, and physical veracity. The act gave the Environmental Policy Act (EPA) the authority to set wastewater standards for industry. The act also required that each state adopt water quality standards, act to protect wetlands, and limit industrial and municipal discharges into navigable waters unless permitted. It funded the construction of wastewater treatment plants for nearly every city in the United States, under construction grant programs from the EPA and recognized the need for planning for future problems that posed a threat from nonpoint source pollution (Clean Water).

Clean Water Act, Section 404-Wetland Preservation: This act regulates activities in wetland areas and authorizes EPA to restrict or prohibit the use of an area as a disposal site for dredged or fill material if the discharge will have unacceptable adverse affects on municipal water supplies, shellfish beds and fishery areas, wildlife and/ or recreational areas. A permit must be issued that is based on regulatory guidelines developed in coincidence with the U.S. Army Corps of Engineers and the EPA (CWA Sec. 404).

Endangered Species Act of 1973: This act provides a plan for the protection of threatened and endangered plants and animals and the habitats in which they are found. Congress finds and declares that various species of fish, wildlife, and plants in the United States have been caused to become extinct, or are so depleted in numbers they are in danger of becoming extinct, as a result of economic development and expansion without adequate concern for conservation. Aesthetic, ecological, educational, historical, recreational, and scientific importance come from these species and are a value to our nation and its people. The U.S. will conserve, to a practicable extent, the species that face extinction and will encourage the States through federal assistance to develop and maintain conservation programs. The reason for the Act is to provide a means in which ecosystems with endangered and threatened species will be conserved. It is also declared that all state and local agencies resolve water resource issues in connections with conservation of endangered species (Endangered).

Floodplain Management Policy: The main points of the policy are to reduce the loss of life and property and the disruption of societal and economic pursuits

caused by flooding or facility operations as well as to restore, sustain, and enhance the natural resources, ecosystems, and other functions of the floodplains. Activities will search for a balance between the, sometimes competing, uses of floodplains in a way that makes the most benefit to society. To pursue and encourage appropriate use of floodplains and to avoid long and short term negative impacts associated with the inhabitants and modification of floodplains and to avoid direct and indirect support of floodplain development, whenever there is a practicable alternative. **"**Functions (Natural) of floodplains include natural moderation of floods; fish, wildlife, and plant resources and habitat; groundwater recharge; and water quality maintenance. Uses of floodplains include storm water management; erosion control; open space; natural beauty, opportunity for scientific study, outdoor education, recreation, and cultural preservation; and compatible economic utilization of floodplain resources by human society" (Floodplain, Reclamation).

National Historic Preservation Act of 1966: This act was found and declared by Congress because "the spirit and direction of the Nation are founded upon and reflected in its historic heritage…the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people." Some of the other main points of the act include the awareness of historic properties that are being lost or substantially altered. The preservation will continue a legacy of cultural, educational, aesthetic, inspirational, economic, and energy benefits for future generations. The knowledge of historic resources and "the encouragement of their preservations will improve the planning and execution of Federal and federally assisted projects and will assist economic growth and development. The act would like to use measures that will foster conditions in which historic resources can exist in productive harmony with present and future generations (National).

Section 106 of NHPA "requires all Federal agencies to take into account the effects of their actions on historic properties, and provide ACHP with a reasonable opportunity to comment on those actions and the manner in which Federal agencies are taking historic properties into account in their decisions" beginning at the early stages of planning to mitigate any adverse effects on historic properties (Section 106).

The Richter Magnitude Scale

The Richter Magnitude Scale

Seismic waves are the vibrations from earthquakes that travel through the earth; they are recorded on instruments called seismographs. Seismographs record a zig-zag trace that shows the varying amplitude of ground oscillations beneath the instrument. Sensitive seismographs, which greatly magnify these ground motions, can detect strong earthquakes from sources anywhere in the world. The time, locations, and magnitude of an earthquake can be determined from the data recorded by seismograph stations.

The Richter magnitude scale was developed in 1953 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquake. On the Richter scale, magnitude is expressed in the whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy that the amount associated with the preceding whole number value.

At first, the Richter Scale could be applied only to the records from instruments of identical manufacture. Now, instruments are carefully calibrated with respect to each other. Thus, magnitude can be computed from the record or any calibrated seismograph.

Earthquakes with magnitude of about 2.0 or less are usually called micro earthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of about 4.5 or greater are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes such as the 1964 Good Friday earthquake in Alaska have magnitudes of 8.0 or higher.
Description of Richter Scale from USGS Earthquake Hazards Program

Modified Mercalli Intensity and PGA Equivalents

MMI	Acceleration (%g) PGA	Perceived Shaking	Potential Damage
I	<0.17	Not Felt	None
II	0.17-1.4	Weak	None
III	0.17-1.4	Weak	None
IV	1.4-3.9	Light	None
V	3.9-9.2	Moderate	Very Light
VI	9.2-18	Strong	Light
VII	18-34	Very Strong	Moderate
VIII	34-65	Severe	Moderate to Heavy
IX	65-124	Violent	Heavy
X	>124	Extreme	Very Heavy
XI	>124	Extreme	Very Heavy
XII	>124	Extreme	Very Heavy

Table expressing relationship of peak horizontal ground acceleration (PGA) to Modified Mercalli Intensity (MMI) adapted after (Wald et al., 1999).

The map shows the national Peak Ground Acceleration (PGA) values for the United States with a 10% chance of being exceeded over 50 years. This is a common earthquake measurement that shows three things: the geographic area affected (all colored areas on the map), the probability of an earthquake of each given level of severity (10% chance in 50 years), and the severity (the PGA is indicated by color). ***2. Locate your planning area on the map.***

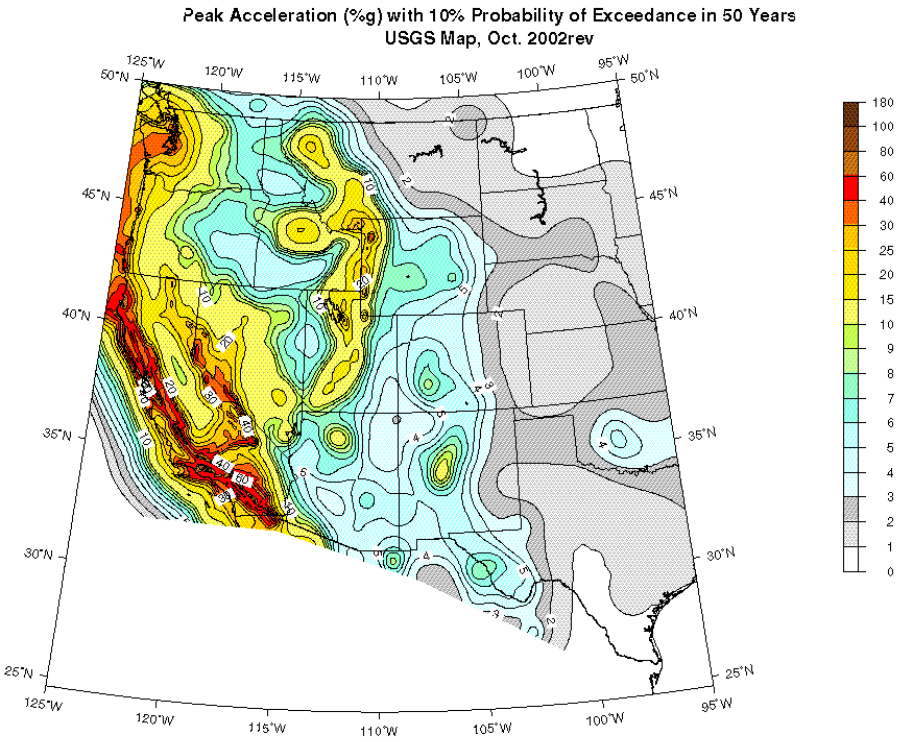
You can also generate maps based on zip codes or longitude and latitude by following the directions on the Website. ***3. Determine your Peak Ground Acceleration.***
Determine the PGA zone(s) in which your planning area is located. This is done by identifying the color associated with your planning area and correlating it with the color key located on the map. Large planning areas may be located in more than one zone.

Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (g) (980 cm/sec/sec). For example, In an earthquake with an acceleration of the ground surface of 244 cm/sec/sec, the PGA or rate in change of motion is 25% g where:

%g= Ground Surface Acceleration/ Rate of Acceleration due to Gravity

%g= 244 cm/sec/sec/980 cm/sec/sec

%g= 25%


Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
180
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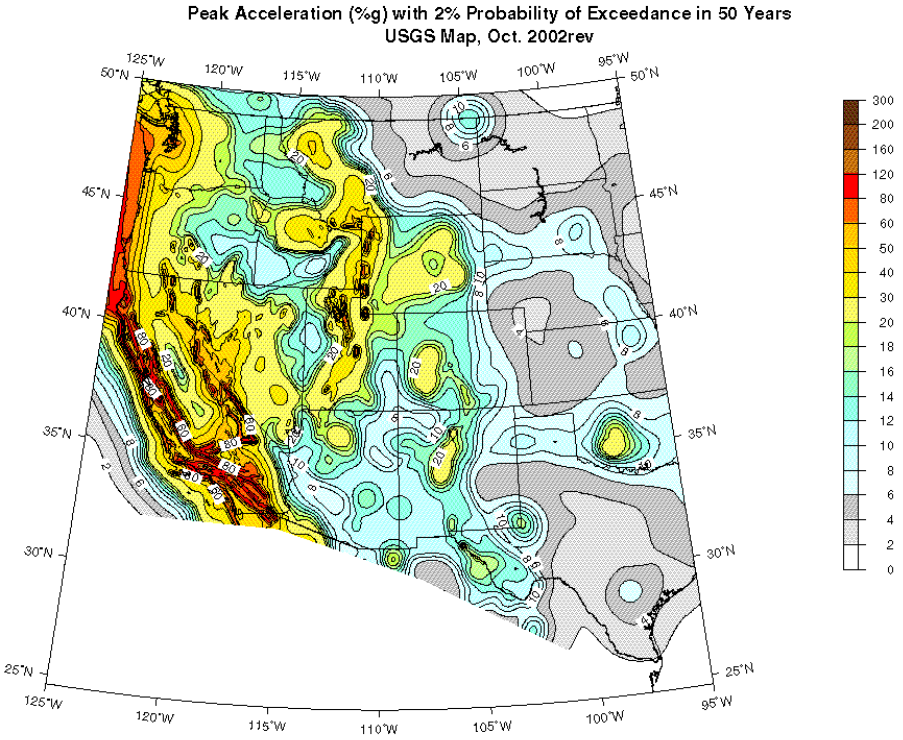
5
4
3
2
1
0


Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev
125°W
120°W
115°W
110°W
105°W
100°W
95°W
50°N
45°N
40°N
35°N
30°N
25°N
300
200
160
120
80
60
50
40
30
20
18
16
14
12
10
8
6
4
2
0

Building Code Effectiveness Grading Report

The Building Code Effectiveness Grading Report was implemented in 1995 to evaluate current building codes in a particular community and determine how well the community enforces its building codes. This program assigns each municipality a grade of 1 to 10 with one showing excellent commitment to building code enforcement. Insurance Services Office Inc, developed and uses the rating classifications 1-3, 4-7, 8-9, 10. Insurance Services Office Inc. gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept of the Building Code Effectiveness Grading Reports (BCEGS) is for those communities with effective, well-enforced building codes. These communities should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. In addition, FEMA uses these scores to give higher credits in competitive grant programs to those communities with lower scores.

Building Code Effectiveness Grading Report			
City	**County**	**BCEGS Res/Com**	**Date**
Uintah CO	Uintah	4/4	2003
Vernal	Uintah	2/2	2001
Manila	Daggett	4/4	2003
Duchesne	Duchesne	Unclassified	1999
Duchesne CO	Duchesne	Unclassified/3	2003
Roosevelt	Duchesne	Unclassifed/5	2001

Explanation of FEMA Hazard Profile

A hazard profile was created for each hazard in each county within Uintah Basin Association of Governments jurisdiction. These profiles including potential severity or magnitude, frequency, location, seasonal pattern, duration, and speed of onset, were developed based on a model suggested by FEMA Region VIII. The information within each field of the table was derived by the Counties participating in the mitigation planning process based on GIS risk analysis, history of occurrence, and expert advice.

FEMA Hazard Profile

Frequency	Possible
Severity	Catastrophic
Location	A large magnitude earthquake would produce ground shaking felt throughout the entire region. Surface fault rupture is expected in areas of known historic fault movements, for earthquake with a magnitude 6.5 or greater.
Seasonal Pattern	None
Duration	Actual ground shaking will be under one minute yet after shocks may occur for weeks after.
Speed of Onset	No warning

Frequency:

- Highly Likely
  Near 100% probability in next year.
- Likely
  Between 10% and 100 % probability in the next year, or at least one chance in 10 year period.
- Possible
  Between 1% and 10% probability in the next year, or at least one chance in next 100 years.
- Unlikely
  Less than 1% probability in the next 100 years.

Severity or Magnitude:

- Catastrophic
  - Multiple fatalities if event were to occur
  - Complete shutdown of facilities for 30 days or more
  - More than 50 percent of property is severely damaged

- Critical
    - Injuries and/or illnesses results in permanent disability
    - Complete shutdown or critical facilities for at least 2 weeks
    - More than 25 percent of property is severely damaged
- Limited
    - Injuries and/or illnesses result in permanent disability
    - Complete shut down of critical facilities for more than one week
    - More than 10 percent of property is severely damaged
- Negligible
    - Injuries and/or illnesses are treatable with first aid
    - Minor quality of life lost
    - Shutdown of critical facilities and services for 24 hours or less
    - Less than 10 percent of property is severely damaged

Location:
Areas most likely to be affected or the sectors most likely to be affected.

Seasonal Pattern:
The particular season the event is most likely to occur. Examples include tornado season and hurricane season.

Duration:
The amount of time between when an event starts to when the event ends. For example the ground shaking caused by an earthquake is only a minute (where as a hurricane event can be several days.)

Speed of Onset:
Probable amount of warning time before an event occurs.

- Minimal or no warning time
- 6 to 12 hours warning time
- 12 to 24 hours warning time
- More than 24 hours warning

Warning time is vital as it allows people to seek safe locations or shelters and prepare their property in hopes of reducing damages.

Flood

Prevention
- Planning and zoning
- Floodplain open space preservation
- Building construction regulations
- Regulation of other facilities (critical)
- Stormwater management

Property Protection
- Relocation
- Acquistion
- Building Elevation
- Floodproofing
- Lifeline protection
- Flood insurance

Natural Resource Protection
- Wetland protection
- Erosion and sediment control

Emergency Services
- Flood threat recognition
- Warning dissemination
- Flood response
- Critical facilities protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects
- Reserviors/impoudments
- Levees
- Diversions
- Channel and drainage modifications
- Channel and basin maintenance

Public Information
- Flood hazard Maps

Earthquake

Prevention
- Planning and zoning
- Building construction regulations
- Regulation of other facilities (critical)

Property Protection
- Non-Structural Methods
- Retrofit upgrades
- Earthquake insurance

Natural Resource Protection
- Identified fault rupture zones
- Identified secondary impact

Emergency Services
- Earthquake threat recognition
- Emergency planning for secondary impact
- Emergency response (mutual aid, CERT)
- Critical facilities protection
- Health and safety maintenance
- Post-Disaster recovery and mitigation

Structural Projects
- Rebuild or retrofit critical facilities higher seismic code

- Map information
- Outreach projects
- Real estate disclosure
- Library
- Technical Assistance
- Environmental education

Dam Failure

Prevention

- Dam failure inundation maps
- Planning, zoning, open space preservation in risk area
- Building codes with elevation based on dam failure
- Dam safety inspections
- Rigorous dam maintenance schedule
- Draining dam when conditions are unsafe

Property Protection

- Acquisition of structures in inundation path
- Flood Insurance

Natural Resource Protection

- Prohibit development in high-risk areas.

Emergency Services

- Monitor condition dam
- Warning and evacuation plans based on dam failure
- Develop and conduct dam failure emergency exercise

Structural Projects

- Dam improvements, spillway enlargements
- Remove unsafe dams

Public Information

- Seismic maps; liquefaction, faults, zones
- Map information
- Outreach projects
- Real estate disclosure
- Library
- Technical Assistance
- Education

Wildfire

Prevention

- Zoning ordinances to reflect fire risk zones
- Restrict development areas near fire protection and water resource
- Planning to include; spacing of buildings, firebreaks, on-site water storage, wide roads, multiple accesses
- Code standards for roof materials and fire protection systems
- Maintenance programs to clear dead and dry brush
- Regulations on open fires
- Open space around structures

Property Protection

- Retrofitting roofs, add spark arrestors
- Create and maintain defensible space
- Insurance
- Eliminate ladder fuels
- Install sprinkling systems
- Develop fire resistant plans
- Have home addresses displayed
- Clean out rain gutter

Public Information

- Develop outreach materials on dams, dam failure and community emergency plan for dam failure

Landslides

Prevention

- Monitor and evaluate areas after wildfire
- Install ground monitoring instruments on landslides for movement
- Restrict development in landslide-prone areas
- Establish codes (grading, construction, excavation), in landslide-prone areas
- Slope grading

Property Protection

- Control and monitor surface and groundwater drainage
- Control building in areas of landslides
- Evaluate property maintenance in areas of landslides (over watering)
- Avoid ground level windows that face upslope

Natural Resource Protection

- Complete a watershed management plan
- Limit use of ATV's in areas of landslides to manage erosion
- Evaluate impact of wildfire in areas of landslides
- Restrict development in landslide-prone areas
- Maintain natural vegetation

Emergency Services

- Monitor and warning systems

Natural Resource Protection

- Prohibit development in high-risk areas
- Understand impact of non-native vegetation
- Promote tread soft ATV use
- Develop watershed management plan
- Maintain watershed
- Establish and promote fuel reduction

Emergency Services

- Mutual aid agreements for fire fighting
- Participate in State Wildfire Suppression Fund
- Develop and exercise local wildfire response plan and evacuation plans

Structural Projects

- Construct wildfire fuel breaks
- Install heliport water stations
- Tree and underbrush thinning in critical areas
- Increase number of fire hydrants
- Install water tanks

Public Information

- Develop maps for wildfire hazard area
- Wildfire information mailout to high risk residents
- Develop urban wildfire "how to protect your home from wildfires" book
- Newspaper article on wild fires
- Presentation on wildfires at community meetings
- Develop wildfire displays for display in public building

- Evacuation plans and exercises

Structural Projects

- Build buttress, retaining walls other engineered structures
- Install subsurface drainage materials
- Remove landslide materials
- Constructing Debris Basins
- Control rock falls, catch fences, tie back walls, rock bolts, cut benches and berms

Public Information

- Updated maps of landslide areas
- Real estate disclosure
- Develop outreach material (newsletters, articles, displays)
- Notice to homeowners in landslide areas detailing hazard

Drought

Prevention

- Establish economic incentives for water conservation
- Encourage water conservation
- Develop early warning system, monitoring
- Implement water metering and leak detection programs
- Develop early warning system, monitoring program

Property Protection

- Evaluate potential wildfire due to drought
- Identify secondary affects from drought
- Real estate disclosure of high hazard wild fire area.

Severe Weather

Prevention

- Early warning and notification systems
- Building codes to address wind and snow load
- Properly ground structures for lightning
- Public education for severe weather conditions
- Restrict development in areas of avalanche

Property Protection

- Structural tie down of roofs for high winds
- Restrict development in areas of avalanche
- Monitor NWS weather warnings and watches

Natural Resource Protection

- Evaluate impact of severe weather
- Restrict development in areas of avalanche

Emergency Services

- Monitor NWS weather warnings and watches
- Develop plans and exercises for severe weather related incidents

Structural Projects

- Install sheds over roads below avalanche terrain
- Install drift fences along snow drift areas
- Install avalanche fencing along ridgelines

Natural Resource Protection

- Legislation to protect stream flow
- Protect water aquifers

Emergency Services

- Alert procedures for water quality issues
- Create inventory of pumps, filters, other equipment
- Establish water hauling program
- List livestock watering location
- Establish hay hotline
- Fund water system improvements (wells, systems)
- Lower well intakes
- Develop drought contingency plan
- Issue emergency permits for water use

Structural Projects

- Redesign or create new reservoir storage
- Provide pumps and piping for distribution

Public Information

- Develop drought education material
- Water conservation outreach material
- Other outreach for awareness

Public Information

- Develop outreach document on avalanche safety
- Become and NWS Storm Ready Community
- Promote lightning safety week
- Develop cold weather safety materials

Problem Soils

Prevention

- Planning and zoning restrictions and regulations
- Open space
- Building codes
- Drain system maintenance

Property Protection

- Insurance
- Remove Soil
- Ensure rain gutters extend away from structures

Natural Resource Protection

- Leave area as open space

Emergency Services

- Identify structures impacted by problem soils

Structural Projects

- Presoak and/or compact soils
- Install drain fields
- Bring in fill
- Remove soils

Public Information

- Develop information on problem soils
- Outreach materials on problem soil mitigation

HAZUS-MH: Earthquake Event Report

Region Name: ***Daggett County 2500 Year Event***

Earthquake Scenario: ***Daggett County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 721.94 square miles and contains 1 census tracts. There are over 0 thousand households in the region and has a total population of 921 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 0 thousand buildings in the region with a total building replacement value (excluding contents) of 88 (millions of dollars). Approximately 100.00 % of the buildings (and 94.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 503 and 66 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 0 thousand buildings in the region which have an aggregate total replacement value of 88 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 41% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilites into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 3 schools, 2 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 5 dams identified within the region. Of these, 2 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 569.00 (millions of dollars). This inventory includes over 103 kilometers of highways, 10 bridges, 0 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	10	5.40
	Segments	6	390.40
	Tunnels	0	0.00
		Subtotal	**395.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segmens	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	3	16.00
	Runways	3	91.40
		Subtotal	**107.40**
		Total	**503.20**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	1	65.30
	Pipelines	0	0.00
		Subtotal	**65.30**
Natural Gas	Facilities	1	1.10
	Pipelines	0	0.00
		Subtotal	**1.10**
OIL Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**66.30**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Daggett County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 341 thousand buildings will be at least moderately damaged. This is over 37.00 % of the total number of buildings in the region. There are an estimated 9 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.11	0	0.08	0	0.11	0	0.16	0	0.26
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.11	0	0.08	0	0.11	0	0.16	0	0.22
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	116	35.19	115	45.05	166	66.94	61	73.74	7	72.6
Single Family	213	64.60	140	54.79	82	32.83	22	25.95	3	26.8
Total	**330**		**256**		**249**		**83**		**10**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.01	0	0.01	0	0.01
MH*	116	35.19	115	45.05	166	66.94	61	73.74	7	72.68
Precast	0	0.00	0	0.00	0	0.00	0	0.01	0	0.02
RM*	30	8.97	11	4.31	18	7.21	10	11.95	1	7.94
Steel	0	0.04	0	0.03	0	0.04	0	0.04	0	0.11
UM*	3	0.97	3	1.21	4	1.61	2	2.94	1	12.15
Wood	181	54.72	126	49.31	60	24.06	9	11.16	1	6.92
Total	**330**		**256**		**249**		**83**		**10**	

*Note:

RM Reinforced Masonry
URM Unreiforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 6: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Least Moderate Damage > 50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	0	0	0	0
Schools	3	0	0	0
EOCs	0	0	0	0
PoliceStations	1	0	0	0
FireStations	2	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	6	0	0	6	6
	Bridges	10	0	0	10	10
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	1	0	0	1	1
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	340	0	0	0	0	0
Electric Power		340	340	340	340	340

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 46.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 921 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**2**	**0**	**0**	**0**
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**

Economic Loss

The total building-related economic loss estimated for the earthquake is $7.06 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 7.06 (millions of dollars); 7 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 90 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.05	0.05	0.00	0.02	0.11
	Capital-Related	0.00	0.02	0.05	0.00	0.00	0.08
	Rental	0.17	0.08	0.02	0.00	0.01	0.27
	Relocation	0.02	0.01	0.00	0.00	0.00	0.02
	Subtotal	**0.18**	**0.15**	**0.12**	**0.00**	**0.03**	**0.49**
Capital Stock Loses							
	Structural	0.81	0.40	0.07	0.00	0.06	1.34
	Non_Structural	2.85	1.01	0.13	0.00	0.13	4.12
	Content	0.84	0.15	0.06	0.00	0.06	1.11
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**4.49**	**1.56**	**0.26**	**0.00**	**0.26**	**6.57**
	Total	**4.67**	**1.71**	**0.38**	**0.00**	**0.29**	**7.06**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	390	0	0.00
	Bridges	5	0	2.38
	Tunnels	0	0	0.00
	Subtotal	**395.80**	**0.10**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	16	3	21.45
	Runways	91	0	0.00
	Subtotal	**107.40**	**3.40**	
	Total	**503.20**	**3.60**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	1.10	0.00	0.00
	Subtotal	**1.07**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	65.30	0.00	0.00
	Subtotal	**65.27**	**$0.00**	
	Total	**66.34**	**$0.00**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-2.50
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-7.61
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-9.79
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-9.79
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-9.79
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-9.79

Appendix A: County Listing for the Region

- Daggett,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Daggett	921	83	4	88
Total State		**921**	**83**	**4**	**88**
Total Region		**921**	**83**	**4**	**88**

HAZUS-MH: Earthquake Event Report

Region Name: ***Duchesne County 2500 Year Event***

Earthquake Scenario: ***Duchesne County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3,251.34 square miles and contains 4 census tracts. There are over 4 thousand households in the region and has a total population of 14,371 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 780 (millions of dollars). Approximately 99.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 950 and 130 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 780 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 55% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilites into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 42 beds. There are 16 schools, 2 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 38 dams identified within the region. Of these, 11 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,080.00 (millions of dollars). This inventory includes over 174 kilometers of highways, 80 bridges, 0 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	80	34.90
	Segments	28	843.80
	Tunnels	0	0.00
		Subtotal	**878.70**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segmens	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	10.70
	Runways	2	60.90
		Subtotal	**71.60**
		Total	**950.30**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	2	130.50
	Pipelines	0	0.00
		Subtotal	**130.50**
Natural Gas	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
OIL Systems	Facilities	4	0.40
	Pipelines	0	0.00
		Subtotal	**0.40**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**130.90**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Duchesne County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 1,722 thousand buildings will be at least moderately damaged. This is over 30.00 % of the total number of buildings in the region. There are an estimated 92 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2	0.08	1	0.08	1	0.09	1	0.12	0	0.17
Commercial	30	1.05	3	0.23	5	0.43	3	0.64	1	1.00
Education	1	0.03	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.07	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	3	0.12	1	0.10	2	0.18	1	0.23	0	0.35
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	551	19.17	335	29.10	606	53.83	340	67.46	65	70.0
Single Family	2,283	79.47	812	70.49	512	45.47	159	31.54	26	28.4
Total	**2,873**		**1,153**		**1,126**		**504**		**92**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	8	0.03	0	0.01	0	0.02	0	0.02	0	0.04
MH*	529	18.43	335	29.06	606	53.79	340	67.41	65	69.94
Precast	5	0.15	0	0.04	1	0.09	1	0.20	0	0.32
RM*	313	10.87	60	5.21	117	10.38	82	16.20	11	11.68
Steel	10	0.04	0	0.01	0	0.03	0	0.07	0	0.11
UM*	50	1.75	16	1.35	24	2.11	18	3.48	11	12.02
Wood	1,956	67.89	739	64.09	374	33.18	61	12.18	5	5.28
Total	**2,873**		**1,153**		**1,126**		**504**		**92**	

*Note:

RM Reinforced Masonry
URM Unreiforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 42 hospital beds available for use. On the day of the earthquake, the model estimates that only 42 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 6: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Least Moderate Damage > 50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	1	0	0	1
Schools	16	0	0	2
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	2	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	28	0	0	28	28
	Bridges	80	2	0	80	80
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	2	0	0	2	2

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	2	0	0	1	2
Natural Gas	0	0	0	0	0
Oil Systems	4	0	0	1	4
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,559	0	0	0	0	0
Electric Power		4,559	4,559	4,559	4,559	4,559

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 40.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (28 households to be displaced due to the earthquake. Of these, 6 people (out of a total population of 14,371 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Residential	13	2	0	0
	Single Family	14	3	0	1
	Total	**28**	**5**	**1**	**1**
2 PM	Commercial	11	3	0	1
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	3	1	0	0
	Residential	3	0	0	0
	Single Family	3	1	0	0
	Total	**25**	**6**	**1**	**2**
5 PM	Commercial	10	3	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Residential	5	1	0	0
	Single Family	6	1	0	0
	Total	**23**	**5**	**1**	**1**

Economic Loss

The total building-related economic loss estimated for the earthquake is $52.09 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 52.09 (millions of dollars); 8 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 78 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.27	0.85	0.07	0.02	1.21
	Capital-Related	0.00	0.11	0.76	0.05	0.02	0.94
	Rental	1.15	0.43	0.43	0.03	0.00	2.04
	Relocation	0.11	0.03	0.02	0.00	0.00	0.16
	Subtotal	**1.26**	**0.83**	**2.05**	**0.16**	**0.05**	**4.35**
Capital Stock Loses							
	Structural	5.71	2.13	1.23	0.50	0.65	10.22
	Non_Structural	18.93	5.69	2.56	1.29	0.58	29.04
	Content	5.17	0.83	1.11	0.79	0.37	8.28
	Inventory	0.00	0.00	0.04	0.12	0.04	0.20
	Subtotal	**29.80**	**8.66**	**4.93**	**2.70**	**1.65**	**47.73**
	Total	**31.07**	**9.49**	**6.98**	**2.85**	**1.69**	**52.09**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	844	0	0.00
	Bridges	35	1	2.09
	Tunnels	0	0	0.00
	Subtotal	**878.70**	**0.70**	
Railways	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	11	2	21.25
	Runways	61	0	0.00
	Subtotal	**71.60**	**2.30**	
	Total	**950.30**	**3.00**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.40	0.04	9.46
	Subtotal	**0.39**	**$0.04**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	130.50	8.30	6.36
	Subtotal	**130.54**	**$8.30**	
	Total	**130.93**	**$8.33**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.79
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-2.42
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-3.11
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-3.11
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-3.11
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-3.11

Appendix A: County Listing for the Region

- Duchesne,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Duchesne	14,371	628	152	780
Total State		**14,371**	**628**	**152**	**780**
Total Region		**14,371**	**628**	**152**	**780**

HAZUS-MH: Earthquake Event Report

Region Name: ***Uintah County 2500 year Event***

Earthquake Scenario: ***Uintah County 2500 Year Event***

Print Date: ***October 20, 2003***

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Utah

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 4,492.86 square miles and contains 5 census tracts. There are over 8 thousand households in the region and has a total population of 25,224 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,199 (millions of dollars). Approximately 99.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,469 and 284 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,199 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 66% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilites into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 29 beds. There are 10 schools, 2 fire stations, 3 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 32 dams identified within the region. Of these, 12 of the dams are classified as 'high hazard'. The inventory also includes 9 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data is provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,753.00 (millions of dollars). This inventory includes over 349 kilometers of highways, 62 bridges, 0 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	62	26.30
	Segments	32	1,182.30
	Tunnels	0	0.00
		Subtotal	**1,208.60**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	1	15.10
	Tunnels	0	0.00
		Subtotal	**15.10**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segmens	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.10
		Subtotal	**1.10**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	6	32.00
	Runways	7	213.20
		Subtotal	**245.30**
		Total	**1,469.90**

Table 3: Utility System Lifeline inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Waste Water	Facilities	1	65.30
	Pipelines	0	0.00
		Subtotal	**65.30**
Natural Gas	Facilities	3	3.20
	Pipelines	0	0.00
		Subtotal	**3.20**
OIL Systems	Facilities	2	0.20
	Pipelines	0	0.00
		Subtotal	**0.20**
Electrical Power	Facilities	2	215.60
		Subtotal	**215.60**
Communication	Facilities	5	0.50
		Subtotal	**0.50**
		Total	**284.80**

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Uintah County 2500 Year Event
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	
Probabilistic Return Period	2,500
Longitude of Epicenter	0.00
Latitude of Epicenter	0.00
Earthquake Magnitude	7.00
Depth (Km)	0
Rupture Length (Km)	0.00
Rupture Orientation (degrees)	0.00
Attenuation Function	

Building Damage

Building Damage

HAZUS estimates that about 2,138 thousand buildings will be at least moderately damaged. This is over 28.00 % of the total number of buildings in the region. There are an estimated 58 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	23	0.74	14	0.62	18	1.15	9	1.85	2	2.81
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.05	1	0.05	1	0.09	1	0.14	0	0.20
Industrial	6	0.19	4	0.20	6	0.37	3	0.61	1	0.99
Religion	1	0.04	1	0.03	1	0.05	0	0.07	0	0.09
Residential	427	13.50	394	17.81	521	32.51	188	39.23	22	37.8
Single Family	2,705	85.47	1,799	81.29	1,054	65.83	278	58.10	34	58.1
Total	**3,165**		**2,212**		**1,602**		**478**		**59**	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	11	0.02	0	0.02	1	0.04	0	0.05	0	0.10
MH*	346	10.94	339	15.30	485	30.30	177	37.09	21	35.55
Precast	5	0.10	2	0.08	3	0.21	3	0.54	0	0.78
RM*	392	12.35	145	6.55	236	14.71	131	27.30	10	17.67
Steel	11	0.04	1	0.04	2	0.15	2	0.42	0	0.63
UM*	43	1.36	42	1.88	54	3.34	33	6.83	16	27.14
Wood	2,357	74.31	1667	75.33	800	49.92	125	26.13	9	16.03
Total	**3,165**		**2,212**		**1,602**		**478**		**59**	

*Note:

RM Reinforced Masonry
URM Unreiforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 29 hospital beds available for use. On the day of the earthquake, the model estimates that only 29 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 6: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Least Moderate Damage > 50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	1	0	0	1
Schools	10	0	0	0
EOCs	1	0	0	1
PoliceStations	3	0	0	0
FireStations	2	0	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	32	0	0	32	32
	Bridges	62	0	0	62	62
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	1	1
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	6	0	0	6	6
	Runways	7	0	0	7	7

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	3	0	0	1	3
Oil Systems	2	0	0	1	2
Electrical Power	2	0	0	1	2
Communication	5	0	0	1	5

Table 9 : Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	0	0	0
Waste Water	0	0	0
Natural Gas	0	0	0
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	8,187	0	0	0	0	0
Electric Power		8,187	8,187	8,187	8,187	8,187

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.02 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 8 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 34.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates (104 households to be displaced due to the earthquake. Of these, 26 people (out of a total population of 25,224 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	1	0	0	0
	Residential	14	2	0	0
	Single Family	33	6	1	1
	Total	**49**	**8**	**1**	**2**
2 PM	Commercial	21	5	1	1
	Commuting	0	0	0	0
	Educational	8	2	0	0
	Hotels	0	0	0	0
	Industrial	4	1	0	0
	Residential	3	0	0	0
	Single Family	7	1	0	0
	Total	**43**	**9**	**1**	**2**
5 PM	Commercial	19	4	1	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	2	1	0	0
	Residential	5	1	0	0
	Single Family	13	2	0	0
	Total	**40**	**8**	**1**	**2**

Economic Loss

The total building-related economic loss estimated for the earthquake is $105.80 (millions of dollars), which represents % of the total replacement value of the region's buildings. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 105.80 (millions of dollars); 11 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 68 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.46	2.67	0.20	0.17	3.50
	Capital-Related	0.00	0.19	2.26	0.13	0.03	2.62
	Rental	2.08	1.23	1.58	0.03	0.09	5.02
	Relocation	0.20	0.04	0.08	0.01	0.02	0.34
	Subtotal	**2.28**	**1.93**	**6.60**	**0.37**	**0.30**	**11.48**
Capital Stock Loses							
	Structural	10.13	2.11	4.13	1.38	0.67	18.42
	Non_Structural	35.78	7.91	7.88	3.63	1.38	56.58
	Content	10.56	1.67	3.86	2.03	0.71	18.84
	Inventory	0.00	0.00	0.16	0.31	0.02	0.48
	Subtotal	**56.48**	**11.69**	**16.02**	**7.35**	**2.78**	**94.32**
	Total	**58.76**	**13.62**	**22.62**	**7.72**	**3.08**	**105.80**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,182	0	0.00
	Bridges	26	0	0.30
	Tunnels	0	0	0.00
	Subtotal	**1208.60**	**0.10**	
Railways	Segments	15	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**15.10**	**0.00**	
Light Rail	Segments	0	0	0.00
	Bridges	0	0	0.00
	Tunnels	0	0	0.00
	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1	0	0.00
	Subtotal	**1.10**	**0.00**	
Ferry	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0	0	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	32	7	22.04
	Runways	213	0	0.00
	Subtotal	**245.30**	**7.10**	
	Total	**1469.90**	**7.10**	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Communication	Facilities	0.50	0.05	10.55
	Subtotal	**0.49**	**$0.05**	
Electrical Power	Facilities	215.60	13.35	6.19
	Subtotal	**215.60**	**$13.35**	
Natural Gas	Pipelines	0.00	0.00	0.00
	Facilities	3.20	0.25	7.89
	Subtotal	**3.20**	**$0.25**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.20	0.01	6.68
	Subtotal	**0.20**	**$0.01**	
Potable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	65.30	0.00	0.00
	Subtotal	**65.27**	**$0.00**	
	Total	**284.76**	**$13.67**	

Table 15. Indirect Economic Impact
(with outside aid)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(23)	-14.36
Second Year			
	Employment Impact	0	0.00
	Income Impact	(25)	-15.69
Third Year			
	Employment Impact	0	0.00
	Income Impact	(26)	-16.18
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(26)	-16.18
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(26)	-16.18
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(26)	-16.18

Appendix A: County Listing for the Region

Uintah,UT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Utah					
	Uintah	25,224	955	244	1,199
Total State		**25,224**	**955**	**244**	**1,199**
Total Region		**25,224**	**955**	**244**	**1,199**

Glossary of Terms

Abutment (dam) - the valley side against which a dam is constructed.

Acre-foot of water - approximately 326,000 gallons of water, or approximately a football field covered by one foot of water.

Active Faults - An active fault is defined as a fault displaying evidence of displacement along one or more of its traces during Holocene time (about the last 11,000 years).

Aftershocks - earthquakes during the seconds, hours, days to months following a larger earthquake (main shock) in the same general region.

Alluvial fan - a cone-shaped deposit of stream sediments, generally deposited at the base of a mountain where a stream encounters flatter terrain.

Amplitude (seismic waves) - the maximum height of a wave crest or depth of a trough. Amount the ground moves as a seismic wave passes, as measured from a seismogram.

ATV All Terrain Vehicle

Avalanche path - the area in which a snow avalanche runs; generally divided into starting zone, track, and runout zone.

Basin and Range physiographic province - consists of north-south-trending mountain ranges separated by valleys, bounded by the Rocky Mountains and the Colorado Plateau to the east and the Sierra-Cascade Mountains to the west (includes western Utah).

Bearing capacity - the load per unit area which the ground can safely support without excessive yield.

Bedrock - solid in-place rock, sometimes exposed and sometimes concealed beneath the soil.

Collapsible soil (hydrocompaction) - loose, dry, low-density soil that decreases in volume or collapses when saturated for the first time following deposition.

Critical Areas - Environmentally sensitive areas which include wetlands fish and wildlife habitat conservation areas; geologically hazardous areas; areas with a critical recharging effect on aquifers used for potable water; and frequently

flooded areas. Critical areas have measurable characteristics which, when combined, create a value for or potential risk to public health, safety and welfare.

Critical/Essential Facilities - Structures meeting one or more of the following criteria:

- Fire stations, police stations, storage facilities for vehicles/equipment needed after a hazard event, and emergency operation centers.
- Hospitals, nursing homes, and housing which is likely to contain occupants who may not be sufficiently mobile to avoid injury or death as a result of a hazardous event
- Public and private utility facilities, which are vital to maintaining or restoring normal services to, damaged areas after a hazardous event.
- Structures or facilities that produce, store, or use highly flammable, explosive, volatile, toxic and/or water reactive materials

Debris flow - involves the relatively rapid, viscous flow of surficial material that is predominantly coarsegrained.

Debris slide - involves predominantly coarse-grained material moving mainly along a planar surface.

Delta - a deposit of sediment formed at the mouth of a river where it enters an ocean or lake.

Earth flow - involves fine-grained material that slumps away from the top or upper part of a slope, leaving a scarp, and flows down to form a bulging toe.

Earthquake - a sudden motion or trembling in the earth as fracture and movement of rocks along a fault release stored elastic energy.

Earthquake Fault Zone - earthquake fault zones are regulatory zones around active faults. The zones are used to prohibit the location of critical facilities and structures designed for human occupancy from being built astride an active fault. Earthquake Fault Zones are plotted on topographic maps at a scale of 1-inch equals 2,000 feet. The zones vary in width, but average about one-quarter mile wide.

Earthquake induced Seiches - Earthquake generated water waves causing inundation around shores or lakes and reservoirs.

Epicenter - the point on the earth's surface directly above the focus of an earthquake.

Erosion - the removal of earth or rock material by many types of processes, for example, water, wind, or ice action.

Expansive soil and rock - soil and rock which contain clay minerals that expand and contract with changes in moisture content.

Fault - A -break in the earth along which movement occurs.

Fault segment - section of a fault that behaves independently from adjacent sections.

Fault zone - an area containing numerous faults.

FEMA - The Federal Emergency Management Agency was authorized under Section 404 of the Stanford Act. Provides funding for hazard mitigation projects that are cost-effective and comply with existing post-disaster mitigation programs and activities. These projects cannot be funded through other programs to be eligible.

Fill - material used to raise the surface of the land generally in a low area.

Fire-resistant vegetation - plants that do not readily ignite and burn when subjected to fire because of inherent physiological characteristics of the species such as moisture content, fuel loading, and fuel arrangement.

Flood plain - an area adjoining a body of water or natural stream that has been or may be covered by flood water.

Flood way - An area of land immediately adjacent to a stream or river channel that, in times of flooding, becomes an enlarged stream or river channel and carries the floodwater with the highest velocity.

Floodplain - an area adjoining a body of water or natural stream that has been or may be covered by floodwater.

Floodplain (100 year) - Floodplains that have the potential to flood once every 100 years or that has a one percent chance of flooding equal to or in excess of that in any given year.

Fluvial - concerning or pertaining to rivers or streams.

Focus - the point of origin of an earthquake within the earth, and the origin of the earthquake's seismic waves.

Formation (geologic) - a mappable rock unit consisting of distinctive features/rock types separate from units above and below.

Frequency (seismic waves) - the number of complete cycles of a seismic wave passing a point during one second.

Fuel (fire) - vegetation, building material, debris, and other substances that will support combustion.

Fuel break - a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located strip of land to reduce or hinder the rate of fire spread.

Fuel type - a category of vegetation used to indicate the predominate cover of an area.
Glacial moraine - debris (sand to boulders) transported and deposited by glacial ice along a glacier's sides or terminus.

Graben - a block of earth downdropped between two faults.

Gradient (slope) - a measure of the slope of the land surface.

Ground failure - a general term referring to any type of ground cracking or subsidence, including landslides and liquefaction-induced cracks.

Ground shaking - the shaking or vibration of the ground during an earthquake.

Ground water - that portion of subsurface water which is in the zone of saturation.

Gypsiferous deposits - soil or rock containing gypsum, which can be subject to dissolution.

Gypsum - a mineral composed of hydrated calcium sulfate. A common mineral of evaporites.

Hazard Mitigation Plan - The plan resulting from a systematic evaluation of the nature and extent of vulnerabilities posed by a hazard present in society that includes the strategies needed to minimize future vulnerability to hazards.

Hazard Mitigation - Any action taken to reduce or permanently eliminate the long-term risk to human life and property and the environment posed by a hazard.

HAZUS - Hazard United States. Earthquake Loss estimation software using GIS databases developed by FEMA.

Head (landslide) - the upper parts of the slide material along the contact between the disturbed material and the main scarp.

Holocene - geologic epoch covering the last 10,000 years (after the last Ice Age).

Igneous rocks - rocks formed by cooling and hardening of hot liquid material (magma), including rocks cooled within the earth (for example, granite) and those that cooled at the ground surface as lavas (such as basalt).

Impermeable - materials having a texture that does not permit water to move through.
Intermountain seismic belt - zone of pronounced seismicity, up to 120 miles wide and 800 miles long, extending from Arizona through central Utah to northwestern Montana.

Lacustrine - concerning or pertaining to lakes.

Lake Bonneville - a large, ancient lake that existed 30,000 to 12,000 years ago and covered nearly 20,000 square miles in Utah, Idaho, and Nevada. The lake covered many of Utah's valleys, and was almost 1,000 feet deep in the area of the present Great Salt Lake.

Lake Bonneville sediments - sediments deposited by Lake Bonneville, found in the valleys, which range from gravels and sands to clays.

Landslide - a general term for a mass of earth or rock, which moves down slope by flowing, spreading, sliding, toppling, or falling (see slope failure).

Lateral spread - lateral down slope displacement of soil layers, generally several feet or more, above a liquefied layer.

Levee (flood) - a berm or dike used to contain or direct water, usually without an outlet or spillway.

Liquefaction - sudden large decrease in shear strength of a cohesionless soil (generally sand or silt) caused by collapse of soil structure and temporary increase in pore-water pressure during earthquake ground shaking.

Magnitude (earthquake) - a quantity characteristic of the amplitude of the ground motion of an earthquake. The most commonly used measurement is the Richter magnitude scale; a logarithmic scale based on the motion that would be measured by a standard type of seismograph 60 miles from the earthquake's epicenter.

Metamorphic rocks - rocks formed by high temperatures and/or pressures (for example, quartzite formed from sandstone).

Middle Rocky Mountains physiographic province - consists of mountainous terrain of high relief, extending from northern Utah to Wyoming, Idaho, and Montana (includes the Wasatch Range and Uinta Mountains in Utah).

Modified Mercalli intensity (MMI) - the most commonly used intensity scale in the U.S.; it is a measure of the severity of earthquake shaking at a particular site as determined from its effect on the earth's surface, man, and man's structures.

Montmorillonite - a clay mineral characterized by expansion upon wetting and shrinking upon drying.

Natural vegetation - native plant life existing on a piece of land before any form of development.

Normal fault - fault caused by crustal extension in which relative movement on opposite sides is primarily vertical; for example, the Wasatch fault.

Oolite - spherical grains of carbonate sand with a brine shrimp fecal pellet nucleus.
Outlet (dam) - a conduit through which controlled releases can be made from the reservoir.

Peat - unconsolidated surficial deposit of partially decomposed plant remains.

Period (geologic) - a standard (world-wide) geologic time unit.

Permeability - the capacity of a porous rock or soil for transmitting a fluid.

Physiographic province - a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piping (problem soil and rock) - a weak incoherent layer in unconsolidated deposits that acts as a channel directing the movement of water. As the layer becomes saturated it conducts water to a free face (cliff or stream bank for example) that intersects the layer, and material exits out a "pipe" formed in the free face. Piping can occur in a dam as the result of progressive development of internal erosion by seepage.

Pore space - the open spaces in a rock or soil between solid grains. The spaces may be filled with gas (usually air) or liquid (usually water).

Porosity - the ratio of the volume of pore space in rock or soil to the volume of its mass, expressed as percentage.

Probable Maximum Flood (PMF) - a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in a region.

Probable Maximum Precipitation (PMP) - the maximum amount and duration of precipitation that can be expected to occur on a drainage basin.
Problem soil and rock - geologic materials that are susceptible to volumetric changes, collapse, subsidence, or other engineering geologic problems.

Project Impact - An initiative of the Federal Emergency Management Agency intended to modify the way in which the United States handles natural disasters. The Goal of Project Impact from a Federal Government perspective is to reduce the personal and economic costs of hazard events by bringing together the private and public sector to better enable the citizens of a community to protect themselves from natural hazards.

Quaternary - a geologic time period covering the last 1.6 million years.

Recurrence interval - the length of time between occurrences of a particular event (an earthquake, for example).

Rock fall- abrupt free fall or down slope movement, such as rolling or sliding, of loosened blocks or boulders from an area of bedrock. The rock-fall runout zone is the area below a rock-fall source which is at risk from falling rocks.

Rock topple - forward rotation movement of a rock unit(s) about some pivot point.

Runout zone (avalanche) - where a snow avalanche slows down and comes to rest (deposition zone). For large avalanches, the runout zone can include a powder- or wind-blast zone that extends far beyond the area of snow deposition.

Sand boil (earthquake) - deposit of sandy sediment ejected as water and sand to the surface, formed when ground shaking has caused liquefaction at depth.

Scarp - a relatively steeper slope separating two more gentle slopes. Scarps can form as result of earthquake faulting.

Sediment - material that is in suspension, is being transported, or has been moved from its site of origin by water, ice, or wind, and has come to rest on the earth's surface either above or below the sea level.

Sedimentary rocks - rocks formed from loose sediment such as sand, mud, or gravel deposited by water, ice, or wind, and then hardened into rock (for example, sandstone); or formed by dissolved minerals precipitating out of solution to form rock (for example, tufa).

Seiche - a standing wave generated in a closed body of water such as a lake or reservoir. Ground shaking, tectonic tilting, sub aqueous fault rupture, or landsliding into water can all generate a seiche.

Seismic waves - vibrations in the earth produced during earthquakes.

Seismicity - seismic or earthquake activity.

Sensitive clay - clay soil that experiences a particularly large loss of strength when disturbed. Deposits of sensitive clay are subject to failure during earthquake ground shaking.

Shear strength - the internal resistance that tends to prevent adjacent parts of a solid from "shearing" or sliding past one another parallel to the plane of contact. It is measured by the maximum shear stress that can be sustained without failure.

Shear stress - a stress causing adjacent parts of a solid to slide past one another parallel to the plane of contact.

Slope failure - a general term referring to any type of natural ground movement on a sloping surface (see landslide).
Slump - a slope failure that slides along a concave rupture surface. Generally slumps do not move very far from the source area.

Snow avalanche - a rapid down slope movement of a mass of snow, ice, and debris.

Stafford Act Robert T. Stafford Disaster Relief and emergency Assistance Act, PL 100-707, signed into law November 23 1988: amended the Disaster Relief Act of 1974, PL 93-288

Starting zone (avalanche) - where the unstable snow or ice breaks loose and starts to slide.
Subsidence - a settling or sinking of the earth's crust.

Surface fault rupture (surface faulting) - propagation of an earthquake-generated fault rupture to the ground surface, displacing the surface and forming a scarp.

Tectonic subsidence - subsidence (down dropping) and tilting of a basin on the down dropped side of a fault during an earthquake.

Toe (landslide) - the margin of disturbed material most distant from the main scarp.

Track (avalanche) - the slope or channel down which a snow avalanche moves at a fairly uniform speed.

Unconsolidated basin fill - uncemented and nonindurated sediment, chiefly clay, silt, sand, and gravel, deposited in basins.

Urban area - a geographical area, usually of incorporated land, covered predominately by engineered structures including homes, schools, commercial buildings, service facilities, and recreational facilities.

Urban/Wildland Interface (Urwin) - a geographical area where two different environments, wildland and urban residential, meet and affect each other.

Velocity (ground motion) - the rate of displacement of an earth particle caused by passage of a seismic wave.

Wasatch fault - a normal fault that extends over 200 miles from Malad City, Idaho to Fayette, Utah, and trends along the western front of the Wasatch Range.

Watershed - the area of land above a reference point on a stream or river, which contributes runoff to that stream.

Weathering - a group of processes (such as the chemical action of air, rain water, plants, and bacteria and the mechanical action of temperature changes) whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.
Wildfire - uncontrolled fire burning in vegetation.

Wildland area - a geographical area of unincorporated land covered predominately by natural vegetation.

Wildland Urban Interface - Wildland vegetation and forested areas adjacent to or intermingled with residential developments.

Zone of deformation (earthquake) - the width of the area of surface faulting over which earth materials have been disturbed by fault rupture, tilting, or subsidence.

List of Acronyms and Recognized Abbreviations

AGRC	Automated Geographic Reference Center
AOG	Association of Governments
Assoc.	Association
ATV	All Terrain Vehicle
Bldg.	Building
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
Bur.	Bureau
CEM	Comprehensive Emergency Management
Corp.	Corporation
CRS	Community Rating System
Dept.	Department
DESHS	Division of Emergency Services and Homeland Security
Div	Division
DMA 2000	Disaster Mitigation Act of 2000
DOT	Department of Transportation
DNR	Division of Natural Resources
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute

FEMA	Federal Emergency Management Agency
FFSL	Forestry Fire and State Lands
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FS	Forest Service
GIS	Geographic Information Systems
HAZMAT	Hazardous Materials
HAZUS MH	Hazards United States
ICS	Incident Command System
LEPC	Local Emergency Planning Committee
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
SCS	Soil Conservation Service
SEUALG	Southeastern Utah Association of Local Governments
SLC	Salt Lake City
SPI	Standardized Precipitation Index
SWSI	Surface Water Supply Index
UGS	Utah Geological Survey
URWIN	Urban-Rural Wildland Interface Zone

USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UT.	Utah
WFRC	Wasatch Front Regional Council

POPULATION

The Uintah Basin was originally established as a farming and ranching region by a sparse population of Caucasian settlers around the turn of the century and did not see a significant increase in population until oil was first discovered in Uintah County in 1948. Then in the late 1950's and early 1960's the Uintah and Daggett County populations increased dramatically during the construction of Flaming Gorge Dam.

> Upon completion of the project, Daggett County suffered a tremendous out-migration and lost about 60 percent of its population by 1965. Daggett County's population in 1970 was 666, 1980 - 769 and 1990 - 690.

The most impressive growth took place with the "oil boom"in the early 1970s when the Uintah Basin grew at nearly twice the overall rate of the state after being behind in the statewide growth for at least 40 years. The growth took place primarily in Uintah and Duchesne Counties. Duchesne County's population began its largest increase with the development of the Altamont and Bluebell oil fields.

> Duchesne County experienced a net increase of 5,250 people between 1970 and 1980--compared to only 220 people during the 1960s. Duchesne County had 7,299 in 1970 and increased by 71 percent to 12,565 people by 1980, and 12,645 in 1990.

Uintah County's growth from 1960 to 1980 was the direct result of large construction projects--like Flaming Gorge Dam, Central Utah Water Projects, and the start-up phases of the White River Oil Shale facilities and the Deseret Generation &Transmission Power Plant, as well as, the exploration and extraction of oil.

Uintah County experienced a net growth of 1,200 people between 1960 and 1970, and grew by 7,822 people between 1970 and 1980 representing a 62 percent population increase. Uintah County' population in 197- was 12,684, 1980 - 20,506, and 1990 - 22,211.

Population figures for the Uintah Basin from 1990 to 1999 further illustrate the instability of the area's economic base. Growth rates between 1994 to 1996 show the latest boom or economic upswing and the three years following show the results of the most recent recessionary period and bust side of the cycle: decreasing population growths - Daggett County -6.2% and -5.3%, Duchesne County -0.2% and Uintah County -0.8%. Population forecasts by the Utah State Office of Planning and Budget for the Uintah Basin are projected to increase, but at very low growth rates. These estimates are based on the feeling that oil prices will not dramatically increase and that the development of a synfuels (oil shale and tar sands) will not emerge again until the energy prices and demands justify it.

The latest population ***estimate*** for the Uintah Basin stands at 40,147 (December 1999). Of this amount, 25,029 of the people reside in Uintah County with about 7,111of those in Vernal City (the largest community in the Basin) and 1,466 in neighboring Naples City. Duchesne County consists of 14,381 of the population, with about 4,292 people residing in Roosevelt City and 1,447 in Duchesne City. Daggett County only consists of 737 of the Basin's population with about 256 residing in the Town of Manila.

UINTAH BASIN POPULATION ESTIMATES

DAGGETT COUNTY						
As of July 1	1994	1995	1996	1997	1998	1999
Total Population	750	768	803	753	713	737
of Change from Prior Year	7.1%	2.4%	4.6%	-6.2%	-5.3%	3.4%

DUCHESNE COUNTY						
As of July 1	1994	1995	1996	1997	1998	1999
Total Population	13,500	13,549	14,032	14,402	14,376	14,381
% of Change from Prior Year	2.3%	.04%	3.6%	2.6%	-0.2%	.035%

UINTAH COUNTY						
As of July 1	1994	1995	1996	1997	1998	1999
Total Population	24,700	24,335	24,276	24,637	24,436	25,029
% of Change from Prior Year	4.7%	-1.5%	-0.2%	1.5%	-0.8%	2.4%

STATE OF UTAH		
As of July 1	1998	1999
Total Population	2,082,502	2,121,053
% of Change from Prior Year		1.9%

1998 Population Estimates for Cities & Towns in the Region

DAGGETT COUNTY		DUCHESNE COUNTY		UINTAH COUNTY	
Manila Town	256	Roosevelt City	4,292	Vernal City	7,111
Remainder	457	Duchesne City	1,447	Naples City	1,466
		Myton City	519	Ballard City	735
		Altamont Town	192	Remainder	15,124
		Tabiona Town	137		
		Remainder	6,587		

Source: Utah Governor's Office of Planning and Budget

Native Americans are a significant segment of the Uintah Basin population. Approximately 3,350 members of the Ute Tribe live on the Uintah and Ouray Indian Reservation. There are 1,270 Hispanics, 142 Asian/ Pacific Islander, and 30 Blacks for a total minority population of 4,801.

Based on 1996 estimates, "Population by Ethnic Groups and Sex show that Daggett County has a total population of 750, with 27 minorities. The total female population is 367 with 14 being minority. Duchesne County has a total population of 13,500, with 1,375 minorities. The total female population is 6,683 with 722 being minority. Uintah County has a total population of 24,700 with 3,435 minorities. The total female population is 12,477 with 1,771 being minority.

POPULATION AND EMPLOYMENT BY ETHNIC GROUP AND SEX FOR DAGGETT

DAGGETT COUNTY	Total Population	Civilian Labor Force	Total Employed
Both Sexes Total	750	441	418
Black	0	0	0
Native American	7	5	5
Asian/Pacific	4	0	0
Hispanic	16	6	6
Total Minority	27	11	11
Non-Minority	723	430	407
Females Total	367	171	150
Black	0	0	0
Native American	1	0	0
Asian/Pacific	2	0	0
Hispanic	11	3	3
Total Minority	14	3	3
Non-Minority	354	168	147

POPULATION AND EMPLOYMENT BY ETHNIC GROUP AND SEX FOR DUCHESNE COUNTY

DUCHESNE COUNTY	Total Population	Civilian Labor Force	Total Employed
Both Sexes Total	13500	5657	5093
Black	15	8	7
Native American	795	268	212
Asian/Pacific	41	17	16
Hispanic	524	199	149
Total Minority	1375	492	384
Non-Minority	12125	5165	4709
Females Total	6683	2266	2053
Black	6	3	3
Native American	424	111	94
Asian/Pacific	29	9	9
Hispanic	263	94	74
Total Minority	722	218	180
Non-Minority	5961	2048	1873

POPULATION AND EMPLOYMENT BY ETHNIC GROUP AND SEX FOR UINTAH COUNTY

UINTAH COUNTY	Total Population	Civilian Labor Force	Total Employed
Both Sexes Total	24700	9911	9180
Black	15	11	11
Native American	2581	814	649
Asian/Pacific	95	34	32
Hispanic	744	243	225
Total Minority	3435	1102	917
Non-Minority	21265	8809	8263
Females Total	12477	4068	3810
Black	5	2	2
Native American	1343	357	281
Asian/Pacific	53	16	15
Hispanic	370	93	85
Total Minority	1771	467	383
Non-Minority	10706	3601	3427

POPULATION AND EMPLOYMENT BY ETHNIC GROUP AND SEX FOR THE UINTAH BASIN

UINTAH BASIN	Total Population	Civilian Labor Force	Total Employed
Both Sexes Total	38950	16009	14691
Black	30	19	18
Native American	3350	1075	652
Asian/Pacific	142	54	51
Hispanic	1279	447	379
Total Minority	4801	1595	1304
Non-Minority	34149	14414	13387
Females Total	19527	6505	6013
Black	11	5	5
Native American	1753	464	382
Asian/Pacific	86	25	24
Hispanic	642	189	162
Total Minority	2491	684	563
Non-Minority	11462	3828	3615

Source: Utah Department of Employment Security, Labor Market Info. Services, 1996

Even though actual births have out numbered the amount of deaths within the Uintah Basin since 1970, the boom and bust cycles have been most evident in the migration patterns in and out of the area. The downturn period of the late1970's, mid 1980's and early 1990's have shown a tremendous exit of people from the area. Regardless of this pattern, along with a lower population growth forecast for the next 25 years, emphasizes the need for economic development and stabilized growth in order to keep individuals in the area.

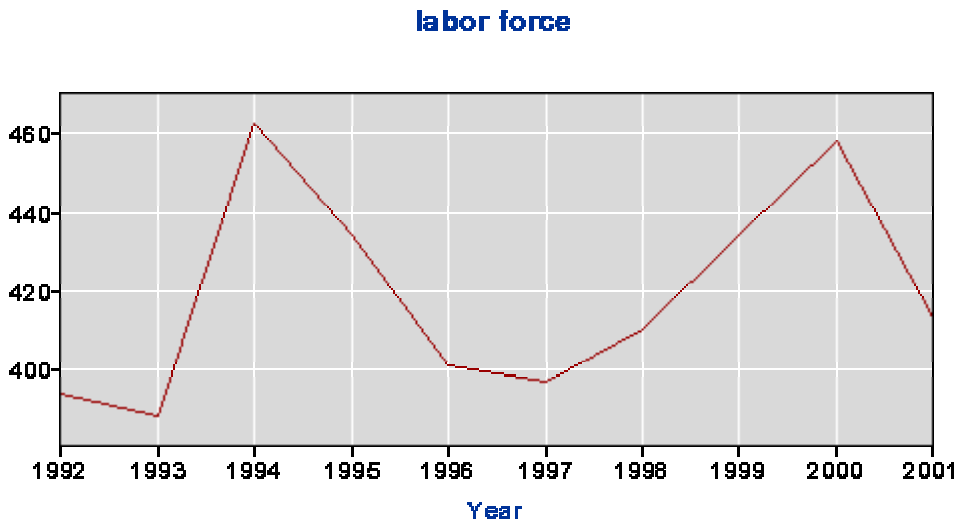
EMPLOYMENT

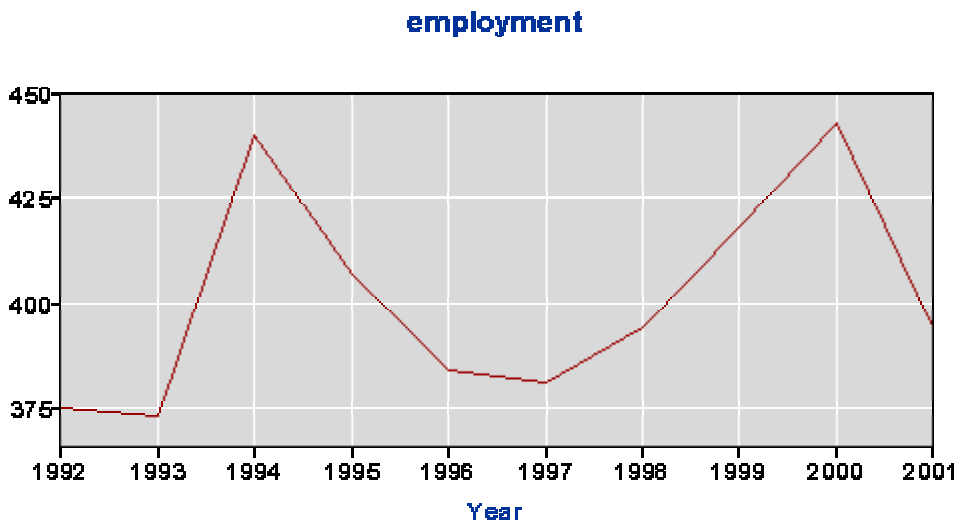
Daggett County

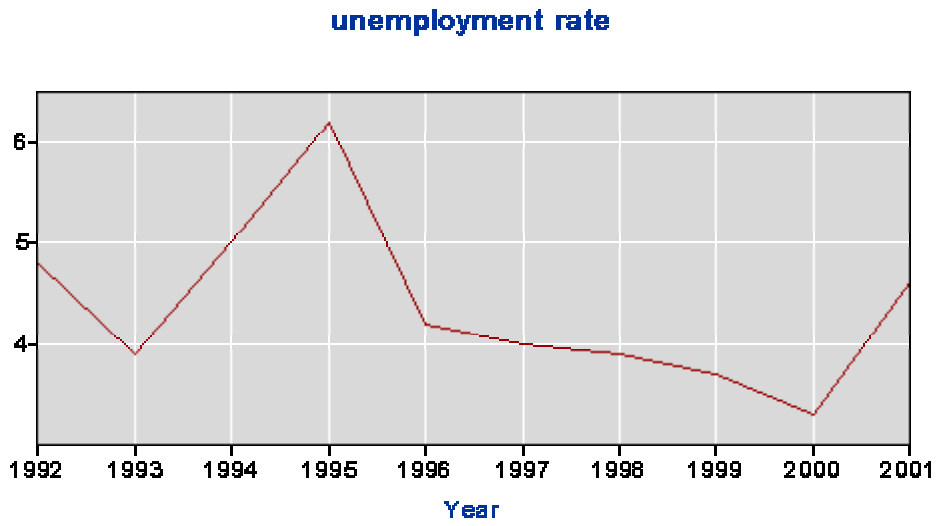
Area: Daggett County, UT

Area Type: **COUNTIES** AND EQUIVALENTS

State/Region/Division: UTAH







Year	Period	labor force	employment	unemployment	unemployment rate
1992	Annual	394	375	19	4.8
1993	Annual	388	373	15	3.9
1994	Annual	463	440	23	5.0
1995	Annual	434	407	27	6.2
1996	Annual	401	384	17	4.2
1997	Annual	397	381	16	4.0
1998	Annual	410	394	16	3.9
1999	Annual	434	418	16	3.7
2000	Annual	458	443	15	3.3
2001	Annual	413	394	19	4.6

DAGGETT COUNTY MAJOR EMPLOYERS

Flaming Gorge Lodge	Daggett County	Daggett Co. School Dist.
US Forest Service	Red Canyon Lodge	US Bureau of Reclamation
	Flaming Gorge Corp.	

Source: Utah Governor's Office of Planning & Budget, Department of Workforce Services

Second quarter 1999 nonfarm employment in Daggett County rose 3.1 percent, from 456 to 470 jobs, compared to second quarter 1998 data. The employment rate in Daggett County was reduced from an estimated 4.7 percent for second quarter 1998 to 3.6 percent in second quarter 1999.
Trade added nine new positions, most at grocery stores and a few at eating and drinking establishments. **Government** grew 2.3 percent by adding five jobs. Federal and state positions decreased for environmental and social services. Local government jobs expanded for roadwork and corrections, but contracted for education and transportation. **Services** reported only slight growth. Lodging saw an increase, but these were offset by losses for engineering and management services. Finally, **Construction** also increased slightly as road repair and plumbing/hearing/air conditioning grew. However, losses in concrete work nearly offset the gains. **Manufacturing** reported no change in employment, while **Transportation, Communications** and **Public Utilities** showed a decrease of two portions related to electric and gas service.

"Covered agriculture" jobs in Daggett County remained unchanged, as sic jobs were reported in the second quarter of 1998 and in second quarter 1999. Ranching activities dominated. It should be noted that "covered agricultural" employment is not included in total nonagricultural employment discussed above. Moreover, many jobs in agriculture are not subject to unemployment insurance reporting requirements. As a result they are not discussed in this report.

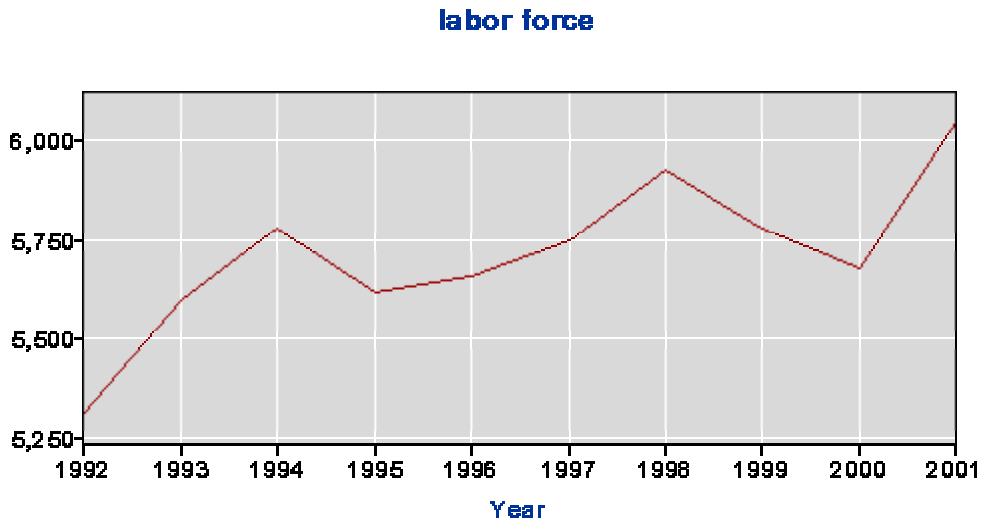
Second quarter 1999 data indicate that new car and truck registration improved compared to the same time period for 1998. No **permit-authorized construction** activity was reported during the second quarter of 1999.

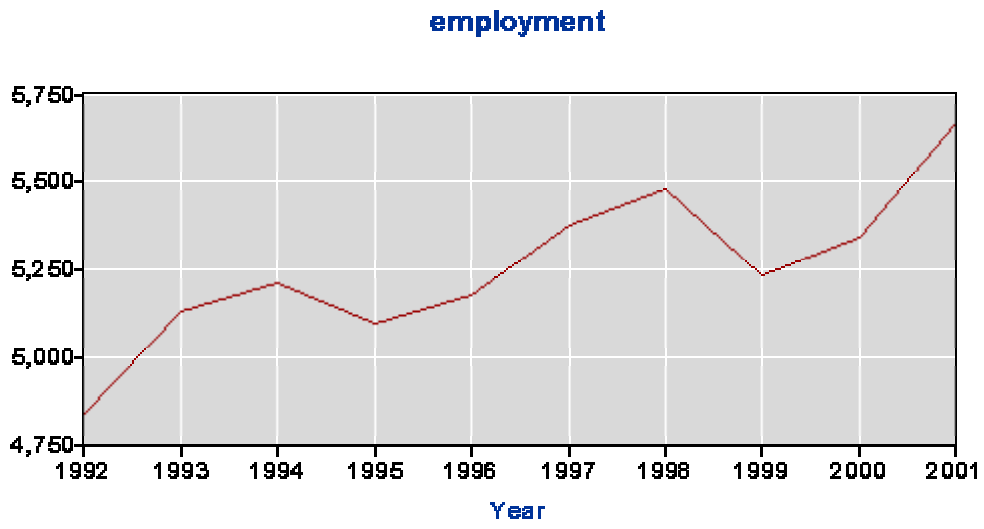
Duchesne County

Area: Duchesne County, UT

Area Type: COUNTIES AND EQUIVALENTS

State/Region/Division: UTAH





Year	Period	labor force	employment	unemployment	unemployment rate
1992	Annual	5309	4832	477	9.0
1993	Annual	5596	5129	467	8.3
1994	Annual	5780	5209	571	9.9
1995	Annual	5618	5094	524	9.3
1996	Annual	5660	5175	485	8.6
1997	Annual	5747	5376	371	6.5
1998	Annual	5925	5477	448	7.6
1999	Annual	5781	5231	550	9.5
2000	Annual	5679	5343	336	5.9
2001	Annual	6048	5671	377	6.2

Agriculture has historically dominated the economic life of Duchesne County. The county remains a significant producer of crops and livestock. However, during the second half of the 20th Century, the development of oil and gas reserves provided an important boost to the economy, and this industry remains a major contributor to growth. Other expanding industries include government and trade. Duchesne County includes part of the tribal lands of the Uintah-Ouray Indian Reservation. New retail and service developments on tribal lands help sustain the Native American population and add to the economic vitality of the area.
For the third consecutive quarter, nonfarm employment in Duchesne County reported a year-over decline. Second quarter data for 1999 showed a decrease of 4.2 percent. Slowdowns in oil and gas activity continue to stymie economic growth in the area. Duchesne County's unemployment rate jumped from 7.2 percent in second quarter 1998 to 8.4 percent in second quarter 1999, one of the highest rates in Utah.

Mining again reported the greatest decline among industries, as 171 positions were lost between second quarter 1998 and second quarter 1999. Even with rising oil prices, oil and gas drilling and exploration has failed to increase employment, as firms remain cautious over price stability and profit. **Transportation, Communications,** and **Public Utilities** experienced a 6.1 percent decline in jobs with a loss of 31 positions. Over-the-road trucking felt the pinch of declining oil and gas operations as positions decreased. However, local trucking and communication jobs did report improvements. **Manufacturing** suffered a decrease of 54 jobs, a year-over 24.0 percent decline. Durable and nondurable manufacturing goods contracted, particularly for petroleum refining, bottled/canned beverages, and industrial measuring instruments. **Finance, Insurance** and **Real Estate** position declined 9.3 percent, or by 11 jobs, mostly among multifamily property management. A few additional jobs were reported in banking. **Trade** lost a scant two positions. All of the losses were in wholesale trade as recreational goods declined. Retail trade jobs rose 0. Percent as grocery stores and eating and drinking places added workers. However, retail trade lost nearly the same number of jobs in hardware and variety stores and at gasoline service stations.

Three industrial divisions showed increased employment between second quarter 1998 and 1999. However the increases were modest. **Services** added 35 positions among skilled nursing care facilities, auto repair services and non-vocational youth education. **Government** reported 19 more jobs, a 1.1 percent increase. Overall, federal jobs showed a slight increase, while state government jobs declined for social services. Local government accounted for most of the growth as road work, recreation and education expanded. **Construction** jobs increased 4.8 percent, or 11 positions. Highway and road construction accounted for most of the growth. Residential and non-residential contractors grew moderately, as did special trade contractors.

Agriculture is an important component of the economic strength of Duchesne County. Unfortunately, agricultural employment data is generally not available the only source of employment information due to reporting required by unemployment insurance laws, which cover only a few agricultural jobs. Most of Duchesne County's agricultural employment falls outside the reporting requirements. Duchesne County's "covered agricultural" reported only two persons employed during the second quarter of 1999. These are not included in the "nonagricultural" figures reported above.

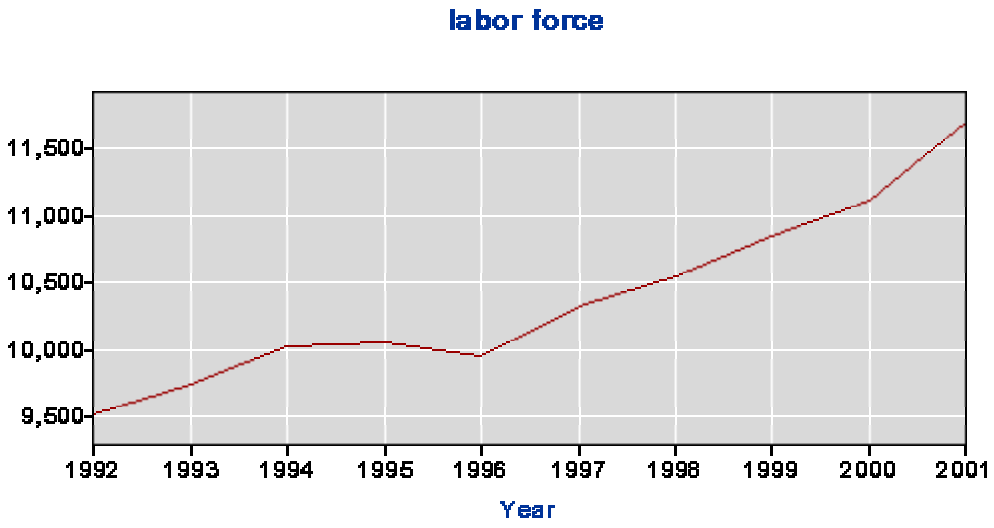
Slower economic growth has slowed the demand for construction in Duchesne County. The total valuation of second quarter permit-authorized construction slipped from $6.8 million in 1998 $4.6 million in 1999. Residential construction continued to slow, as new dwelling unites fell from 88 to 73. The value of residential construction declined from $5.2 million to $3.4 million. Nonresidential building slowed from building slowed from $1.0 million in 1998 to $820,600 in 1999 as fewer nonresidential projects were authorized. Total additions, alternations, and repairs dropped 29.2 percent in valuation; however, renovations to commercial structure did improve slightly.

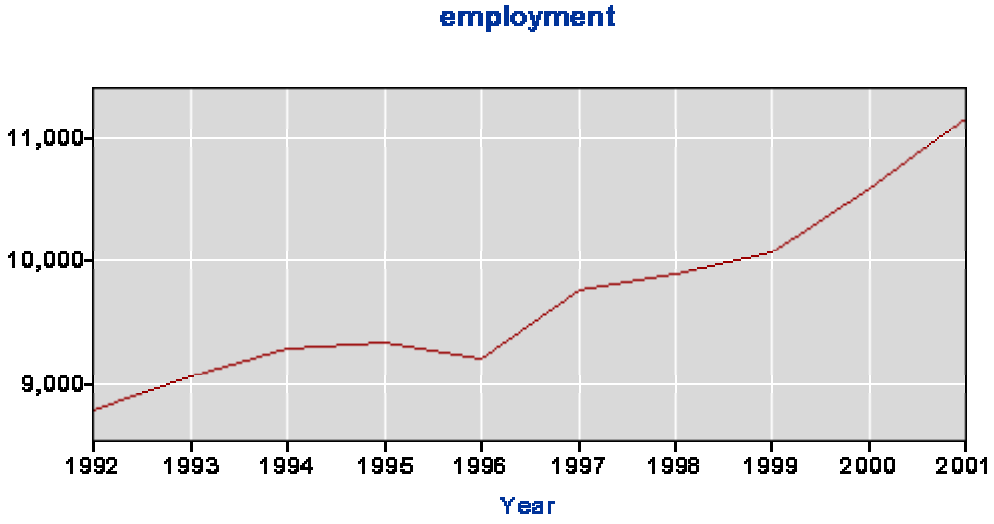
Uintah County

Area: Uintah County, UT

Area Type: COUNTIES AND EQUIVALENTS

State/Region/Division: UTAH





Year	Period	labor force	employment	unemployment	unemployment rate
1992	Annual	9516	8785	731	7.7
1993	Annual	9751	9061	690	7.1
1994	Annual	10032	9294	738	7.4
1995	Annual	10061	9345	716	7.1
1996	Annual	9953	9216	737	7.4
1997	Annual	10330	9759	571	5.5
1998	Annual	10544	9897	647	6.1
1999	Annual	10847	10076	771	7.1
2000	Annual	11112	10587	525	4.7
2001	Annual	11707	11165	542	4.6

Uintah County's economy has always relied on agriculture and mining to sustain its growth. The area has benefitted from the development of several geologic deposits, such as gilsonite, oil shale, tar sand and oil, which have shaped its economic growth. While mining and agriculture remain significant to the economy, other industries such as government services, trade and the Ute Indian Tribe, are developing. These new industries help stabilize and diversify the economy.

Nonagricultural employment in Uintah County rose 2.3 percent to 8,745 by adding nearly 200 jobs between the second quarter of 1998 and the second quarter of 1999. Increased construction activity and service employment sustained economic growth. Uintah County's unemployment rate rose to 6.3 percent in 1998 to 6.4 percent for the comparable period of 1999.

Construction employment jumped 50.8 percent by adding 190 positions. All of the growth was in heavy construction for water, sewer, pipeline and communications systems. Residential, nonresidential, and special trade contractors reported slight growth. **Services** added 170 positions, and 8.4 percent year-over growth. Home health care, offices and clinics of doctors, video rental stores, temporary help agencies, residential care facilities, and tribal organizations reported growth, while jobs for equipment rental declined. **Government** jobs increased 4.6 percent by adding 81 positions. Increases were reported for federal, state and local government, although local government positions dominated growth. Federal jobs related to land and wildlife management increased moderately, while state employment reported slight increases in several areas. Local positions rose for roadwork, recreation and education, but contracted for environmental and transportation services. **Manufacturing** employment experienced an increase of 17 jobs both durable and nondurable goods manufacturing added positions. Wood kitchen cabinet manufacturing, construction machinery, and publishing accounted for the growth. Oil and gas equipment reported a decline. **Finance, Insurance** and **Real Estate** year-over data indicate a net increase of one position. Real estate and insurance agents expanded, while banking/lending positions declined.

The **Transformation, Communications** and **Public Utilities** division showed a loss of 21 jobs, a 3.9 percent decrease. Cutbacks in local trucking, related to weakness in mining activity, accounted for the losses. **Trade** positions declined by 2.2 percent as retail job losses were felt at grocery stores, gas service stations, and eating and drinking establishments. Wholesale trade jobs fell for industrial machinery, medical equipment, and computer equipment. Wholesale trade did report a moderate employment increase in grocery products, while retail jobs expanded at sporting goods and bookstores. **Mining** remained in the doldrums, as firms are reluctant to add to payrolls. Rising energy prices should increase demand for employment and production, but apparently firms are remaining cautious waiting for overseas production and

crude prices to stabilize. Mining lost nearly 200 year-over second quarter jobs in the oil and gas industry.
"Covered agriculture" jobs in Uintah County rose between second quarter 1998 (38 jobs) and second quarter 1999 (53 jobs). The growth was concentrated in livestock production. It should be noted that "covered agricultural" employment is not included in total nonagricultural employment discussed above. Moreover, many jobs in agriculture are not subject to unemployment insurance reporting requirements. As a result they are not discussed in this report.

Construction activity in Uintah County, as measured by permit authorizations, declined during the year ending second quarter of 1999. The total value of permit-authorized construction fell 14.0 percent form $4.4 million in 1998 to $3.8 million in 1999. Residential building reported an increase in dwelling units from 29 to 36, primarily due to the construction of a 19-unit apartment complex. The value of residential construction decreased slightly: from $2.3 million to $2.2 million. Nonresidential construction values, which can fluctuate dramatically, plummeted, from $1.7 million to a mere $172,000. A dearth of new major nonresidential projects resulted in this decline. Additions, alterations and repairs reported a strong increase, with a meteoric rise in the valuation of renovations to residential structures.

Percent of Total Employment and Average Monthly Wage for Selected Industries

Daggett County

	%	Ave. Monthly Wage
Government	53.0	$2,341
Services	24.4	$1,304
Trans., Comm., Public Utilities	10.4	$1,806
Trade	10.2	$ 790
Construction	1.5	$3,046
Manufacturing	0.5	b

b = not shown to avoid disclosure of individual firm data
Average Annual Wage (all industries combined) $21,960

Duchesne County

	%	Ave. Monthly Wage
Government	35.8	$2,003
Trade	21.2	$1,215
Services	10.7	$1,208
Mining	10.5	$2,820
Trans., Comm., Public Utilities	9.5	$2,475
Manufacturing	5.1	$2,519
Construction	4.6	$1,891
Finance, Insur., & Real Estate	2.5	$1,385

Average Annual Wage (All Industries combined) $20,076

Uintah County

	%	Ave. Monthly Wage
Trade	24.0	$1,121
Services	22.9	$1,422
Government	22.6	$2,134
Mining	14.3	$2,933
Trans., Comm., Public Utilities	7.5	$2,777
Construction	4.0	$1,621
Manufacturing	3.0	$1,382
Fin., Insur., R.E. “F.I.R.E,”	1.6	$1,544

Average Annual Wage (all industries combined) $20,940

YEAR	DAGGETT	DUCHESNE	UINTAH	STATE OF UTAH
1994	$1,845.00	$1,591.00	$1,686.00	$1,867.00
1995	$1,771.00	$1,626.00	$1,702.00	$1,936.00
1996	$1,763.00	$1,640.00	$1,720.00	$2,017.00
1997	$1,770.00	$1,749.00	$1,842.00	$2,114.00
1998	$1,690.00	$1,869.00	$1,929.00	$2,207.00
1999	$1,677.00	$1,781.00	$1,931.00	N/A

FEDERAL INCOME TAX RETURNS DATA BY COUNTY
Average adjusted gross income per year

COUNTY	1996	1997	1998
Beaver	23,390.00	24,710.00	23,233.00
Box Elder	31,625.00	32,393.00	33,788.00
Cache	29,636.00	30,930.00	32,927.00
Carbon	29,428.00	30,686.00	31,912.00
Daggett	29,982.00	31,926.00	28,996.00
Davis	36,702.00	38,439.00	40,230.00
Duchesne	23,514.00	25,523.00	26,169.00
Emery	28,806.00	30,337.00	30,778.00
Garfield	21,758.00	22,821.00	23,474.00
Grand	24,990.00	25,933.00	27,003.00
Iron	25,730.00	26,695.00	28,083.00
Juab	25,027.00	26,864.00	28,462.00
Kane	22,222.00	23,072.00	24,129.00
Millard	25,715.00	27,249.00	25,392.00
Morgan	34,728.00	36,617.00	38,059.00
Piute	20,533.00	20,425.00	22,568.00
Rich	22,650.00	25,896.00	27,337.00
Salt Lake	35,748.00	37,929.00	40,022.00
San Juan	23,934.00	25,086.00	26,480.00
Sanpete	24,351.00	25,506.00	26,825.00
Sevier	26,508.00	27,531.00	28,969.00
Summit	55,160.00	57,666.00	61,224.00
Tooele	31,539.00	33,288.00	35,012.00
Uintah	25,474.00	27,457.00	28,725.00
Utah	31,447.00	32,871.00	35,011.00
Wasatch	33,452.00	34,857.00	37,584.00

Washington	30,344.00	31,456.00	33,358.00
Wayne	20,912.00	21,751.00	24,122.00
Weber	33,067.00	34,941.00	35,999.00

Source: Utah State Tax Commission 1998-99 Annual Report

UNEMPLOYMENT

Job growth in Utah continues to increase, and the State maintains one of the lowest unemployment rates in the nation. Joblessness in the Uintah Basin however remains among the highest in the State.

RESOLUTION NO. #12

A RESOLUTION ADOPTING THE UINTAH BASIN ASSOCIATION OF GOVERNMENTS PRE-DISASTER HAZARD MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

WHEREAS, President William J. Clinton signed H.R. 707, the *Disaster Mitigation and Cost Reduction Act of 2000*, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Uintah Basin Association of Governments (UBAOG) has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the UBAOG Area, and

WHEREAS, the UBAOG Executive Council approved UBAOG Staff to write the plan on October 2002, and

WHEREAS, Vernal City is within the UBAOG Area, and

WHEREAS, Vernal City is concerned about mitigating potential losses from natural disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential loses and potential mitigation measures to limit loses, and

WHEREAS, Vernal City has determined that it would be in the best interest of the community as a whole to adopt the Pre-Disaster Hazard Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY VERNAL CITY THAT:

The attached "Uintah Basin Association of Governments Pre-Disaster Mitigation Plan" be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This Resolution shall be effective on the date it is adopted.

DATED this _____ day of _____, 2003.

_____
William Kremin, Jr., Mayor
Vernal City

ATTEST:

_____
, Recorder

A new federal law was passed to try and reduce the cost of natural disasters. Local governments now have to plan ways to reduce the impacts of disasters in order to be eligible for certain types of federal disaster assistance. With the counties and cities help communities can have a plan in place that will make them eligible for mitigation grants to address hazards identified in the plan. Please answer the following questions about your town, city, or county.

HAZARD PROFILE

HAZARD:

- ❑ Avalanche
- ❑ Dam Failure
- ❑ Drought
- ❑ Earthquake
- ❑ Flash flooding
- ❑ Flooding
- ❑ Infestation
- ❑ Landslide
- ❑ Soil Subsidence
- ❑ Tornado
- ❑ Wildfire
- ❑ Winter/Summer Storms
- ❑ Other

HISTORY (please include History information for all hazards on an attached page):

- ❑ Year
  ⇒
- ❑ Location
  ⇒
- ❑ Event Description
  ⇒
- ❑ Response and Recovery Costs
  ⇒
- ❑ Comments
  ⇒

MITIGATION PROJECTS:

- ❑ Present
  - ⇒ Hazard_____
  - ⇒ Location_____
  - ⇒ Year_____
  - ⇒ Reason_____
- ❑ Potential
  - ⇒ Hazard_____
  - ⇒ Location_____
  - ⇒ Year_____

ORDINANCES (please attach a copy):

- ❑ Storm water management

❑ Zoning ❑ Stream maintenance ❑ Subdivisions ❑ Erosion control ❑ Floodplain management ❑ Natural hazards **Current Building Codes:** ⇒ Date of update_____ ⇒ Which codes are used_____
National Flood Insurance Program: Currently in Good Standing with the NFIP?
Previous Hazard Mitigation Plan: ⇒ Date published_____ ⇒ Date of update_____
Fire Insurance Rating (ISO): ⇒

Flood Hazard Identification Study
Uintah Basin Association of Governments

By:
United States Army Corps of Engineers
Utah Division of Emergency Services and Homeland Security

August 1, 2003

Introduction

The US Army Corps of Engineers Sacramento District completed this flood hazard identification study through a contract with the seven Associations of Governments. Funding was provided under the USACE Planning Assistance to States Program (Section 22). The intent of the study is to aid in detailing natural hazards associated with fluvial process for entities within each AOG currently unmapped as part of the National Flood Insurance Program or mapped as D zone areas.

Acknowledgements

The following agencies aided in preparation, interpretation, and completion of this flood hazard investigation study.

Utah Associations of Governments
Uintah Basin Association of Governments
Sacramento District Corps of Engineers
Utah Division of Emergency Services and Homeland Security

Scope of Work

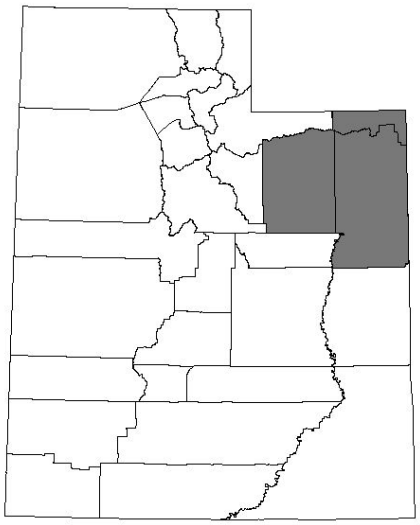
This study will evaluate and identify areas with a high flood hazard and identify potential mitigation solutions. The areas evaluated in this study include the three unincorporated counties of Daggett, Duchesne, and Uintah. Municipalities within the three counties were studied if they met the following criteria:

1. Jurisdiction has not been mapped by FEMA,
2. Jurisdiction mapped by FEMA as a Zone D, area of undetermined flood hazard.

Fluvial hazards within the cities and towns of Dutch John, Manila, Altamont, Roosevelt, Tabiona, Ballard, and Naples were studied.

Description of the Study Area

Uintah Basin Association of Government UBAG serves the following counties and municipalities with this counties: Daggett, Duchesne, and Uintah. The three counties in the study area are very rural, with the total population of the Uintah Basin being only 40,516. Each counties population is: Daggett 921, Duchesne 14,371, and Uintah 25,244. The principle draining in the area is the Green River with the Duchesne and White Rivers as major tributaries. The Uintah basin is divided into



two drainages—the North Slope and the south slope of the Uinta Mountains. Elevations in the basin range from 13,528 feet and Kings Peak in the Uinta Mountains to 4,600 feet along the green river near it's excite from Uintah County.

The Uinta Mountain range is unique, being the only major range of mountains in North America running east and west. The Uintah Mountains were extensively glaciated, and glacial features dominate the present landscape. Glacial erosion has created many picturesque examples of horns, arêtes, cirques, and glacial troughs. Lateral and terminal moraines often form natural dams, creating over a thousand small lakes that dot the region.

Numerous small streams exit the north and south slope of the Uinta range. These include such streams as the Sheep Creek, Carter Creek, Currant Creek, Red Creek, Rock Creek, Yellowstone, Whiterocks, and Strawberry River.

Discussion, Data, and Observations

Data presented in this study are from the following sources:

- Daggett County Emergency Response Plan
- Uintah County Emergency Response Plan
- Duchesne County Emergency Response Plan
- City of Naples Storm Water Master Plan
- State Water Plan
- Utah State Water Plan Uintah Basin (December, 1999)

In addition to incorporating existing studies and plans completed in the area, this flood hazard study also contains information from technical experts familiar with the study area. The mitigation projects are purely suggested actions, which based on past experience, will reduce or eliminate the identified fluvial hazard. These mitigation recommendations in no way represent the only measure to attain fluvial mitigation. In many cases the proposed or best solution is simply avoidance. This method of mitigation is implemented through the use of zoning, and represents in most cases the lowest cost mitigation measure.

Disclaimer

The information provided in this study was developed from a number of sources including:

- Past USACE studies done within the region and drainage basins,
- Personal knowledge,
- Limited onsite visits,
- Map interpolations,
- Current GIS work.

Even though care was taken to ensure a measure of correctness and field checks were preformed on the information and data gathered, it is important to note this flood hazard study is presented "as is". The United States Army Corps of Engineers, Division of Emergency Service and Homeland Security, or any other agency assisting in completion of this study cannot accept any responsibilities for errors, omissions, or accuracy. There are no warranties, which

accompany this product. Users are cautioned to field verify information provided in this product before making any decisions. In no way does the mapping presented in this study take the place of a regulatory FEMA Flood Insurance Rate Map (FIRM), or replace any flood hazard identification product developed by FEMA / National Flood Insurance Program (NFIP).

Need For Additional Research

Additional research should be conducted to better map communities currently mapped as a FEMA Zone D, or currently unmapped communities, and communities with out dated Flood Insurance Rate Maps. Communities would benefit from knowing peak flows and stages on tributaries of concern.

How Communities Where Ranked

The communities within this study were ranked based on a committee's evaluation. The evaluation committee consisted of the:

- Utah State Floodplain Program Manager
- Utah State Hazard Mitigation Officer,
- Natural Hazard Mitigation Planner,
- U.S. Army Corp of Engineers,
- State Earthquake Program Manager.

This committee researched each of the twenty-nine counties and all 269 incorporated areas within the State of Utah. Each jurisdiction was assigned one of five ratings: Very High, High, Moderate, Low, or Not Rated. These ratings in no way reflect actual flood threat. The ratings were assigned based on the following variables:

- Perceived flood threat based on topography, past flooding occurrences, and experience of committee members.
- Participation in the National Flood Insurance Program (NFIP).
- Past studies included, but not limited to, regulatory FEMA/NFIP Flood Insurance Studies (FIS), other flood studies, and reconnaissance reports.
- Population growth within the jurisdiction.
- If the community is mapped by FEMA/National Flood Insurance Program NFIP), and type of map which identifies high, moderate and low flood threats

Ratings were used to set the scope of work for each community within this study**.** Information on excluded communities was added were available.

A Word about Wildfires

Almost every year several communities around the state are flooded and/or affected by post burn debris flows. Wildfire damaged watersheds have conditions which increase the potential for debris flows which may damage structures and infrastructure in the impacted area. Overall, the heightened risk associated with alluvial fans is always of concern. Post fire revegetation and stabilization efforts in many cases do not alleviate the threat due to flooding and debris flow.

A Word About Dams

Dams are a critical support function for water managers in the State and also act as a flood control measure. If a dam remains stable, does not get overtopped, or is not impaired as the result of an earthquake, then, at a minimum, they do provide incidental flood control. If not then they can add to the flood threat. There are 117 dams within Uintah Basin of these 20 have received an high hazard rating by Utah Division of Water Rights Dam Safety section. The State Dam Safety Section has developed a hazard rating system for all non-federal dams in Utah. Downstream uses, size, height, volume, and incremental risk/damage assessments are a variable used to assign dam safety classification. Using the hazard ratings systems developed by the State Dam Safety Section, dams are placed into one of three classifications high, moderate, and low. Dams receiving a low rating would have insignificant property loss do to dam failure. Moderate hazard dams would cause significant property loss in the event of a breach. High hazard dams would cause a possible loss of life in the event of a rupture. The frequency of dam inspection is designated based on hazard rating with the Division of Water Rights inspecting high-hazard dams annually, moderate hazard dams biannually, and low-hazard dams every five years.

Daggett County

- Flaming Gorge
- Long Park

Duchesne County

- Cliff Lake
- Browns Draw
- Starvation
- Twin Pots
- Moon Lake
- East Timothy
- Red Creek
- Chepeta Lake
- Stillwater
- Big Sand Wash

Uintah County

- Brough
- Whiterocks
- East Park
- Paradise Park
- Bullock Draw
- Lapoint
- Montes Creek
- Cottonwood

Daggett County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Daggett	**Unincorporated**	413		**Not Participating**	Green River & Tribs
Daggett	**Dutch John**	200	D8	**Not Participating**	Dutch John Canyon
Daggett	**Manila**	308	D8	**Not Participating**	Sheep Creek Canal

Daggett County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flash Flood Daggett	June 10, 1965	Palisades Campground	7 deaths	Source Sheep Creek
Flood Daggett Presidential	1983	County wide	Damage to culverts and roads. The one lane bridge over Green River was destroyed	Source Birch, Red, Crouse, and Pat Creeks.

(All dollar values for given are for year of disaster)

Daggett County Flood Mitigation Goals -

Goal 1 Reduce Risk of Potential Flooding

Unincorporated Daggett County – Problem Identification: Daggett is one of the smallest counties in the state both in terms of population and size. However, almost half of its residents live in the unincorporated county making that population one of the largest percentages in the state. The County does not participate in the National Flood Insurance Program. No major rivers threaten existing urban development. Therefore, no structural flood control projects are warranted at this time. Flood sources include the Green River, Sheep, Carter, Pott Creeks, and their tributaries, and other potential flood sources such as Flaming Gorge Reservoir.

Objective: Minimize future flood damage in the unincorporated County

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent

(100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Dutch John – Problem Identification: Dutch John, one of Utah's smallest communities, does not participate in the National Flood Insurance Program. No major rivers threaten Dutch John. Dutch John Canyon Creek and the other unnamed drainages would; however, pose threats during a major flood event.

Objective: Minimize future flood damage in Dutch John.

Alternative Action: A structural mitigation project for this community could be a deflector levee from the canyon mouth, extending west past all development for distance of about a mile.

Timeframe:
Funding:
Estimated Cost: The preliminary cost for the levee project would be about $250,000.
Staff:

Alternative Action: A nonstructural project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Manila – **Problem Identification:** Manila does not participate in the National Flood Insurance Program. No major rivers flow through or threaten Manila. However, flooding could be experienced from the Sheep Creek Canal if overtopped or if failure were to occur. The drainages surrounding Manila in the unincorporated county create a less severe flood threat from time to time.

Objective: Minimize future flood damage in Manila.

Alternative Action: In light of several canal failures around the state, a stability study of the Sheep Creek Canal could be conducted. If study findings reveal deficiencies, perform all remedial measures identified. Also, all new development could be permitted a safe distance away from the unnamed drainages surrounding Manila.

Timeframe:
Funding:
Estimated Cost: A detailed canal stability study could be up to $50,000.
Staff:

Alternative Action: A nonstructural project could consist of zoning of the flood prone area to insure that all new developments are sited as far away from the channels as possible (or at least constructed so as to be higher in elevation than the flood threat). This however, would do nothing to protect existing development.

Timeframe:
Funding:
Estimated Cost: minimal.
Staff:

Duchesne County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Duchesne	**Unincorporated**	7798		**Not Participating**	Duchesne River and Tributaries
Duchesne	**Altamont**	178	E7	**Not Participating**	Unnamed drainages east & west of town
Duchesne	Duchesne	1408	E7	D-490055 - 2/4/88	
Duchesne	Myton	539	E7	490056 - 2/4/88	
Duchesne	**Roosevelt**	4299	E7	**Not Participating**	Cottonwood Creek and tributary
Duchesne	**Tabiona**	149	E6	**Not Participating**	Duchesne River and Tributaries

Duchesne County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Duchesne	September 13, 1940	Duchesne	Damage in Indian Canyon and roads flooded	Source: Indian Canyon
Flood Duchesne	August 7, 1941	Mountain Home	Destroyed bridges washed out road over Kofford wash in caused damage in Rock Creek	
Flood Duchesne	August 7, 1945	Strawberry Creek area	Damage to roads, ranches, and irrigation diversions near Strawberry Creek.	Source Strawberry Creek.
Flood Duchesne	August 1, 1953	Sowers Canyon	Damage to farm house and 200 acres of farmland	

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Duchesne	August 5, 1957	Tabiona/Hanna	Damage to homes, roads, farms, and crops	Farm Creek
Flood Duchesne	September 2, 1960	Hanna	Flood homes and damaged approximately 100 acres of farmland	
Flood Duchesne	August 11, 1969	Duchesne	Damage to town due to flooding	Source Strawberry Creek and Indian Creek.
Flood Duchesne Presidential	1983	County Wide	Damage to roadways, stream embankments, blockage of culverts, and bridges.	Source Yellowstone River, Strawberry River, Duchesne River, and Red Creek.
Flood Duchesne Presidential				

(All dollar values for given are for year of disaster)

Duchesne County Flood Mitigation Goals -

Goal 1 Reduce Risk of Potential Flooding

Unincorporated Duchesne County - Problem Identification: Well over 50 percent of the population lives in unincorporated areas of the county – one of the highest percentages in the state – many in the vicinity of Roosevelt. The highest point in the state, Kings Peak at 13,528 ft is located in northern Duchesne County, making the Duchesne Watershed a significant resource. These high mountain watersheds provide much needed water but also pose flood threats from time to time. The County does not participate in the National Flood Insurance Program, therefore flood studies are not available. Flood threats include the Duchesne River and its numerous tributaries. Other potential flood sources include Starvation and other reservoirs.

Objective: Minimize future flood damage in the unincorporated County

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing.
Staff:

Altamont – Problem Identification: Altamont does not participate in the NFIP. This community and Mt. Evans just to the southeast appear to have a moderate flood threat from unnamed channels in the immediate vicinity.

Objective: Minimize future flood damage in Altamont.

Alternative Action: A structural mitigation project for this community could be a deflector levee around the community, extending south on both sides past existing development. The overall length would be about a mile.

Timeframe:
Funding:
Estimated Cost: The preliminary cost for the levee project would be about $250,000.
Staff:

Alternative Action: Zoning to prevent development of structures near all drainages would be prudent (100 ft minimum setback or greater). The cost of modifying city ordinances to include these is minimal and the benefits substantial (although this would not reduce the flood threat to existing structures).

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing**.**
Staff:

Roosevelt – Problem Identification: This community does not participate in the NFIP. Although Cottonwood Creek runs through the north and east parts of town, the channel appears to be very incised and, as a result, would only pose a flood threat during major events. (There is also a tributary through the south side of town that the same would hold true for.)

Objective: Minimize future flood damage in Roosevelt.

Alternative Action: Maintaining the channel clear of debris and snags would be a very low cost method of minimizing flood damages in Roosevelt.

Timeframe:
Funding:
Estimated Cost: Minimal – city crews and equipment could be used when they are available.
Staff:

Alternative Action: Zoning to prevent development of structures near all drainages would be prudent (100 ft minimum setback or greater). The cost of modifying city ordinances to include these is minimal and the benefits substantial (although this would not reduce the flood threat to existing structures).

Timeframe:
Funding:
Estimated Cost: Minimal – almost nothing**.**
Staff:

Tabiona – Problem Identification: This community is the smallest incorporated town in Duchesne County with 149 residents. It does not participate in the NFIP. Tabiona is bounded by flood threats from virtually every side. The Duchesne River runs along the southwest side of town and two tributaries are located to the east and to the west – all posing flood threats.

Objective: Minimize future flood damage in Tabiona.

Alternative Action: Given the relatively few number of existing structures, flood proofing may be a viable alternative – especially for those structures with a history of being flooded. Zoning to prevent new structures from being built in the floodplain would be very helpful and cost effective.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: A structural mitigation project for this community could be a deflector levee on the east side of the community, extending north and south past existing development. The overall length would be about a mile.

Timeframe:
Funding:
Estimated Cost: The preliminary cost for the levee project would be about $250,000.
Staff:

Uintah County

COUNTY	CITY/TOWN	POPULATION	STATE MAP LOCATION	NFIP STATUS	THREAT (or NSFHA-eligible)
Uintah	**Unincorporated**	15664		490147 – 2/1/86(L)	Green River, Ashley Creek, and Tribs
Uintah	**Ballard**	566	E7	**Not Participating**	NSFHA-eligible
Uintah	**Naples**	1300	E8	**Not Participating**	Ashley Creek Tribs
Uintah	Vernal	7714	E8	490149 - 3/18/86(M)	

Uintah County Flood and Dam failure History

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flash Flood Uintah	September 1, 1909	Ashley River near Vernal	1 death	Man crossing Ashley Creek with a wagon
Flash Flood Uintah	July 4, 1925	Five Mile Canyon near Vernal	1 death	Child swept from automobile
Flood Uintah	August 9, 1941	Vernal/Jensen	Approximately $75,000 to crops was caused by heavy rain and hail. Red Wash bridge damaged	
Flood Uintah	August 25, 1955	Lapoint	$3,000 in damage to bridges and roads	
Flood Uintah	July 30, 1956	Jensen	$25,000 damage to farmlands and crops	
Flood Uintah	June 10, 1965	Maeser/Ouray	Damage to homes, crops, and waterlines	Source: Ashley Creek, Dry Fork, The Green, White, and Duchesne Rivers.

Hazards	Date	Location	Critical Facility or Area Impacted	Comments
Flood Uintah Presidential	1983	County Wide	Limited flooding in Vernal, damage to roads, and bridges	Source Ashley and Deep Creeks and the Green River.
Flood Uintah Presidential				

(All dollar values for given are for year of disaster)

Uintah County Flood Mitigation Goals -

Goal 1 Reduce Risk of Potential Flooding

Unincorporated Uintah County - Problem Identification: Well over half of its residents – 62 percent live in the unincorporated county – many in the area surrounding Vernal - making that population one of the highest percentages in the state. Flood sources include the Green River, Ashley Creek, and their tributaries. Other potential flood sources include Steinaker and Red Fleet and smaller Reservoirs.

Objective: Minimize future flood damage in the unincorporated County.

Action: Nonstructural measures appear to be the most prudent option for the county to implement in the unincorporated areas. Zoning to prevent development of structures near all rivers, creeks, and lakes would be prudent (100 ft minimum setback or greater) as well as not allowing development on alluvial fans. New development near canals should also be discouraged, as there have been several potentially deadly flood events in the state due to flooding caused by canal failures. The cost of modifying county laws to include these is minimal and the benefits substantial (although there will be a small percentage of the population that will oppose any zoning or other changes in the laws for that matter).

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Ballard – Problem Identification: While not participating in the NFIP, this community does not appear to be subject to flood threats from any rivers, creeks, or streams and is; therefore, probably eligible for a NSFHA designation.

Objective: Minimize future flood damage in Ballard.

Action: Identify Ballard as a NSFHA-eligible community.

Timeframe:
Funding:
Estimated Cost: Minimal
Staff:

Naples – Problem Identification: This community does not participate in the NFIP. It does have a relatively serious flood threat as evidenced by the many washes that run through it to the Ashley Creek on the east side. The county floodplain map identifies the flood threat on both sides of Naples in the unincorporated area. It can be assumed that a similar (or probably greater) threat exists for the town itself.

Objective: Minimize future flood damage in Naples.

Alternative Action: Because there are multiple drainages, a levee would likely not be viable. Flood proofing of individual structures; however, may be a viable alternative – especially for those structures with a history of being flooded.

Timeframe:
Funding:
Estimated Cost: $10k - $30k for the average home to flood proof.
Staff:

Alternative Action: An alternative action would be zoning to prevent new structures from being built in the floodplain would be very helpful and cost effective. However it would NOT reduce flood damages to existing development.

Timeframe:
Funding:
Estimated Cost: Minimal.
Staff:

Daggett County Mitigation Strategies

Note: Countywide in this document refers to a mitigation strategy benefiting the cities, towns and communities of: Dutch John and Manila

Wildfire

County-Wide

Problem Identification: Continuing non-compliance with existing building and fire codes.

Goal 1- Priority High

Objective 1.1 -Decrease non-compliance with existing building and fire codes.

Action: Develop and enforce current local, state and national codes.
Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes.

Problem Identification: Specific areas of the county are susceptible to wildland fire danger.

Goal 2- Priority High

Objective 2.1 - Reduce the threat of Wildfire

Action: Complete a community fire plan for the entire County with the assistance of the Regional State Fire Warden, local Fire Chief, USFS and BLM.
Time Frame: next fiscal year
Funding: Local, state, federal
Estimated Cost: Minimal
Staff: Regional State Fire Warden, local, state and federal agencies (ie. BLM, USFS)
Background: There have been repeated wildfires in the county; the majority of wildfires have started on federal lands. The fire in 1977 took the lives of 3 firefighters. The 2002 Mustang fire caused the entire Dutch John area to be evacuated the cost was 1.5 million dollars. This fire effected the county, the cost to the county was not just the money to extinguish the fire, the economic impact still lingers presently. The cost to the Bridger Valley

Electric power company was approximately $250,000; several other power companies also lost money. There was also a cost to the pipeline companies. The county is able to address the private lands and educate the public, however they have no control over the Federal agencies and how they manage the land.

Landslide

County-Wide

Problem Identification: Potential landslides Highway 44 & 191

Goal 1- Priority High

Objective 1.1 - Reduce landslide impact on Hwy 44 and 191, the potential for damage to either Hwy. 44 or 191 would necessitate a plan to reroute traffic and repair the damage to the highway. Damage repair would be coordinated as needed.
.

Action: Assess the probability of landslides and identify specific area at risk. Determine hazard and refer to UDOT
. **Time Frame:** According to UDOT.
Funding: According to UDOT funding.
Estimated Cost: Undetermined
Staff: UDOT
Background: Rocks that falls on highway 44 cause a danger to motorists from falling as well as a hazard in the road, the problem will be referred to UDOT.

Problem Identification: Potential risk to structures in mountainous areas that could be damaged by landslides.

Goal 2- Priority Medium

Objective 2.1 - Reduce potential landslide risk on commercial and residential structures on upper elevations.

Action: Assessing possibility of landslides.
Time Frame: 5 years
Funding: USFS
Estimated Cost: Unknown
Staff: USFS

Background: Soil surveys and other engineer surveys are needed.

Earthquake

County-Wide

Problem Identification: Unknown number of seismically unsafe structures around the county.

Goal 1- Priority Medium

Objective 1.1 - Have a study done to determine seismic resistance of structures within the county ie. elementary school, high schools, public buildings, and highways. etc.

Action: Structural and non-structural earthquake hazard assessment.
Time Frame: 3 to 4 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Unknown
Background: Contact DESHS earthquake program specialist. Several seismographic tests have been done within the county most likely for oil.

Problem Identification: Residents uneducated about earthquakes.

Goal 2- Priority Medium

Objective 1.2 - Public Awareness

Action: Conduct pubic awareness campaign. Enhance earthquake instructions in school.
Time Frame: Ongoing
Funding: Federal and state grants, local sources.
Estimated Cost: Minimal
Staff: LEPC, volunteers and school administration.
Background: Contact DESHS earthquake program specialist.

Goal 2- Priority Medium

Objective 2.1 – Verify Building Codes are updated

Action: Check with Planning and Zoning on building codes.
Time Frame: Ongoing
Funding: Local sources.

Estimated Cost: Minimal
Staff: County and Town Planning and Zoning.
Background: It is unclear if earthquake building codes are in place.

Flood

County-Wide

Problem Identification: There is not enough flood information on flood areas in Daggett County to identify the problem at this time.

Goal 1- Priority Medium

Objective 1.1 - Identify flood prone areas in County

Action: County flood mapping of potential flood areas.
Time Frame: Unknown
Funding: FEMA
Estimated Cost: Undetermined
Staff: State and FEMA personnel.
Background: Contact DESHS flood map specialist.

Action: Join NFIP
Time Frame: Immediate
Funding: None required
Estimated Cost: None
Staff: County Emergency Management and State Floodplain Office
Background: Daggett County has yet to be mapped with Special Flood Hazard Areas. Flood insurance is not available in the County because the County has yet to join NFIP.

Problem Identification: Possible flood because of the 2002 Mustang Fire, high spring run off, or thunderstorms due to lack of vegetation.

Goal 2- Priority High

Objective 2.1 - To reduce the threat of flood in the Dutch John area that may occur because of the Mustang Fire.

Action: Flood Ordnance
Time Frame: Ongoing
Funding: FEMA, state flood plan manager and local.
Estimated Cost: Minimal
Staff: County Emergency Management, County Commission, State DES.
Background: The Mustang 2002 Fire could cause flooding or mudslides to the residents of Dutch John, there was a flash flooding last summer at Littlehole due to no vegetation to hold back water. High run off in the spring could cause flooding. Contact DESHS flood map specialist.

Problem Identification: Control flooding in Town of Manila flooding occurs from heavy rains and fast moving thunderstorms.

Goal 3- Priority Medium

Objective 3.1 - To reduce the threat of flood of the Manila.

Action: Technical Analysis on the irrigation canals
Time Frame: Ongoing
Funding: FEMA, state and local.
Estimated Cost: Unknown.
Staff: : Unknown
Background: There has been flooding in the Town of Manila in the past due to heavy rains and high run off in the spring.

Objective 3.2- Reduce debris in Sheep Creek Canal.

Action: Develop a debris removal plan
Time Frame: 3 months to 2 years (depending on funding)
Funding: Local, State and Federal grants
Estimated Cost: Unknown
Staff: Town of Manila, Sheep Creek Irrigation

Background: The canal is used as a storm drain during high water debris such as weeds, garbage and trees back up canal causing flooding. The canal needs to be kept free of obstructions.

Objective 3.3- Reduce debris in Sheep Creek Canal.

Action: Public Education
Time Frame: 2 years
Funding: Local state and federal grants
Estimated Cost: Unknown
Staff: Town of Manila, Sheep Creek Irrigation
Background: The canal is used as a storm drain during high water, the tourists throw garbage in the canal causing flooding of canal.

Objective 3.4- - Identify flood prone areas in Manila.

Action: Flood mapping of potential flood areas in Manila.
Time Frame: Unknown (depending on funding)
Funding: FEMA grants
Estimated Cost: Unknown
Staff: Unknown
Background: Flooding has happened in the past, we were unable to establish which areas were at risk.

Objective 3.5: Design master storm drainage plans for residential areas.

Action: Design master storm drainage plans to handle storm water runoff in residential areas.
Time Frame: 5 years, (depending on funding)
Funding: Grants
Estimated Cost: Unknown
Staff: Unknown
Background: Engineers need to design master storm drainage plans for the residential areas as well as new subdivisions.

Drought

County-Wide

Problem Identification: Limited water supplies, increasing population and several years of drought place a strain on availability of community culinary water resources Water Storage

Goal 1 – Priority High

Objective 1.1 Excessive water used for landscaping

Action: Develop and enforce policies to limit the amount of area that can be used as water requiring landscape.
Time Frame: Ongoing
Funding: minimal
Estimated Cost: To be determined
Staff: Special Service District
Background: Daggett County has had several years of drought and has at time been unable to supply water to residents on the Manila side of the county.

Objective 1.2 - Develop more water storage tanks in several areas in the county.

Action: Conduct feasibility study.
Time Frame: 5 years
Funding: Grants
Estimated Cost: Unknown
Staff: Unknown
Background: Daggett County on the Manila side has had several years of drought and does not have enough storage to enable the water district to store spring run off for summer use. There have been several years that the water district was unable to supply water to residents due to not enough storage.

Problem Identification: Earthen irrigation systems throughout the County.

Goal 2- Priority Medium

Objective 2.1 - Upgrading irrigation systems.

Action: Improve canal in order to have better efficiency of water.
Time Frame: Unknown (depends on funding)
Funding: State and Federal grants and loans.
Estimated Cost: Unknown
Staff: NRCS, UACD, USU Extension, etc. Irrigation Company
Background: Several years of drought and a need for water conservation.

Problem Identification: There has not been enforcement of water law.

Goal 3 - **Priority High**

Objective 3.1 -The County has not enforced water law.

Action: Find out who is responsible to enforce the water law, then enforce it.
Time Frame: Unknown
Funding: Unknown
Estimated Cost: Unknown
Staff: County Commission and Special Service District.
Background: May start by litigation.

Problem Identification: Lack of public awareness of efficient water usage.

Goal 4 - **Priority High**

Objective 4.1 - Education

Action: Use several ways in educating the public on efficient water usage.
Time Frame: Ongoing
Funding: State, Federal grants, city and county funds, irrigation companies.
Estimated Cost: Minimal
Staff: LEPC, County, Town.

Background: Create programs to make the public aware. Use newsletters and the newspapers..

Insect Infestation

County-Wide

Problem Identification: Heavy infestations of Mormon crickets and grasshoppers.

Goal 1- Priority High

Objective 1.1 - Have government agencies develop better control methods on federal state and county grounds.

Action: Eradicate crickets and grasshoppers.
Time Frame: Ongoing.
Funding: Federal government.
Estimated Cost: Unknown
Staff: BLM and other federal and state agencies.
Background: The County has heavy infestation of crickets and grasshoppers, a particular type was created by the drought.

Problem Identification: The County has infestations of mosquitoes.

Goal 2 - Priority High

Objective 2.1 Reduce the impact of insects and West Nile Virus

Action: Spread insect bait and spray for mosquitoes
Time Frame: When required
Funding: Federal, State and County funds. Mosquito abatement funds (come from property tax).
Estimated Cost: Unknown
Staff: County Mosquito Abatement District
Background: Mosquito's are of particular concern to elderly residents because of the West Nile Virus, the virus has been identified in the counties that surround Daggett County namely Sweetwater Wy., Moffat Co., and Uintah Co. Ut.

Severe Weather

County-Wide

Problem Identification: Wind damage to property and resulting loss of power to facilities in the County.

Goal 1- Priority High

Objective 1.1 - Reduce power outages.

Action: Improve infrastructures to minimize power outages.
Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Local utilities.
Background: Contact utilities on current situation.

Problem Identification: Strong winds can cause trees to fall on power lines, causing power outages

Goal 2 – Priority High

Objective 2.1 Improve electrical power system reliability by reducing risk from damage by trees falling in windstorms.

Action: Prune trees back from power lines.
Time Frame: Unknown
Funding: Power Companies
Estimated Cost: Not determined, minimal to moderate
Staff: Power Companies
Background: The County has a history of severe windstorms and thunderstorm activity.

Problem Identification: Wind damage to crops and structures.

Goal 3- Priority Medium

Objective 3.1 - Reduce damage to crops and structures.

Action: Improve conditions to reduce soil erosion.
Time Frame: Ongoing
Funding: USDA and other government programs.
Estimated Cost: Unknown
Staff: NRCS, FSA
Background: Encourage people to sign up for assistance and education.

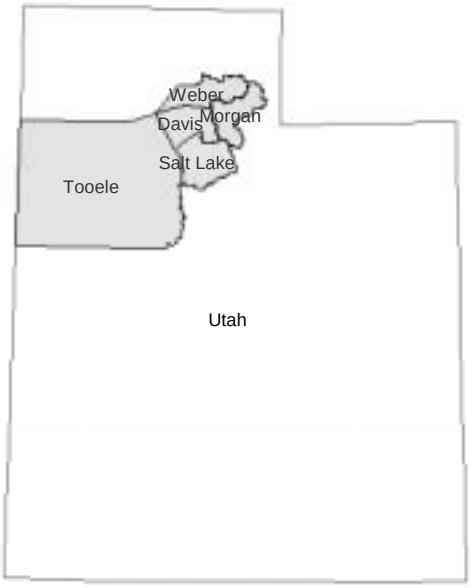
Problem Identification: The County has a history of damaging high winds.

Goal 4 – Priority High

Objective 4.1 Reduce damage to structures through strict adherence to building codes

Action: Ensure that High wind load requirement are established and are met by builders
Time Frame: Ongoing
Funding: Fees from Building permits
Estimated Cost: Minimal
Staff: Building Inspector
Background: Adherence to building code requirement for tying roof structures to supporting walls will minimize damage from high wind events.

Natural Hazard
Pre-Disaster Mitigation Plan



Utah's Wasatch Front

Davis, Morgan, Salt Lake, Tooele, and Weber Counties

Wasatch Front Regional Council
December 2003

Natural Hazard Pre-Disaster Mitigation Plan

Prepared by LaNiece Dustman with assistance from Jim Boes in the offices of the Wasatch Front Regional Council. Guidance provided by Ryan Pietramali from the Utah Division of Emergency Services and Homeland Security.

December 2003

Executive Summary

Plan Mission
The mission of the Wasatch Front Regional Council (WFRC) Pre-Disaster Mitigation Plan (PDM) is to substantially and permanently reduce the region's vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer more sustainable community.

Plan Organization
The WFRC plan was developed and organized within the rules and regulations established under 44 CFR 201.6. The plan contains a discussion on the purpose and methodology used to develop the plan, a profile on communities within WFRC, as well as a hazard identification study and a vulnerability analysis of eight hazards. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This is intended to improve the communities within the WFRC planning district ability to handle disasters, and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing
The WFRC PDM Plan has been financed and developed under the PDM Program provided by the Federal Emergency Management Agency (FEMA) and the Department of Public Safety Division of Emergency Services and Homeland Security (DESHS). The WFRC aided in funding and provided in-kind assistance to local governments.

Plan Participation
The WFRC PDM Plan has been completed as a result of a collaborative effort between The WFRC, DESHS, City and County Emergency Managers, Fire Departments, Sheriff Departments, Public Works Departments, Planning Commissions, Assessor's Office, City and County GIS Departments, Elected Officials, Public Employees, and Citizens of the cities and towns within Davis, Morgan, Salt Lake, Tooele, and Weber Counties. Interviews were conducted with stakeholders from the communities, and a workshop was conducted during the plan development. Additionally, through public hearings, workshops, and draft plan displays; ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan.

Hazards Identified
It was suggested by the DESHS that at a minimum, the PDM plan address the hazards of: earthquake, flood, landslide, problem soils, wildfire, dam failure, severe weather, and drought. However, there are other hazards that were identified which are not in the minimum criteria established by DESHS that were added to the discussion.

The hazard identification study recognized the following hazards as being the most prevalent and posing the most potential risk to the counties and towns within the WFRC five county planning districts.

- Earthquake
- Flood
- Drought
- Landslide
- Wildfire
- Dam Failure
- Severe Weather
- Infestation

Plan Goals
In an effort to ensure that the mission of the WFRC PDM Plan is met, the participants in the development of this plan defined and established a list of goals, which are directly relevant to meeting the mission of the plan.

The following is a list of the goals identified by the participants of this plan:

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities
- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains
- Minimize the impacts of flooding
- Minimize the impacts of drought
- Minimize the impacts of severe weather
- Minimize the risk of wildfire

Acknowledgements

The Wasatch Front Regional Council would like to extend their appreciation to the following agencies, which assisted in the development of this plan.

- Utah Division of Emergency Services and Homeland Security
- Federal Emergency Management Agency
- National Weather Service
- National Climate Data Center
- Utah Army Corps of Engineers
- Utah Geologic Survey
- Utah Division of Forestry Fire, and State Lands
- Utah Department of Agriculture
- Utah Avalanche Center
- Utah Automated Geographic Resource Center
- University of Utah
- University of Utah Seismic Station
- Utah State University
- Councils of Governments
- Association of Governments
- Davis County and municipalities including the City of Bountiful, Centerville City, Clearfield City, Clinton City, Farmington City, Fruit Heights City, Kaysville City, Layton City, City of North Salt Lake, South Weber City, Sunset City, Syracuse City, West Bountiful City, West Point City, and Woods Cross City
- Davis County emergency manager Brian Law
- Davis County elected officials and planning commission members
- Davis County residents and other interested members
- Davis County agencies including; public works, GIS office, assessors office, LEPC, emergency services division, fire and sheriff's office
- Morgan County and municipalities including Morgan City
- Morgan County emergency manager Terry Turner
- Morgan County elected officials
- Morgan County agencies including; the planning commission, public works, assessors office
- Morgan County residents and other interested members of the public
- Tooele County and municipalities including Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the city of Wendover
- Tooele County emergency managers Kari Sagers, John Michaelson, and Marilyn Candeleria
- Tooele County elected officials
- Tooele County agencies including engineering department, planning commission, assessors office, USU Extension Office, Natural Resource Conservation Service
- Tooele County public and other interested members
- Salt Lake County and municipalities town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City
- Salt Lake County emergency managers Dennis Stanley, Bob Halloran, Kathy Cuff Case
- Salt Lake County elected officials
- Salt Lake County agencies including public works, GIS departments, engineering departments, planning commission, assessors office, LEPC, emergency services division, fire and sheriff's office
- Salt Lake County public and interested members
- Weber County and municipalities including Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View

City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City

- Weber County emergency manager Lance Peterson
- Weber County elected officials
- Weber County agencies including planning commission, GIS department, fire and sheriff's office, emergency services division

- In addition, we offer sincere thanks to the Town of Merrimack, Clackamas County, Dunkerton, Iowa, Dunn County North Dakota, Jefferson County West Virginia, and Salt Lake City.

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Cover Photo: Elk Point- Mount Timpanogos Avalanche. The debris covers perhaps ten football fields with almost all the debris deeper than 10 feet. The avalanches started way up high, around 10,800' and descended on the people below during one of the largest snow storms in years. US Forest Service- Bruce Tremper 12/27/2003.

Part I. Introduction

The State of Utah is vulnerable to natural, technological, and man-made hazards that have the possibility of causing serious threat to the health, welfare, and security of our citizens. The cost of response to and recovery from potential disasters can be substantially reduced when attention is turned to mitigating their impacts and effects before they occur or re-occur.

Hazard mitigation is defined as any cost-effective action that has the effect of reducing, limiting, or preventing vulnerability of people, property, and/or the environment to potentially damaging, harmful, or costly hazards. Hazard mitigation actions, which can be used to eliminate or minimize the risk to life and property, fall into three categories: first, those that keeps the hazard away from people, property, and structures: second, those that keeps people, property, and structures away from the hazard: and third, those that do not address the hazard at all but rather reduce the impact of the hazard on the victims such as insurance. This mitigation plan has strategies that fall into all three categories.

Hazard mitigation actions must be practical, cost effective, environmentally, and politically acceptable. Actions taken to limit the vulnerability of society to hazards must not in themselves be more costly than the value of anticipated damages.

Capital investment decisions must be considered in conjunction with natural hazard vulnerability. Capital investments can include; homes, roads, public utilities, pipelines, power plants, chemical plants, warehouses, and public works. These decisions can influence the degree of hazard vulnerability of a community. Once a capital facility is in place very few opportunities will present themselves over the useful life of the facility to correct any errors in location or construction with respect to hazard vulnerability. It is for these reasons that zoning ordinances, which restrict development in high vulnerability areas, and building codes, which ensure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

In the past, mitigation has been the most neglected aspect within emergency management. Since the priority to implement mitigation activities is generally low in comparison to the perceived threat, some important mitigation measures are neglected in favor of high-profile events. Mitigation success can be achieved, however, if accurate information is portrayed through complete hazard identification and impact studies, followed by effective mitigation management. Hazard mitigation is the key to greatly reducing long-term risk to people and property living in Utah from natural hazards and their effects. Preparedness for all hazards includes response and recovery plans, training, development, management of resources, and the need to mitigate each jurisdictional hazard.

A. Purpose

The purposes of this plan are as follows; to fulfill Federal, State, and local hazard mitigation planning obligations, to engage in long-term mitigation planning, and to direct mitigation actions which would serve to minimize conditions which would have an undesirable impact on our citizens, the economy, environment, and the well-being of the State of Utah. This plan enhances city and state officials, agencies, and public awareness to the threat that hazards have on property and life and what can be done to help prevent or reduce the vulnerability of each Utah jurisdiction.

B. Scope

The WFRC PDM plan was developed in accordance with the requirements of the FEMA Section 322 regulations, DESHS, and local planning agencies.

The goal of this plan is to assist the five counties of the Wasatch Front region (Davis, Morgan, Salt Lake, Tooele, and Weber) in reducing the costs of natural disasters through mitigation practices. This plan provides comprehensive hazard identification, risk assessment, vulnerability analysis, mitigation actions, and an implementation schedule for the region.

Regulations set forth by FEMA were followed during development of this plan. Future monitoring, evaluating, updating and implementation will take place as new incidents occur or every five years.

C. Authority

Federal: Public Law 93-288 as amended, established the basis for federal hazard mitigation activity in 1974. A section of this Act requires the identification, evaluation, and mitigation of hazards as a prerequisite for state receipt of future disaster assistance outlays. Since 1974, many additional programs, regulations, and laws have expanded on the original legislation to establish hazard mitigation as a priority at all levels of government. When PL 93-288 was amended by the Stafford Act, several additional provisions were also added that provide for the availability of significant mitigation measures in the aftermath of Presidential declared disasters. Civil Preparedness Guide 1-3, Chapter 6- Hazard Mitigation Assistance Programs places emphasis on hazard mitigation planning directed toward hazards with a high impact and threat potential.

President Clinton signed the Disaster Mitigation Act of 2000 (DMA 2000) into Law on October 30, 2000. Section 322, defines mitigation planning requirements for state, local, and tribal governments. Under Section 322 States are eligible for an increase in the Federal share of hazard mitigation, if they submit a mitigation plan (which is a summary of local and/or regional mitigation plans) that identifies natural hazards, risks, vulnerabilities, and which describes proposed actions to mitigate the hazards risks and vulnerabilities in that plan.

State: The Governor's Emergency Operation Directive, The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended, Title 44, CFR, Federal Emergency Management Agency Regulations, as amended, State Emergency Management Act of 1981, Utah Code 53-2, 63-5, Disaster Response Recovery Act, 63-5A, Executive Order of the Governor, Executive Order 11, Emergency Interim Succession Act, 63-5B.

Local: Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In the counties and cities making up the WFRC the local executive responsible for carrying out plans and policies are the county Commissioners and city or town Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document.

Association of Governments: The Association of Governments have been duly constituted under the authority of Title XI, Chapter13, Utah Code Annotated, 1953, as amended (The Inter-local Cooperation Act) and pursuant to Section 3 of the Executive Order of the Governor of the State of Utah, dated May 27, 1970, with the authority to conduct planning studies and to provide services to its constituent jurisdictions.

D. Goals and Objectives

The goals and objectives of the PDM plan included coordination with local governments to develop a regional planning process meeting each plan component identified in the FEMA Region VIII Crosswalk document, DESHS planning expectation, and local input. And meet the need of reducing risk from natural hazards in Utah, through the implementation of and updating of regional plans.

Local Goals: These goals form the basis for the development of the PDM Plan and are shown from highest priority, at the top of the list, to those of lesser importance nearer the bottom.

- Protection of life before, during, and after the occurrence of a disaster
- Preventing loss of life and reducing the impact of damage where problems cannot be eliminated
- Protection of emergency response capabilities (critical infrastructure)
- Communication and warning systems
- Emergency medical services and medical facilities
- Mobile resources
- Critical facilities

- Government continuity
- Protection of developed property, homes and businesses, industry, education opportunities and the cultural fabric of a community, by combining hazard loss reduction with the community's environmental, social and economic needs
- Protection of natural resources and the environment, when considering mitigation measures
- Promoting public awareness through education of community hazards and mitigation measures
- Preserving and/or restoring natural features that provide mitigation such as floodplains

Long Term Goals:

- Eliminate or reduce the long-term risk to human life and property from identified natural and technologic hazards
- Aid both the private and public sectors in understanding the risks they may be exposed to and finding mitigation strategies to reduce those risks
- Avoid risk of exposure to identified hazards
- Minimize the impacts of those risks when they can not be avoided
- Mitigate the impacts of damage as a result or identified hazards
- Accomplish mitigation strategies in such away that negative environmental impacts are minimized
- Provide a basis for funding of projects outlined as hazard mitigation strategies
- Establish a regional platform to enable the community to take advantage of shared goals, resources, and the availability of outside resources

Objectives: The following objectives are meant to serve as a measure upon which individual hazard mitigation projects can be evaluated. These criteria become especially important when two or more projects are competing for limited resources.

- Identification of persons, agency or organization responsible for implementation
- Projecting a time frame for implementation
- Explanation of how the project will be financed including the conditions for financing and implementing as information is available
- Identifying alternative measures, should financing not be available
- Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place for surrounding counties
- Have significant potential to reduce damages to public and/or private property and/or reduce the cost of, state, and federal recovery for future disasters
- Be the most practical, cost-effective, and environmentally sound alternative after consideration of the options
- Address a repetitive problem, or one that has the potential to have a major impact on an area, reducing the potential for loss of life, loss of essential services and personal
- Property, damage to critical facilities, economic loss, and hardship or human suffering
- Meet applicable permit requirements
- Not encourage development in hazardous areas
- Contribute to both the short and long term solutions to the hazard vulnerability risk problem
- Assuring the benefits of a mitigation measure is equal to or exceeds the cost of implementation
- Have manageable maintenance and modification costs
- When possible, be designed to accomplish multiple objectives including improvement of life-safety risk, damage reduction, restoration of essential services, protection or critical facilities, security or economic development, recovery, and environmental enhancement
- Whenever possible, use existing resources, agencies and programs to implement the project

Part II. Adoption Process and Documentation

The WFRC PDM plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 of the local hazard planning regulations the final plan was to be adopted by each of the municipalities as well as the five counties. This section documents the adoption process of each local government in order to demonstrate compliance with this requirement. The plan was adopted prior to being submitted to FEMA region VIII for final review. Table 1 identifies the communities that participated in the planning process and have adopted the plan. The following is a sample of the Adoption Resolutions.

Table 1 Participating Communities

Counties	Participated (Yes/ No)	Date
Davis County		
City of Bountiful		
Centerville City		
Clearfield City		
Clinton City		
Farmington City		
Fruit Heights City		
Kaysville City		
Layton City		
City of North Salt Lake		
South Weber City		
Sunset City		
Syracuse City		
West Bountiful City		
West Point City		
Woods Cross City		
Morgan County		
Morgan City		
Salt Lake County		
Town of Alta		
Bluffdale City		
City of Draper		
Herriman		
Holladay- Cottonwood City		
Midvale City		
Murray City		
Riverton City		
Salt Lake City		
Sandy City		
City of South Jordan		
City of South Salt Lake		
City of Taylorsville		
West Jordan City		
West Valley City		
Tooele County		
Grantsville City		

Ophir Town		
Rush Valley Town		
Stockton Town		
Tooele City		
Vernon Town		
City of Wendover		
Weber County		
Farr West City		
City of Harrisville		
Hooper City		
Huntsville City		
Marriott-Slaterville		
North Ogden City		
Ogden City		
Plain City		
Pleasant View City		
Riverdale City		
Roy City		
South Ogden City		
Town of Uintah		
City of Washington Terrace		
West Haven City		

RESOLUTION NO._____

A RESOLUTION ADOPTING THE WASATCH FRONT REGIONAL COUNCIL NATURAL HAZARD PRE-DISASTER MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

WHEREAS, President William J. Clinton signed H.R. 707, the Disaster Mitigation and Cost Reduction Act of 2000, into law on October 30, 2000.

WHEREAS, the Disaster Mitigation Act of 2000 requires all jurisdictions to be covered by a Pre-Disaster Hazard Mitigation Plan to be eligible for Federal Emergency Management Agency post-disaster funds,

WHEREAS, Wasatch Front Regional Council (WFRC) has been contracted by the State of Utah to prepare a Pre-Disaster Mitigation Plan covering all of the jurisdictions in the WFRC area, and

WHEREAS, the WFRC Executive Council approved WFRC staff to write the plan on February 21, 2002, and

WHEREAS, XXX City is within the WFRC Area, and

WHEREAS, the XXX City Council is concerned about mitigating potential losses from natural hazards/ disasters before they occur, and

WHEREAS, the plan identifies potential hazards, potential losses and potential mitigation measures to limit losses, and

WHEREAS, the XXX City Council has determined that it would be in the best interest of the community as a whole to adopt the Natural Hazard Pre-Disaster Mitigation Plan as it pertains to the City, therefore

BE IT RESOLVED BY THE XXC CITY COUNCIL THAT:

The attached "Wasatch Front Regional Council Natural Hazard Pre-Disaster Mitigation Plan" be adopted to meet the requirements of the Disaster Mitigation and Cost Reduction Act of 2000.

This resolution shall be effective on the date it is adopted.

DATED this _____ day of _____, 2003.

_____
Mayor
XXX City

ATTEST:

_____
Recorder

Part III. Planning Process

This plan was prepared in the offices of the WFRC by appointed staff members LaNiece Dustman, Lane Nielson, and Jim Boes and was supported by the local planning team members of the Emergency Management Service Divisions and other state and local personnel. Other local agencies that have aided in the process include; City and County Geographic Information Systems (GIS) Departments, Elected Officials, Local Officials, Emergency Managers, Fire and Sheriff Departments, Planning Departments, and Local Governmental Agencies. The planning process was based on Section 322 requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and supporting guidance documents developed by FEMA and the Utah DESHS.

The planning process included the following steps.

1. Organize Resources
2. Public Officials Out Reach
3. Establish Continuity in Planning Process
4. Data Acquisition
5. County Hazard Identification and Profile
6. County Vulnerability Assessment
7. Local Mitigation Actions
8. Form County Mitigation Steering Committee
9. Mitigation Strategy Development
10. Prioritization of Identified Mitigation Strategies
11. State Plan Review
12. Adoption

Step 1: Organize Resources

The seven regional Association of Governments (AOG) were recommended to conduct the planning efforts by the Utah League of Cities and Towns and the Governors Office of Planning and Budget to ensure coordination with elected officials, emergency managers, planners, public works departments, and information technology specialists. Utah DESHS contracted the seven AOG's as sub-grantees to coordinate, develop, and write the seven multi-regional hazard mitigation plans under the planning guidelines included in the DMA 2000.

WFRC designated a core planning team made up of members outlined in Table 3-1. These members were the main constituents of the planning process from the initiation of the plan, to the development and coordination, and resolution of the plan's adoption. In addition to the core planning team a technical team committee was created on a technical level that is identified in Table3-2. A local committee was also established to ensure local input and is identified in Table 3-3.

Table 3-1 Core Planning Team

Name	Organization
Lane Nielson	Wasatch Front Regional Council, Community Development and Planner
LaNiece Dustman	Wasatch Front Regional Council, Hazard Mitigation Planner
Jim Boes	Wasatch Front Regional Council, Planner

Table 3-2 Technical Team Committee

Name	Organization
Ryan Pietramali	Utah Division of Emergency Services and Homeland Security
Lane Nielson	Wasatch Front Regional Council
LaNiece Dustman	Wasatch Front Regional Council

Jeff Adams	Southeastern Utah Association of Local Governments
Jim Boes	Wasatch Front Regional Council
Jeff Gilbert	Bear River Association of Governments
Ken Sizemore	Five County Association of Governments
Curt Hutchings	Five County Association of Governments
Andrew Jackson	Mountainland Association of Governments
Emery Polelonema	Six County Association of Governments
Edwin Benson	Six County Association of Governments
Yankton Johnson	Uintah Basin Association of Governments

Table 3-3 Local Planning Team

County Name	Member Name	Organization Name
Davis	Sgt. Brian Law	Sheriffs Office, Emergency Services
	Floyd Peterson	Clinton City Fire Department
	Larry Gregory	Farmington City Fire Department
	Kirk Middaugh	Department Public Safety, Utah Highway Patrol
	Dave Adamson	Davis County Public Works
	Paul Child	Centerville City Public Works
	Dustin Lewis	Centerville City
	John Thacker	Kaysville City
	Walt Hokanson	Farmington City
	Bret Millburn	Red Cross
	Norm Whitaker	West Point City
	John Mabey	Utah Amateur Radio Emergency Services
	Anne Blenkenship	Woods Cross City
	Farrell Cook	West Point City
	John Massengale	South Weber City
	Jim Mason	Layton City
Morgan	Terry Turner	Sheriffs Office, Emergency Services
	Kim Turner	Fire Department, Emergency Services
Salt Lake	Dennis Stanley	Emergency Services/ Fire Department
	Bob Halloran	Emergency Services
	Joan Welch	Emergency Services
	Nancy Sanchez	Salt Lake Community College
	Randy Willden	Murray Fire Department
	Stephen Higgs	Midvale Fire Department
	Dawn Black	Salt Lake City Emergency Management
	David Chishaun	City of Holladay
	Chris Evans	South Jordan Public Safety
	Kathy Cuff-Case	Emergency Services
	Kent Miner	Salt Lake Valley Health
Tooele	Kari Sagers	Emergency Management
	John Michaelson	Emergency Management
	Dana Truman	Natural Resources Conservation Society
	Matt Palmer	Utah State University Extension Service
	Nicole Cline	Tooele County Engineers Office
Weber	Lance Peterson	Sheriffs Office, Emergency Services
	George Burbidge	Weber Co. Stormwater
	Chuck Stokes	Weber Fire Department
	Jack Lucero	Weber Fire District
	Curtis Christenson	Weber County Engineer
	Jay Miller	Emergency Manager
	Delon Atkinson	Emergency Service Director

Step 2: Public Officials Outreach
To ensure the planning process had backing from the elected officials a representative from WFRC met with each local elected officials to inform them of the need for the plan and how it can better help their communities. The plan was introduced to local elected official along with public entities through a series of public meeting and an informational brochure created by the WFRC.

Step 3: Establish Continuity in the Planning Process
To meet the requirements set forth by DMA 2000, the seven AOG's were contracted by the DESHS to assist all counties within Utah in completing the seven multi-regional PDM plans. The seven AOG's formed a Technical Team Planning Committee to share ideas and ensure the plans were similar and that there was little duplication of effort.

Step 4: Data Acquisition
Contact was made with the GIS technician or planning commission in each city and county to assess what data was available on a local level. Agreements were put in place to allow the exchange of data between the local jurisdictions and WFRC. Data layers obtained included some or all of the following: local roads, plot maps, county tax assessor's data, hazard data, flood maps, topographic data, aerial photographs, and land development data.

Step 5: County Hazard Identification and Profile
These steps were conducted by gathering data on the hazards that occurred within the planning region. This information was gathered from local, state, and federal agencies and organizations, as well as, from newspaper and other local media accounts, state and local weather records, conversations with the public and local officials, surveys, interviews, and meetings with key informants within the planning area. Mitigation planning meetings were held during this process and are explained in further detail in Table 3-4. During these meetings attendees had the opportunity to review the general information on previous hazards and comment on them in a more specific manner. These meetings also provided a forum for discussion on the background information that was needed to gain a general understanding of the geography, geology, recreation, natural resources, and water resources of the planning region. These initial contacts with local entities also provided visual understanding of the planning region for planners of the core planning team.

Step 6: County Vulnerability Assessment
This step was conducted through a review of local base maps, topographical maps, floodplain maps, USGS and UGS maps, AGRC maps, FEMA hazard maps, and county hazard maps. A detailed vulnerability assessment was completed with the use of GIS software for each county within the WFRC planning region. HAZUS MH was used to determine vulnerability to earthquakes, floods, landslides, and wildfire. Loss estimation methodology was developed by the core planning team, with assistance from the technical team, to determine vulnerability from each identified hazard. When available county parcel data was used to estimate the number of residents that could be affected by the hazard. If county parcel data was unavailable then Census 2000 block data was used.

Step 7: Local Mitigation Actions
This step was conducted through a review of the governing documents of the planning region, as well as, conversations, interviews, and meetings with interested community members. This step identified what goals are already established and adopted for the planning area and whether or not they promote or deter mitigation activities.

Step 8: Form County Mitigation Steering Committee
Davis, Morgan, Tooele, Weber, and Salt Lake Counties all set up a mitigation planning steering committee. These committees were formed of individuals with an interest in mitigation, as well as, public employees with technical expertise pertinent to mitigation. These committees included elected officials, city planners, city engineers, county and city GIS staff, floodplain managers, sheriff and fire staff, and city and county emergency managers. Committee members were tasked with completing the Mitigation Strategies Workbook issued by the DESHS.

Step 9: Mitigation Strategy Development
Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each county that participated in the PDM Planning Grant was asked to evaluate identified and profiled hazards, and the vulnerability assessment completed by WFRC. This information was used to complete the Mitigation Strategies Workbook found in Appendix H.

Step 10: Prioritization of Identified Mitigation Strategies
The DMA 2000 requires state, tribal, and local governments to show how mitigation actions were evaluated and prioritized. The core planning team, the technical team, and the local planning team completed this process. Prioritization was done using the STAPLEE method explained in the FEMA How to Guide, Document 386-3.

Step 11: State Review
DESHS created a formal PDM plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the plans from October 15 through November 1, 2003 and again from January 1 to January 15, 2004 subsequent to submission to FEMA for final review and acceptance.

Step 12: Adoption
The plan went through a public hearing process on (date) and was adopted by the cities and counties listed in Table 1 of Part II. Adoption Process and Documentation.

Table 3-4 Planning Process Timeline

Date	Activity	Purpose
March 29, 2002	Letter of Intent that identifies the seven Association of Governments as sub-grantees of the state to write the PDM plans. The AOG's were chosen by the Utah Interagency Technical Team who is part of Nature-Safe Utah (Utah's Pre-Disaster Mitigation Program).	Continue the relationship with local council members and municipalities.
May 15-16, 2002	Utah's first regional mitigation planning training piloted toward the seven AOG's	Establish a guideline and timeframe.
July 12,2002	News Release from Governor Michael Leavitt announcing the new program to develop local hazard mitigation plans statewide.	Conduct public awareness and involvement.
August, 2002	Gather information.	Data Collection.
September 10, 2002	Meeting. Met with all AOG's and DESHS to discuss the planning process.	Identify planning team and available resources.
September 30, 2002	Public Meeting. Met with Emergency Managers in the Wasatch Front region.	Identify level of involvement.
October 31, 2002	Meeting. Met with DESHS.	Discuss timeline and planning process.
November 2002	Gathered community data for regional data section of the plan.	Data Collection.
November 12, 2002	Public Meeting. Met with Uintah Basin Association of Governments.	Identify sub-committees.
November 14, 2002	Public Meeting. Met with Six County Association of Governments.	Identify sub-committees.

November 18, 2002	Public Meeting. Carbon County meeting with local and state DESHS, city and county officials including Helper City Fire Department, Wellington community member, Price City Emergency Preparation Committee, Carbon County emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 18, 2002	Public Meeting. Emery County meeting with public safety officials from Orangeville City, Building Inspector from Huntington City, Emery City, Clawson City, Cleveland City, Elmo City and Ferron City mayor's. Sheriff and Road Department from Emery County, Castle Dale city planning and zoning, Huntington City and Green River City local community members.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
November 22, 2002	Meeting. Met with technical team members.	Solicit public involvement, Army Corps proposal for flood study, GIS training, timeline, review the regional plans
December, 2002	Gathering data.	Data Collection
January, 2003	Gathering data.	Data Collection.
January 22, 2003	Public Meeting. AOG executive director's meeting.	Signed contracts for Army Corps flood proposal.
February 13, 2003	Public Meeting. Grand County (in Moab and Monticello cities) local community member meeting. GIS staff, geologist, planning commission, hydrologist, state DESHS, AOG's staff members all attended the meeting.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
February 13, 2003	Public Meeting. San Juan County community member meeting. Met with GIS staff, state DESHS, local AOG members, and county emergency manager.	Kick off meeting. Handed out questionnaires and brochures for local comment and awareness.
February 27, 2003	Meeting. Met with technical team members in St. George.	Review of plans, mapping.
March, 2003	Information gathering	Data Collection, plan
April 21, 2003	Meeting. AOG executive director's meeting.	PDM extension and additional money.
April, 2003	Drafting of the plan.	For review.
May 16, 2003	Meeting. AOG executive directors meeting.	Discussion of progress; plans to DESHS by December with additional money.
May 22, 2003	Meeting. Met with technical team members at DESHS.	Progress report, deadlines, mapping, mitigation actions, internal web page.
May, 2003	Gather mapping data.	Complete hazard identification and profile.

June, 2003	Website addressing Natural Hazards.	Public involvement and comment.
July 17, 2003	Meeting. Met with technical team member in Orem City.	Discussed mapping and plan review.
August, 2003	Public meetings. Handed out pamphlets about PDM.	Public involvement.
September 25, 203	Meeting. Technical Team Member meeting.	Army Corps of Engineers Flood Study review, training.
October 15, 2003	Technical Team Training. Pre-Disaster Mitigation Training provided by DESHS.	Informational meeting regarding FEMA requirements, ideas on mitigation strategies.
October 15, 2003	Plan Submission.	Turned plans into DESHS for review.
November 4, 2003	Local Planning Team Meeting/ Mitigation Strategies. Weber County.	Identified local planning team for Weber County. Local mitigation actions were identified.
November 13, 2003	Local Planning Team Meeting/ Mitigation Strategies. Tooele County	Identified local planning team for Tooele County. Local mitigation actions were identified.
November 20, 2003	Local Planning Team Meeting/ Mitigation Strategies. Davis County	Identified local planning team for Davis County. Local mitigation actions were identified.
November 20, 2003	Local Planning Team Meeting/ Mitigation Strategies. Morgan County	Identified local planning team for Morgan County. Local mitigation actions were identified.
November 30, 2003	Local Planning Team Meeting/ Mitigation Strategies. Price City.	Second mitigation strategies workbook meeting for Price City.
December 3, 2003	Local Planning Team Meeting/ Mitigation Strategies. Tooele County	Second mitigation strategies workbook meeting.
December 3, 2003	Local Planning Team Meeting/ Mitigation Strategies. Salt Lake County	Identified local planning team for Salt Lake County. Local mitigation actions were identified.
December 10, 2003	Met with Utah DESHS for review.	Track progress.
December 31, 2003	Turned plan into Utah DESHS for final State review.	State review.

A. Public Involvement

Public involvement opportunities were available and incorporated throughout the development of this plan. Such opportunities included a public website and public meetings for comment review. Emergency managers, fire and sheriff departments, state and local agencies, business leaders, educators, non-profit organizations, private organizations, and other interested members that could be affected by a hazard within the region or other interested members, were all a part of the planning process.

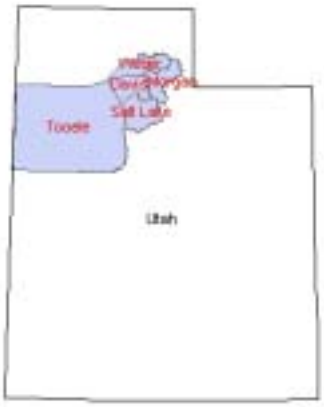
Following the preliminary FEMA approval, this Natural Hazard Mitigation Plan was placed on the Utah Division of Emergency Services and Homeland Security, and the Wasatch Front Regional Council websites for further public comment and review. These websites were placed in the local paper (Salt Lake Tribune and/ or the Deseret News) for public advertisement and awareness. In addition, interested members were notified through email or phone of the comment period. Such members included Emergency Services and Managers, Fire and Sheriff's departments, Public Works department, American Red Cross, Utah Geological Survey, Planning Commissions, Planning Agencies, GIS departments, and other Association of Governments.

B. Information Sources

The following sources and plans were used and reviewed while completing the plan.

- Federal Emergency Management Agency (How-to Guides).
- National Weather Service (hazard profile).
- National Climate Data Center (drought, severe weather)
- Army Corps of Engineers (flood data).
- Utah Division of Emergency Services and Homeland Security (Salt Lake City Mitigation Plan, GIS data, flood data, HAZUS data for flood and earthquake).
- Utah Geologic Survey (GIS data, geologic information).
- Utah Division of Forestry Fire and State Lands (fire data).
- Utah Avalanche Center, Snow and Avalanches in Utah Annual Report 2001-2002 Forest Service.
- Utah Automated Geographic Resource Center (GIS data).
- University of Utah (drought climate charts from internship students).
- University of Utah Seismic Station (earthquake data).
- Utah State University (climate data).
- Councils or Government
- Association of Governments
- Davis County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Morgan County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, transportation data, property and infrastructure data).
- Tooele County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, transportation data, property and infrastructure data).
- Salt Lake County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data).
- Weber County and municipalities (Emergency Operations Plan, histories, mitigation actions, public input, GIS data, assessor data, transportation data, property and infrastructure data, parcel data, county projects, county plans).
- Earthquake Safety in Utah
- Utah Natural Hazard Handbook
- Utah Statewide Fire Risk Assessment Project
- A Strategic Plan for Earthquake Safety in Utah
- Natural Disaster Analysis, State of Utah Office of Emergency Services 1976
- State of Utah Mitigation Plan 1999 and 2001
- State of Utah Wildfire Plan 2002
- State of Utah Drought Plan
- State of Utah Water Plan
- Salt Lake City Vulnerable Analysis and Multi-Hazard Mitigation Plan 2002
- Ogden Valley General Plan
- Regional Storm Water Management Plan Weber County, UT 1999
- Planning for a Sustainable Future
- Town of Merrimack, NH Hazard Mitigation Plan 2002
- Clackamas County Mitigation Plan 2002
- Hazard Mitigation Plan Dunkerton, Iowa
- Dunn County North Dakota Multi-Hazard Mitigation Plan 2001
- Jefferson County West Virginia All Hazard Mitigation Plan 2003

Part IV. Regional Data



The Wasatch Front is made up of Davis, Morgan, Salt Lake, Tooele, and Weber counties. All are very distinct in regards to geography, population, and economy. Salt Lake County is the most urbanized county in the region as well as the entire state whereas Tooele County is the least urbanized within the region. Table 4-1 identifies each cities population using Census 2000 data.

Table 4-1 Municipalities within Wasatch Front Regional Council

Davis County	**2000 City Pop.**	**Morgan County**	**2000 City Pop.**	**Salt Lake County**	**2000 City Pop.**	**Tooele County**	**2000 City Pop.**	**Weber County**	**2000 City Pop.**
City of Bountiful	41,301	Morgan City	2,635	Town of Alta	370	Grantsville City	6,015	Farr West City	
Centerville City	14,585			Bluffdale City	4,700	Ophir Town	23	City of Harrisville	
Clearfield City	25,974			City of Draper	25,220	Rush Valley Town	453	Hooper City	
Clinton City	12,585			Herriman	1,523	Stockton Town	443	Huntsville City	
Farmington City	13,000			Holladay-Cottonwood City	14,561	Tooele City	22,502	Marriott-Slaterville	
Fruit Heights City	5,400			Midvale City	27,029	Vernon Town	236	North Ogden City	15,026
Kaysville City	20,351			Murray City	34,024	City of Wendover	1,537	Ogden City	77,226
Layton City	58,474			Riverton City	25,011			Plain City	
City of North Salt Lake	10,000			Salt Lake City	181,743			Pleasant View City	5,632
South Weber City	4,500			Sandy City	88,418			Riverdale City	7,656
Sunset City	5,200			City of South Jordan	29,437			Roy City	32,885
Syracuse City	10,000			City of South Salt Lake	22,038			South Ogden City	14,377

West Bountiful City	5,000			City of Taylorsville	57,439			Town of Uintah	
West Point City	7,300			West Jordan City	68,336			City of Wash-ington Terrace	8,551
Woods Cross City	6,000			West Valley City	108,896			West Haven City	
Unincorporated	2,500								

A. Geographic and Physiographic Background

Davis County is located in the northern region of Utah and encompasses approximately 633 square miles. Two thirds of the land area is covered by the Great Salt Lake allowing for only 233 square miles of usable land. The Great Salt Lake is the largest water body within the state and was named the Great Salt Lake because of the high salt content. Davis County is bordered by the Wasatch Mountain Range to the east, Weber County and the Weber River to the northeast, the Great Salt Lake to the west, and Salt Lake County to the south (Davis County Emergency Operations Plan).

Morgan County is located just east of Davis County in the northern portion of the state. It is the third smallest county making up only 610 square miles. Morgan County's landscape includes the Wasatch Mountain Range, steppe valleys, the Weber River, which is one of the main river valleys in northern Utah. Two smaller tributaries also run through the county, namely East Canyon and Lost Creek. Morgan County also has farming and grazing lands and is bordered to the east by Summit County. The county's elevation ranges from 4,895 feet above sea level at Mountain Green to 9,547 feet above sea level at Francis Peak. Morgan City and Mountain Green are the most populated cities within the county (Morgan County Emergency Operations Plan).

Salt Lake County is the largest county in terms of population in the state and is the State Capital. Salt Lake County is in the middle of two mountain ranges, the Oquirrh Mountains to the west and the Wasatch Range to the east. The southern border is the Traverse Mountain Range, which is 10 miles long. The valley floor is about 35 miles long from Davis County to the north and to the point of the mountain to the south, and 33 miles wide from the Oquirrh Mountains from the west to the Wasatch Range on the east. The County is made up of 764 square miles of mountains, valleys, farming, grazing lands, and the Great Salt Lake. The elevation ranges from the historical low of the Great Salt Lake in 1963 of 4,193 feet MSL, to the highest point of the planning region in the Wasatch Range which is 11,330 feet above sea level at Twin Peaks.

The Jordan River is one of the main river drainages in the county and flows north through the middle of the valley to the Great Salt Lake. Other surface water drainages include Big Cottonwood Creek, Little Cottonwood Creek, Mill Creek, Parleys Creek, Emigration Creek, Red Butte Creek and City Creek. All the surface flow drains into the Great Salt Lake, which also receives inflow from the Weber and Bear Rivers (Salt Lake County Emergency Operations Plan).

Tooele County is the second largest county in Utah, with 6,923 square miles of area. Salt Lake and Utah Counties bound it to the east. The southern border is Juab County, the northern border is Davis and Box Elder Counties, and the western border is the State of Nevada. Three fourths of the population lives in the eastern valleys where most of the irrigated and dry farmland is located. The western sectors make up the Great Salt Lake desert and are more arid and generally uncultivated. Altitudes range from the Great Salt Lake to 11,031 feet above sea level at the top of Mount Deseret in the Stansbury Mountains (Tooele County Emergency Operations Plan).

Weber County is located in the north-central part of the state and is the second smallest county in terms of land area, yet the fourth largest in terms of population. Weber County has a total of 662 square miles. The Great Salt Lake covers approximately 112 square miles of the county's land. Elevation ranges from the

Great Salt Lake to over 9,700 feet above sea level at Ben Lomond Peak. The eastern half of Weber County is a high alpine valley and a mountain area, while the western portion is a flat fertile plain formed by alluvial deposits from Lake Bonneville. The Weber River and its tributaries the Ogden River, Coldwater Creek, Burch Creek and several other smaller creeks, are the main river drainages. The Weber River drainage covers approximately 2,460 square miles of land (Weber County Emergency Operations Plan).

B. Geology

The Wasatch Front Region is comprised of the Wasatch, Uintah, Oquirrh, and Stansbury Mountain Ranges. The Wasatch Mountain Range runs north south and is the eastern border of the valley region of the Wasatch Front. The Uintah Mountain Range runs east west and is the eastern most range of the Great Basin, which is part of the much larger Basin and Range province. The Oquirrh Mountain Range is the border between Salt Lake and Tooele County. The Stansbury Mountains are in the western portion of Tooele County.

The geology of this region is a product of Miocene Epoch faulting and folding followed by a period of upheaval. The upheaval raised the valley 3,000 to 5,000 feet in a dome like manner during the Tertiary Period. This disturbance of the valley floor created a tension and a build-up of stress. To accommodate for the change "block-faulting" occurred that allowed for the uplift of the mountain ranges and depression of the valley floor. This depression extends to the lowest portion of the Wasatch Front Region, the Great Salt Lake. Erosion is now the main process of this area.

The Uintah and Wasatch Range are comprised of mainly Tertiary lake deposits and Tertiary and Quaternary volcanic rocks as well as younger Precambrian sedimentary rocks. To the north of Salt Lake City on the Wasatch Front, the hardest, highly altered metamorphosed rocks of schist and gneiss are found and date back about 2.6 billion years. Paleozoic marine sedimentary rocks surround the Precambrian areas of the Range. The Paleozoic sedimentary rocks have a very weak make-up and in conjunction with Utah's heavy precipitation during the winter and summer months many landslides, avalanches, debris flows, and rock falls occur. Refer to Table 4-2 for an explanation of the geologic time scale.

The north end of the Oquirrh Mountain group is almost entirely Pennsylvanian and Permian sedimentary rock. The south end of the Oquirrh Mountains is made up of Tertiary granite and is home to the largest open mine pit, the Bingham Copper Mine. The Salt Flats in the western portion of Tooele County are a remnant of Lake Bonneville's fine compressed sediment and made up of salt that includes the mineral makeup of gypsum, potash, and calcium carbonate.

Table 4-2 Geologic Time Scale

Ages or Eras	Millions of Years Ago	Period	Epoch
CENOZOIC	0-1.8	QUATERNARY	Holocene
			Pleistocene
	1.8-65	TERTIARY	Pliocene
			Miocene
			Oligocene
			Eocene
			Paleocene
MESOZOIC	65-145	CRETACEOUS	Late
			Early
	145-213	JURASSIC	Late
			Middle
			Early
	213-248	TRIASSIC	Late
			Middle
			Early
PALEOZOIC	248-286	PERMIAN	Late

				Early
	286-360	CARBONIFEROUS	PENNSYLVANIAN	Late
			MISSISSIPIAN	Early
	360-410	DEVONIAN		Late
				Middle
				Early
	410-440	SILURIAN		Late
				Middle
				Early
	440-505	ORDOVICIAN		Late
				Middle
				Early
	505-544	CAMBRIAN		Late
				Middle
				Early
PRE-CAMBRIAN	544-4.5 billion years ago, time from the beginning of earth.			
Source: U. S. Geological Survey, Paleontology website: http://geology.er.usgs.gov/paleo/				

C. Climate

Northern Utah is considered a desert climate. Utah has hot dry summers and cold winters. However Utah's climate is variable, it can be wet in one portion of the state and dry in another. This is a function of latitude, elevation, topography, and distance from moisture sources. The Wasatch Front region's climate borders a semi-arid, mid-latitude steppe climate that occurs along the perimeter of the Great Basin Desert, and a humid continental climate found at slightly higher elevations in the Rocky mountain foothills (Critchfield, 1974).

Utah has four seasons, low annual precipitation, convective and frontal storms, dry summers, low humidity, and large annual and diurnal temperature extremes. The Wasatch Mountain Range brings most of the precipitation to the valley floor. The winter months bring heavy snow accumulation over the mountains that are favorable for winter sport activities. Spring runoff is at its peak from April thru June and can cause flooding along the lower streams. Flash flooding affects smaller more localized areas in this region from summer thunderstorms.

The average annual precipitation in the Wasatch Mountain Range can be more than 40 inches, while the Great Salt Lake Desert receives on average less than 5 inches annually. The average accumulation at the Salt Lake International Airport is 15.3 inches of rainfall and 58.9 inches of snowfall. Utah is the second driest state in the nation.

The surrounding mountain ranges act as a barrier to the cold continental arctic masses. This also insolates the area during the day and cools the area rapidly at night. On clear nights the colder air accumulates on the valley floor, while the foothills and benches remain relatively warm.

During the fall and winter months smoke, haze, and fog can accumulate in the lower levels of stagnant air over the valley floor and can last for several weeks at a time. This is because areas of sinking air or high-pressure anticyclones settling over the Great Basin.

Wind speeds are usually light to moderate meaning they range usually below 20 miles per hour. Strong winds can occur in localized areas, mainly in canyon mouths along the western slopes of the Wasatch Mountains and dust storms can occur in the western portions of the region. Tornadoes have occurred in this region but there are generally few. Hailstorms have also occurred in the region during the spring and summer months.

D. Major Rivers

Most of Utah's water is from snowmelt that occurs during the spring and summer. The larger drainage or river basins are formed from the mountain ravines or depressions that merge into perennial rivers and then meet forming the larger drainages. The Greater Wasatch Front Area includes the Jordan River Basin and portions of the Weber River, Utah Lake, West Desert and Bear River Basins.

Source: US Geological Survey, US Department of the Interior. December 2003. <http://ut.water.usgs.gov /Basins/index.html>

Agricultural irrigation is the primary use of developed water in Utah, but municipal, industrial, environmental and recreational uses are increasing and this competition will reform the way water is utilized. With the growing population agricultural land has been decreasing and residential and commercial areas are on the rise. According to the Utah Water Plan the Jordan River, Utah Lake and the Weber River basins are all projected to lose a significant amount of agricultural lands over the next few decades.

Water and Drought

Utah is the second driest states in the nation and ranks second in per capita water use of public supplies. According to the USGS Utah has experienced drought conditions since 1999 on a statewide level. Decreased flow from major rivers has led to a decline in most of the reservoir levels and in the Great Salt Lake. The current drought is unusual because of the severity. The 2002 water year was one of the driest ever recorded.

E. Development Trends

All counties in the Wasatch Front Region of Northern Utah (Davis, Morgan, Salt Lake, Tooele, and Weber) will continue to grow. In general, the "developable" areas are bounded by the Great Salt Lake and the Stansbury Mountains to the west, the Wasatch Mountains to the east, Utah County to the south and Box Elder County to the north. The table below projects population growth in Davis, Salt Lake, and Weber counties (Table 4-3).

Table 4-3

Area	**2000 Population**	**2010 Population**	**2020 Population**	**2030 Population**	**% Growth 2000-2030**
Davis County	238,994	292,201	347,412	386,672	61.8%
Salt Lake County	898,387	1,077,556	1,283,784	1,431,843	59.4%
Weber County	196,533	237,877	286,919	320,770	63.2%
Region	**1,333,914**	**1,607,634**	**1,918,115**	**2,139,285**	**60.4%**
Area	**2000 Households**	**2010 Households**	**2020 Households**	**2030 Households**	**% Growth 2000-2030**
Davis County	71,201	95,281	119,094	138,092	93.9%
Salt Lake County	295,141	371,312	458,906	528,491	79.1%
Weber County	65,698	81,414	99,699	113,835	73.3%
Region	**432,040**	**548,007**	**677,699**	**780,418**	**80.6%**
Area	**2000 HH Size**	**2010 HH Size**	**2020 HH Size**	**2030 HH size**	**Change 2000-2030**
Davis County	3.36	3.07	2.92	2.80	-0.56
Salt Lake County	3.04	2.90	2.80	2.71	-0.33
Weber County	2.99	2.92	2.88	2.82	-0.17
Region	**3.09**	**2.93**	**2.83**	**2.74**	**-0.35**
Area	**2000 Employment**	**2010 Employment**	**2020 Employment**	**2030 Employment**	**% Growth 2000-2030**
Davis County	84,839	106,039	124,662	136,965	61.4%
Salt Lake County	545,052	665,115	781,221	858,158	57.4%
Weber County	88,370	111,556	135,921	153,148	73.3%
Region	**718,261**	**882,710**	**1,041,804**	**1,148,271**	**59.9%**

Davis, Salt Lake, and Weber counties have been known as the urban core of the Wasatch Front Region. Traditionally, almost all growth has occurred in these three counties, however, now Morgan and Tooele counties are experiencing more growth and development pressures.

Morgan County's growth is likely to be not as dramatic as growth in Davis, Salt Lake, and Weber counties. Morgan County's motto is "The Best of Rural America." Morgan County is sometimes referred to being part of the "Wasatch Back" (with Summit and Wasatch counties). The "Wasatch Back" is facing great development pressures while still desiring to maintain a rural lifestyle.

Morgan County's growth has been almost all residential on previous agricultural parcels. Some residential growth has occurred on sensitive soils in the Mountain Green area. Most residents commute to work in Weber, Davis, and Salt Lake counties. Morgan County is working on economic development to diversify and expand its tax base with the desire to also maintain their rural lifestyle. Like the Ogden Valley area of Weber County, property values continue to escalate.

Tooele County has been experiencing some of the strongest residential growth in the State. Most of Tooele County's growth is residential, occurring in the Tooele/Grantsville area. Tooele County has become an affordable housing bedroom community for Salt Lake County. Tooele is one of the fastest growing counties in the State.

Salt Lake County is continuing to infill with residential growth between the Kennecott Copper properties on the Oquirrh Mountains to the west and the Wasatch National Forest Property on the Wasatch Mountains to the east.

Davis County's residential growth will continue to infill previous agricultural and industrial fringe. Some of the residential growth appears to be occurring on more sensitive lands such as hillsides and low lying areas towards the Great Salt Lake. Most growth is occurring in northern Davis County. A major political push is occurring to develop a second north/south transportation route adjacent to the Great Salt Lake.

Weber County's residential growth has been moving west closer to the Great Salt Lake. Growth pressures and demand for a rural atmosphere continue to inflate property values in the Ogden Valley. As growth has occurred in west Weber County, concern for the quantity and quality of ground water has escalated. The Weber-Morgan Health Department has been pursuing funding for a ground water study in west Weber and Morgan counties.

Population growth in the planning region is attributed primarily to residents having children. Some residential growth is attributed to in-migration, particularly from California. Nationally, growth is occurring in the west and in the south. The region's population is projected to continue to increase exponentially. This will result in housing cost increases greater than the rate of inflation. Higher population densities are projected to be concentrated in currently developed areas with recent development occurring at lower densities in the outlying areas.

New commercial development is projected in South Jordan City, Riverton City, and Tooele County. Dispersed areas of commercial development are starting to appear, such as in the Fort Union/Union Park area, the Cottonwood Corporate Center, and the Jordan Landing. Small pockets of neighborhood scale commercial development are expected throughout the region in an effort to adhere to Envision Utah principles in making neighborhoods more pedestrian-friendly.

Development Constraints/Opportunities

Influences on development are many and interrelated. A few are geographic, historic layout, transportation, household size, technology, employment trends, and public policy. Development influences can encourage and/or discourage growth. For example, floodplains, wetlands, slopes and faults, sensitive species, and transportation influences attract and detract development.

Geographic
Geographic constraints on the urban area have created a linear region that stretches more than 60 miles north to south, from the city of Pleasant View in the north to Bluffdale City in the south. At its widest, it is only 15 miles wide. This unique geographic layout has resulted in the development of a transportation system that is focused on the north-south movement of goods and people.

Floodplains
There are a number of identified floodplains in the region that pose challenges, command respect, and generate appeal for development. The three urbanized counties of Weber, Davis, and Salt Lake, are bisected by numerous rivers and streams, which emanate from the mountains and flow westward into the Great Salt Lake. In Weber County, the Ogden/Weber River system is the most significant. In Morgan County the Weber River is the most significant. Hardscrabble Creek, Deep Creek, Lost Creek, East Canyon Creek, and Cottonwood Creek are smaller tributaries within Morgan. In Davis County, several smaller creeks, such as Kays, Farmington, Davis, Deuel, North Canyon, and other Creeks flow from the mountains into the lake. In Salt Lake County, streams from the major mountain canyons flow into the Jordan River, which flows through the middle of the Salt Lake Valley; among these are Little and Big Cottonwood Creeks, Mill Creek, Parley's Creek, Emigration Creek and City Creek. There are other streams too numerous to mention here, but some flow through open channels while sections of others are piped underground. While development is challenged by the floodplain it is also attracted to it.

Wetlands
Wetlands are those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to normally support a prevalence of vegetation typically adapted for life in saturated soil conditions. The greatest and most significant complex of wetlands in the intermountain area can be found adjacent to and surrounding the Great Salt Lake. These wetlands provide important habitat to resident wildlife and internationally significant habitat, to as many as one million migratory shorebirds and waterfowl make annual migrations across North America. A majority of these wetlands are found on the east side of the lake. The east side of the lake is where the lake receives most of the fresh water and also where the development pressures occur. There are numerous rivers and streams, which flow to the lake which supply this area with the fresh water needed to support wetlands plant and animal life. Wetlands can also be found adjacent to the streams, particularly in areas where the streams flow through relatively flat topography or low-lying areas.

Wetlands can be categorized according to their quality and type. Jurisdictional wetlands are those wetlands that are within the extent of the Corps of Engineers (COE) regulatory overview. For an area to be identified as a jurisdictional wetland, the area must exhibit positive indicators of wetland hydrology, hydrophytic vegetation and hydric soils. If wetlands provide a particularly rich habitat for a variety of wildlife species, it is usually considered to be of high quality, or have a high functional value. Also, wetlands can be classified according to their type. This would include types such as marsh, wet meadow, riparian scrub, playa/mudflat, and open water.

Farmlands
Over the years, much of the farmland in the urbanized area has been developed. Morgan and Tooele counties still maintain a good percentage of their land to agriculture. The remaining farmlands where crops are being produced are located in the western portion of Weber County, and to a lesser degree in western portions of Davis County, between I-15 and the lake, and the Salt Lake Valley. There is a limited amount of Prime/Unique Farmland and Farmland of Statewide Importance in western Weber County, northern Davis County, and western Salt Lake Valley. Historically, development followed farmland in an agrarian economy.

Farmlands of Statewide Importance are not as good as Prime Farmlands, but are nevertheless important to the agricultural base of the area. These farmlands have more limitations than Prime Farmlands, such as steeper slope, high water table, and alkali problems. However, these lands can be made just as productive as the Prime Farmlands with proper management of the land. If farmlands of the type described above are located within incorporated city limits, it is presumed they will be eventually developed into urban type

land uses. Currently, a majority of the acreage of these farmlands is being used to grow winter (dry farm) wheat and alfalfa.

Slopes and Faults

The steep slopes of the Wasatch Mountain Range were created by the Wasatch Fault, which runs the entire length of the urbanized areas. The Wasatch Fault and other faults in the area highlight the potential for earthquakes in the area and the need to consider their possible impact on transportation facilities. As development continues to creep higher on the foothills of the Wasatch Mountains, slope stability, erosion and drainage problems will present engineering challenges in designing transportation facilities. Development is usually attracted more to the views of slopes and faults than repealed by the higher risk of soil instability.

Open Space

Open Space is a large influence to residential and commercial development. Generally, people are attracted to open space. The Wasatch Front Region is surrounded by relatively vast amounts of open space. Currently, in Morgan County large amounts of land are privately held open space, and in Tooele County large amounts of land are owned by the federal government. The urbanized area is fortunate to have exceptional public open space in the mountains to the east and to the west of the valleys. Most of the open space to the east of the Wasatch Front Urban Area is part of the Wasatch National Forest, which is administered by the Forest Service. The Bureau of Land Management primarily administers the open space to the west, found mostly in the Oquirrh Mountains. Some of the most notable peaks in the National Forest in the Wasatch Range just east of the Ogden/Layton area are Ben Lomond Peak, Mount Ogden, Thurston Peak, and Francis Peak. In the Salt Lake area they are Lone Peak, Broadfork Twin Peak, and Mt. Olympus. Numerous nationally recognized winter and summer recreation areas for skiers, hikers and rock climbers are in close proximity. As a consequence, hundreds of thousands of people visit the public lands in the foothills and mountains of the Wasatch, annually. Less notable and frequented are the mountains to the west of the urbanized areas, such as the Oquirrh Mountains that divide Salt Lake and Tooele Counties. There are several natural streams emanating from these mountains as well as canyons that are mostly frequented by people living nearby. The majority of the Oquirrh Mountains is owned by Kennecott Copper Corporation, and is not generally available to the public for open space use.

Other open space features in the area are the Jordan River Parkway, which runs along almost the entire length of the Jordan River in Salt Lake County, the Great Salt Lake and associated shorelines, Antelope Island in the Great Salt Lake in Davis County, and the Farmington Bay Bird Refuge, which is a fresh water bay created by a dike of the Great Salt Lake. Over the past several years, population growth in the urbanized areas has impacted the open space resources of the Wasatch Range in a variety of ways. Two of these ways are mentioned here. First, there are many more people visiting the popular places in the adjacent mountains. This has jeopardized the environmental quality of the mountains by degrading surface and ground water quality. The Wasatch Range is a major source of water for the adjacent urbanized areas, and water quality degradation can have far-reaching effects. Secondly, many access points or trail heads to the canyon and other mountain destinations located on public lands that were commonly used in the past have been closed off to the public by private developments. The effect of this is that much of the public open space becomes inaccessible and the opportunity to visit these popular places becomes lost. Remaining access to non-private lands is channeled through an ever-decreasing number of public access points.

Not only can open space resources be found in the mountains of the Wasatch, but private and public open space is also found in the valleys in the form of farms, developed and natural parks, golf courses, water features, vacant land, and the like. In many instances, these resources may receive more intensive use than those found in the adjacent mountains. Recently, because of the rapid growth in the area, people in general, and state and local political leaders, have become concerned about the relatively rapid loss of private open space resources, such as farmland and vacant land. Urban growth has put considerable pressure on the farmlands that can still be found in, or adjacent to, the urbanized areas. Some individuals and lawmakers value farmlands and would like to see some of them preserved for future generations. Management and development of open space has many questions – How, where, and to what degree will these lands be preserved?

Some agricultural lands are receiving state designation as farmland preserves through the use of conservation easements and favorable tax treatments. These designations assist farmers in preserving their lands for future agricultural use and provide aesthetically pleasing open space today. However, as development pressure and property values increase, it may become increasingly difficult to keep many agricultural lands in agriculture and agricultural preserves. Policy decisions relative to open space will affect land use and development patterns, and, as a consequence, will also affect long range plans for the region's transportation systems.

Hazardous Waste Sites

Currently there are numerous hazardous waste sites, or contaminant sources, located within the urbanized areas. Many of these sources are in relatively close proximity to the transportation projects. Construction through potential contaminant sources may add health and safety concerns and affect construction budget expenditures. The impact of these sites on transportation facilities will need to be addressed during the design and construction phase of each highway or transit project.

There are potentially five types of contaminant sources: Underground Storage Tanks; Title 3 Sites; Toxic Release Inventory 1990 Sites; Resource Conservation and Recovery Act (RCRA) Sites; and Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Sites. The Comprehensive Environmental Response, Compensation and Liability Inventory System (CERCLIS) database documents hazardous waste sites where a release or potential threatened release has been investigated. These sites are further defined as a location that has been reported to the Environmental Protection Agency, and where it is probable that some environmentally hazardous materials are present. Also, the State of Utah Division of Solid and Hazardous Waste maintains databases for underground storage Tank Facilities, Leaking Underground Storage Tank sites, and RCRA facilities.

Sensitive Species

Sensitive species are plants and animals, which are considered, threatened or endangered relative to extinction. There are currently 21 species in the Wasatch Front Urban Area that fall into the sensitive species category. The most notable of these are the peregrine falcon, bald eagle, and Ute ladies tresses, which are all on the federal list of endangered and threatened species. Both peregrine falcon and bald eagle sightings have been reported over the past few years on a fairly regular basis. Some examples of other less notable sensitive species, which are known to inhabit certain areas of the Wasatch Front region, include the spotted frog, least chub, western burrowing owl, ferruginous hawk, white faced ibis, Bonneville cutthroat trout, pocket gopher and others. The likelihood of these and other sensitive species being present in the region will depend on whether or not suitable habitats exist.

Ground Water

Much of the water flowing in streams and interfluve areas seeps into the ground. The foothills and the base of the mountains are the locations where much of this water seeps into the ground. These locations are referred to as aquifer recharge areas. The water is stored in aquifers of various types. A considerable amount of the Wasatch Front Region's water resources comes from these aquifers, which can be tapped through wells or natural artesian springs. The Salt Lake International Airport receives only about 15 inches of precipitation a year, yet the benches and ski areas can receive 60 to 100 inches of precipitation a year. This contrast in precipitation can be a challenge in determining best development. Past and present human activities have affected these ground water resources in certain locations. If precautions are not taken, harmful materials found in landfills and mine tailings can be leached by rain and snow and find they're way into the ground water resources. One example of this situation includes the leaching of heavy metals from the Kennecott Mine tailings, which has contaminated the ground water supply of southwestern Salt Lake County. Another example is the plume of contaminated groundwater that is slowly moving westward near the City of Sunset, caused by the inappropriate disposal of solvents and other chemicals at Hill Air Force Base.

Historical Development Layout

Historically, development has occurred according to the "Plat of Zion." Many of the areas along the Wasatch Front have street layouts based on the "Plat of Zion", implemented by Brigham Young when the Mormon Pioneers permanently settled the area beginning in1847. This concept is based on a grid of 10-acre

blocks with wide streets. While the concept is apparent in central city areas, the suburbs deviate. Historically, the street network and connecting highways served the local areas. Intercity travel was via the Bamberger Railroad, which ran passenger service from Salt Lake City to Ogden from 1891 to 1952. In the 1950's, the federal government instituted the Interstate Highway System. Interstate 15 linked Salt Lake City, Ogden, and Provo together with points north and south while Interstate 80 linked the area with points east and west.

Historically, development has also followed along Interstate 15, Highway 89, and major collectors. The recently reconstructed 17-mile segment of I-15 through Salt Lake County forms the backbone of the north-south highway system through the Salt Lake Urbanized Area. Other major north-south facilities in Salt Lake County include Redwood Road, Bangerter Highway, State Street, 700 East, and 1300 East. Interstate 215 forms a three-quarter belt around Salt Lake County. Interstate 15 continues north through Davis and Weber Counties and joins Interstate 84 in Weber County. The other major north-south facility in Davis County is U.S. Highway 89. The historic development as followed the geographic constraints particularly in transportation.

Transportation

Large employment centers, such as Hill Air Force Base, the University of Utah, the Salt Lake City International Airport, and the downtown Central Business District will need to be served with an improved transportation system.

The growth and distribution of population and employment in the Wasatch Front Urban Area will have a significant impact on the transportation demands in the year 2030. Transportation accessibility is one of the major, if not the most important factor, where people live and work. To a large extent, people will live and work where transportation exists. Future development patterns will influence and be influenced by transportation. It is better planning to first conceptually plan the major transportation.

While a majority of the population growth is expected to occur in western and southwestern sections of Salt Lake, Davis, and Weber Counties, Salt Lake City will remain the dominant employment center in the Wasatch Front Urban Area. Anticipated growth will increase the need for north-south travel in the area, which is being addressed in part by the recently reconstructed I-15 and the completion of the north-south portion of the Utah Transit Authority's TRAX light rail transit system. In addition, the Salt Lake Urbanized Area's transportation system will need to serve the growing employment centers in suburban locations by addressing the east-west transportation demands and access to north-south freeways. Finally, travel in the Salt Lake Urbanized Area will increasingly be affected by the population and employment growth in the Ogden/Layton Urbanized Area to the north, the Provo/Orem Urbanized Area to the south, Summit County to the east and Tooele County to the west.

Air quality is an influence on transportation. Greater awareness and concern for the air quality has resulted in tighter air quality standards and decreased transportation emissions.

As the entire Wasatch Front Urban Area continues to grow, the interrelationships among development and transportation will continue to increase. These interrelationships have significant impact on the transportation facilities now and in the future. The Ogden/Layton Area's transportation system will need to develop east and west to serve employment centers in suburban locations, such as Clearfield City's Freeport Center. Travel demand will continue to grow in direct proportion to projected population increases. The population and employment growth in Davis and Salt Lake Counties to the south and, to a lesser extent, Morgan County to the east and Box Elder County to the north, will increasingly affect travel demand in the Ogden/Layton Urbanized Area.

The growth and distribution of the Wasatch Front population and employment will continue to have a significant impact on the transportation needs of the future. Increases in regional population and employment translate into a growing demand for travel. In addition, the number of miles driven continues to increase. The amount and distribution of growth provide insights into the type, size and location of new transportation facilities required to meet present and future travel demand, including new highway projects, transit improvements, and transportation facilities for bicycles and pedestrians.

Household Size
Even with relatively large families, Utah is following the national downward trend in household size. As the population ages, birthrates fall and the household size decreases. There are areas in the region that will experience a slowing of population growth due to falling household sizes, while others will increase due to neighborhood recycling, where young families with children move into a neighborhood as the aging population dies. Examples of these phenomena are found in the 2000 Census. Sandy City's household size declined while Ogden's and Salt Lake City's increased due to changing demographics. Certain areas of the region will remain undeveloped into the future even with projected high growth.

Technology
As technology develops its influence on community development touches every aspect dramatically. Technological influences are massive. This report will only very briefly mention a few. For instance, technology advances in communications have reduced the benefit of commuting to work; the design of light rail has changed where people live and work; advances in agriculture have allowed us to eat with less land; and technological advances allow us to live on previously hazardous natural and manmade sites.

Reclamation of Industrial Land
Many of public and private lands will remain undeveloped because of specific environmental constraints, such as steep slopes, prime wetlands, or hazardous substances, but other environmentally challenging properties are now developable due to advances in technology. Some areas currently being used for industrial or mining activity are planned to be reclaimed for other uses. For example, Kennecott Utah Copper Corporation is planning a 12,000-unit, mixed use development on 4,500 acres that it owns in South Jordan.

Employment Trends
In the past 30 years, the region's economy has diversified resulting in more wide spread development. The region's economy was once heavily dependent on a limited number of industrial sectors, primarily mining (Kennecott Utah Copper Corporation) and government/military (Hill Air Force Base, Internal Revenue Service). No longer dependent on a limited number of sectors, the economy is now based on the service sector and other industries, such as health care, education, and local government. Agricultural industries continue to decline in importance on a regional scale. The distribution of commercial and industrial development will remain much as it is today. Much of the region experienced minimal employment change, up or down, during the past decade. The overall pattern shows that large employment gains are occurring in the suburban areas.

Public Policy
Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. Projections for the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 is based on individual city and county land use assumptions. A majority of the region is expected to be developed for residential uses. These local master plans call for relatively low-density residential and non-residential development patterns, with some pockets of denser activity. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor, and around Hill Air Force Base. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County, northern Davis County, and southern Weber County. Additional, smaller nodes of commercial and retail development are dispersed throughout urban and rural portions of Salt Lake, Davis, and Weber Counties.

The Utah Quality Growth Act of 1999 created the Utah Quality Growth Commission to address the challenges and opportunities that growth brings to Utah. In addition, several public and private partnership planning efforts involved in smart growth initiatives have developed land use alternatives and growth scenarios. Envision Utah's outreach presentations provided local public officials and the general public the opportunity to examine the future consequences of various land use decisions. The growth scenarios ranged from the status quo land use planning to a demonstration of much greater density. These planning exercises and demonstrations proved beneficial in educating participants on development options and their anticipated consequences.

A significant portion of Salt Lake, Davis, and Weber Counties is currently zoned for low-density residential development. Some higher densities are allowed in eastern Salt Lake City, while the southeast and southwest areas of Salt Lake County are zoned for lower housing densities. Industrial land uses are planned for west Salt Lake City, along the I-15 corridor, northern West Valley City, the western portion of North Salt Lake, and the west side of Salt Lake County. Areas for commercial land uses include concentrations in Salt Lake City's central business district and along primary transportation corridors including I-15, I-215, State Street, 400 South, Highland Drive, 3500 South, 4500 South and 7200 South. Additional commercial land use nodes are dispersed throughout Salt Lake County and southern Davis County to serve adjoining residential communities. An extension of the existing transportation network will provide needed highway and transit service to newly developed land. As land use changes, so will the type and size of facilities needed to meet increased travel demand.

Future land use characteristics of the Ogden/Layton Urbanized Area will play a key role in determining future development trends. Large portions of western Weber and North Davis Counties are currently zoned for low-density residential development. Some higher density housing is being built in Ogden City's Canyon Road Community. Industrial land uses are located at the redeveloped Business Depot Ogden (the former Ogden Defense Depot), Hill Air Force Base, the Ogden City Industrial Park and Clearfield's Freeport Center. Areas for commercial land uses include linear concentrations along major arterial roads including Riverdale Road, the southeastern portion of Harrison Blvd., 12th Street between Washington Blvd. and I-15, Hill Field Road near the Layton Hills Mall, State Street (Layton and Clearfield) and Main Street (Kaysville, Clearfield and Sunset). The McKay-Dee Hospital has moved to a new 62-acre location on Glassman Way. Additional commercial nodes are dispersed throughout the Ogden/Layton Urbanized Area to serve adjoining residential communities.

Public Policy is the greatest contributing factor in development. This report has briefly mentioned the general development trends in the region and in each county and the contributing and limiting influences on development. Ultimately, the many development constraints and influences are measured, weighed, compared, and balanced in public policy.

Development public policy is articulated in Master (sometimes referred to as General) Plans, Land Use Management Codes, and other planning documents. Master Plans and Land Use Management Codes are formally adopted whereas other planning documents may not receive formal adoption. All region counties continue to update their Master Plans and Land Use Management Codes. The counties have cooperated in producing the Wasatch Front Regional Open Space Plan; this plan gives each county guideline for preserving and developing open space. The urban counties in the region (Davis, Salt Lake, and Weber) have been supportive of Envision Utah. Envision Utah is partially State supported to advocate smart growth. Envision Utah defines "smart growth" as growth that requires minimal infrastructure and maximizes environmental and human benefits.

Part V. Capabilities Assessment

Within the WFRC, local governments have a diverse and strong capability to accomplish hazard mitigation; yet, enough similarity exists between each of the jurisdictions that this capabilities assessment could be completed for all five counties. General capabilities of the region and for each jurisdiction are addressed then any specific city and county capabilities are mentioned. This assessment analyzes current capacity to mitigate the effects of natural hazards and emphasizes the positive capabilities that should be continued.

The following areas were assessed to determine mitigation capabilities:

1. Staff and Organizational
2. Technical
3. Fiscal
4. Policies and Programs
5. Legal Authority
6. Political Willpower

1. Staff and Organizational

The assessment found that each county, along with most of the large incorporated cities, within the WFRC region have extensive capabilities to accomplish mitigation. Most counties and cities are already protecting their citizens from natural hazards under one if not several departments within their government structure.

City and County Elected Officials

An elected council or a commission consisting between three or seven members governs each county. Either a town or city council, consisting between five or seven members, governs each municipality. The elected officials have the responsibility of making mitigation policies. All cities and counties receive their legal authority to govern from the State of Utah.

County General Capabilities

Listed below is a general organizational list of county governmental administrative divisions that perform pre-disaster mitigation:

- Elected officials
- City Managers
- County and City Attorneys
- County Assessors
- County Clerks
- Human Services/Personnel Directors
- County and City Treasurers/ Finance.
- Public Works
- County Health

Emergency Management

All counties and most of the larger incorporated cities have two state owned Universities that have designated emergency management directors. The emergency management office is responsible for natural and man-made hazard mitigation, preparedness, response, and recovery operations.

Local Emergency Planning Committee (LEPC)

The mission of LEPC is to coordinate emergency preparedness between all public and private emergency task disciplines. At a minimum, the LEPC consists of -- elected state and local officials; law enforcement, civil defense, firefighting, first aid, health, local environmental, hospital, and transportation personnel; broadcast and print media; community groups; and owners and operators of facilities that are required by federal law to have emergency planning. Each county in the region has a LEPC.

Fire Service
Most cities staff fire service organizations, and all five counties have fire service. In some cases a fire district rather than a county fire department provides the fire service.

Public Works
Divisions within public works often include; streets, engineering, water, power, wastewater, and sanitation. The public works departments within the counties and larger cities are very sophisticated and currently account for much of the mitigation already taking place within the Wasatch Front region. Several public works departments have storm water management sections and watershed management departments.

Health Care
The region's hospitals and county health departments provide medical emergency preparedness and response. The region's county health departments organize, coordinate, and direct emergency medical and health services. The health departments assess health hazards caused by damage to sewer, water, food supplies or other environmental systems. They also provide safety information, assess disaster related mental health needs and services, and provide crisis counseling for emergency workers. For the most part, the health departments within the five counties are adequately staffed, trained, and funded to accomplish their missions.

2. Technical Capability
Counties making up WFRC have an advanced technical capability to implement hazard mitigation strategies.

Technical Expertise
Most of the counties and large incorporated cities within the WFRC have full-time planners, emergency managers, building inspectors, housing specialists, and engineers on staff. Salt Lake County also employs a part-time geologist.

Geographic Information Systems (GIS)
Staff experience with GIS varies widely between the large resources of Salt Lake, Davis, and Weber counties, and the relatively small resources of Morgan and Tooele counties. All counties in the region have at least some staff to coordinates data processing and computer capabilities for GIS. GIS is a tremendous geo-referenced set of hardware and software tools that are used to collect, manage, and analyze spatial data. (GIS capabilities are often found in other departments such as public works or information technology.) GIS is most beneficial when data from all departments and planning jurisdictions is inputted for analysis.

Public Safety Communications (PSC)
Public safety communications assures emergency communications through radio, microwave, telephone, satellite, internet, e-mail, intercom, fax, and amateur radio. One of the most beneficial capabilities of PSC is providing cross communication between equipment and bands. PSC coordinates dissemination of emergency information to the media, the public, and emergency personnel; activates internal information systems; acts as a liaison to congressional and legislative elected officials; assists in the provision of emergency information and documentation of emergencies' impacts.

Public Works
Public works departments usually involve the division capabilities of engineering – transportation, GIS; sometimes power; streets; water; wastewater; and sanitation. As a team, public works employees identify critical infrastructure and plan and prepare for emergency mitigation.

Other Technical Capabilities

Utah State Division of Emergency Services and Homeland Security (Utah DESHS)
Utah DESHS assists local governments in preparing for and responding to emergencies. The division serves as the liaison between local, state, and federal emergency assistance. The division educates the

public about earthquakes, hazardous materials, floods, communications, leadership, information technology, funding, coordination and supplies.

Utah State University Cooperative Extension
The extension's mission is to facilitate individuals, families, and communities in putting research-based knowledge to work. Many of the programs and informational courses improve pre-disaster mitigation.

University of Utah
The University of Utah is Utah's flagship state run higher education institution. The University is a technical resource of faculty, mitigation commissions, and internship opportunities.

Wasatch Front Regional Council (WFRC)
The Wasatch Front Regional Council is a valuable cooperative organization between Davis, Morgan, Salt Lake, Tooele, and Weber counties to facilitate pre-disaster mitigation among many other things. The WFRC is a resource for coordination, communication, and planning expertise.

3. Fiscal Capability

All counties have limited fiscal capabilities to implement mitigation actions. The counties of Davis, Salt Lake, Tooele, and Weber have a larger tax base and greater man-made hazards than Morgan County thus allowing for more mitigation to be accomplished. When compared to the state, the budgeted expenditures of Salt Lake, Davis and Weber counties are in the top five, Tooele is at the top of the middle third, and Morgan is near the mid-point of the middle third. It is likely that each county can supply the local fiscal match for existing federal mitigation programs. Each county and most of the cities within WFRC have provided matching funding for federal grants in the past.

Utah classifies counties into five categories according to the Utah State Legislature; Section 17-50-501 update 2003, each County is classified according to its population. Class 1- over 700, 000, Class 2- 125,000-700,000, Class 3- 18,000-125,000, Class 4- 10,000-18,000, Class 5- 3,500-10,000, Class 6- under 3,500.

County	**Population**	**Class**
Davis	238,994	2
Morgan	7,129	5
Salt Lake	898,387	1
Tooele	40,735	3
Weber	196,533	2

The State of Utah grants graduated autonomy according to class size. The lower numbered class counties and cities receive more authority from the State to regulate their own affairs.

4. Policies and Programs

This part of the assessment includes the identification and evaluation of existing plans, policies, programs, ordinances, or activities that either increase or decrease vulnerability to natural hazards. Positive activities, which decrease hazard vulnerability, should be sustained and enhanced if possible. Negative activities, which increase hazard vulnerability, should become targeted for reconsideration and thoroughly addressed within the mitigation actions portion of this plan.

County Ordinances
All five counties have adopted several plans and ordinances that are relevant to the Pre-Disaster Mitigation Plan.

Plans
Each county has a comprehensive land use plan, capital improvement plan, and an emergency operations plan. Most of the large cities also have these plans as well as economic development and community master plans.

The following tables should show areas where pre-disaster mitigation planning can be strengthened through additional plans and ordinances. Often, one plan or ordinance contains language and authority for multiple plans and/or ordinances. For example, in Morgan County, the Morgan County Subdivision Ordinance explains in detail sensitive soils, historic preservation, and drainage. Within the land use planning and subdivision portions of some general plans items such as stream maintenance, erosion, and natural hazards are addressed, but they do not have their distinct separate plan or ordinance (Tables 5-1, 5-2, 5-3, 5-4, 5-5).

Table 5-1 Davis County

Davis County	**Bountiful**	**Centerville**	**Clearfield**	**Clinton**	**Farmington**	**Fruit Heights**	**Kaysville**	**Layton**	**North Salt Lake**	**South Weber**	**Syracuse**	**West Bountiful**	**Woods Cross**	**Unincorporated**
Plans														
Comprehensive	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stormwater Management	Y				Y			Y						Y
Flood Assistance														Y
Capital Improvements	Y							Y						N
Land-Use/General	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Community Rating System	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Emergency Management	Y	Y	Y	Y										Y
Economic Dev.	Y							Y						N
Ordinances														
Zoning	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Subdivision	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Historic Preservation														
Building Code	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Floodplain Management														Y
Drainage														Y
Storm Water														Y
Stream Maintenance														Y
Erosion Control														
Natural Hazards														

Table 5-2 Morgan County

Regulatory Tools (Ordinances, Codes, Plans)	**Local Authority (Y/N)**	**Does State Prohibit (Y/N)**	**Higher Level Jurisdiction Authority (Y/N)**
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	Y
Subdivision Ordinances or Regulations	Y	N	Y
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	N	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	N	N	N
Site Plan Review Requirements		N	

Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	N
Economic Development Plan		N	
Emergency Operations Plan	Y	N	Y
Post-Disaster Recovery Plan	Y	N	Y
Post-Disaster Recovery Ordinance	N	N	N
Real Estate Disclosure Requirements	N		N

Table 5-3 Salt Lake County

Regulatory Tools (Ordinances, Codes, Plans)	Local Authority (Y/N)	Does State Prohibit (Y/N)	Higher Level Jurisdiction Authority (Y/N)
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	N
Subdivision Ordinances or Regulations	Y	N	N
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	Y	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	Y	N	N
Site Plan Review Requirements	Y	N	
Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	Y
Economic Development Plan	Y	N	N
Emergency Operations Plan	Y	N	N
Post-Disaster Recovery Plan	Y	N	N
Post-Disaster Recovery Ordinance	Y	N	Y
Real Estate Disclosure Requirements	Y/N		Y/N

Table 5-4 Tooele County

Regulatory Tools (Ordinances, Codes, Plans)	Local Authority (Y/N)	Does State Prohibit (Y/N)	Higher Level Jurisdiction Authority (Y/N)
Building Code	Y	Y	Y
Zoning Ordinances	Y	N	N
Subdivision Ordinances or Regulations	Y	N	N
Special Purpose Ordinances (Floodplain Management, Stormwater Management, Hillside or Steep Slope Ordinances, Wildfire Ordinances, Hazard Setback Requirements)	Y	N	N
Growth Management Ordinances/ Smart Growth/ Anti-Sprawl Programs	Y	N	N
Site Plan Review Requirements	Y	N	
Master/ General/ Comprehensive Plan	Y	N	Y
Capital Improvements Plan	Y	N	Y
Economic Development Plan	N	N	N
Emergency Operations Plan	Y	N	N
Post-Disaster Recovery Plan	Y	N	N
Post-Disaster Recovery Ordinance	Y	N	Y
Real Estate Disclosure Requirements	N		Y/N

Table 5-5 Weber County

	Farr West	Harrisville	Hooper	Huntsville	Marriot-Slaterville	North Ogden	Ogden	Plain City	Pleasant View	Riverdale	Roy	South Ogden	Uintah	Washington Terrace	West Haven	Un-incorporated
Plans																
Comprehensive						Y	Y					Y				Y
Stormwater Management-Public Works Dept.						Y	N		Y	Y	Y	Y				Y
Flood Mitigation Assistance						N					N	N				Y
Capital Improvement						Y	Y			Y	Y	Y				Y
Land-Use/ General				Y		Y	Y		Y	Y	Y	Y				Y
Community Rating System																Y
Emergency Management						Y	Y		Y	Y	Y	Y				Y
Ordinances																
Zoning				Y		Y	Y		Y	Y	Y	Y				Y
Subdivision				Y		Y	Y		Y	Y	Y	Y				Y
Historical Preservation Ordinance						N	Y		Y		N	N				Y
Building Code-				Y		Y	Y		Y	Y	Y	Y				Y
Floodplain Management						Y	Y			Y	Y	Y				Y
Drainage Ordinance-State Requirements						Y	Y		Y	Y	Y	Y				Y
Storm Water Management						Y	Y		Y	Y	Y	Y				Y
Stream Maintenance							Y			Y	Y					Y
Erosion Control						Y			Y	Y	N	Y				Y
Natural Hazards						N	Y		Y		N					Y
Other					Y	Y	Y		Y	Y						Y

General Plan
The Utah Code Annotated (UCA) has set forth that "Each municipality shall prepare and adopt a comprehensive, long-range general plan for present and future needs of the municipality; growth and development of the land within the municipality or any part of the municipality" (UCA 10-9-301(1) (1997)). "The planning commission shall make and recommend to [city commission] a proposed general plan for the area within the municipality" (UCA 10-9-302(1)(a) (1997)). These plans serve as a guide for decision-making on rezoning and other planning proposals and as the goals and policies of municipalities attempting to guide land use in local jurisdictions. Each plan is recommended to include land use, transportation, environment, public service and facilities, rehabilitation, redevelopment, conservation, and economics. Also recommended are implementing recommendations including the use of zoning ordinances, subdivision ordinances, capital improvement plans, and other suitable actions that the municipality deems appropriate. General plans articulate the jurisdiction's vision and land use management codes implement that vision. General plans and land use management codes are being consulted, reviewed, and changed as necessary.

Emergency Operations Plan (EOP)
Emergency operation plans pre-determine actions to be taken by government agencies and private organizations in response to an emergency or disaster event. An EOP describes the County's capabilities to respond to emergencies and establishes the responsibilities and procedures for responding effectively to the actual occurrence of a disaster.

Most county's EOP were adopted in the early ninety's and are being or have been revised since then. Many plans have a section specific to hazard identification and analysis along with a damage assessment and debris removal section.

The EOP identifies specific operations to be undertaken by the county to protect lives and property immediately before, during, and following an emergency. EOP were reviewed prior to writing this plan.

Building Codes
International and national building codes have been adopted by all jurisdictions in the region. These codes are constantly in review for reasonable preparedness for disasters. Locally, building officials lobby for additions or exceptions to international and/or national building codes according to local conditions. Most insurance policies rely on the international and national building code standards for assurance.

The Insurance Services Office, Inc performs Building Code Effectiveness Grading Reports (BCEGS). The program implemented in 1995 assesses the building codes in effect in a particular community and how well the community enforces its building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with one showing exemplary commitment to building code enforcement. Insurance Services Inc. (ISO) developed advisory rating credits that apply to ranges of BCEGS classifications 1-3, 4-7, 8-9, 10. ISO gives insurers BCEGS classifications, BCEGS advisory Credits, and related underwriting information. The concept is that communities with effective, well-enforced building codes should sustain less damage in the event of a natural disaster, and insurance rates can reflect that. The prospect of lessening natural hazard related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. FEMA also uses these scores in their competitive grant programs giving a higher ranking to those projects with lower scores. The following table highlights the BCEGS scores for Wasatch Front Region jurisdictions (Table 5-6).

Table 5-6 Building Code Effectiveness Grading Reports

Community	**County**	**BCEGS Classification**		**Date**
		Residential	**Commercial**	
Bluffdale	Salt Lake	3	3	2002
Bountiful	Davis	3	3	2001
Centerville	Davis	3	3	1999

Clearfield	Davis	5	5	1999
Clinton	Davis	5	5	2000
Davis County	Davis	5	5	2001
Draper	Salt Lake	4	4	2000
Farmington	Davis	5	5	2000
Farr West	Weber	4	4	2002
Fruit Heights	Davis	5	5	2001
Grantsville	Tooele	99	99	1999
Huntsville	Weber	3	3	2003
Kaysville	Davis	5	5	1999
Layton	Davis	4	4	1999
Marriott-Slaterville	Weber	3	3	2001
Midvale	Salt Lake	4	4	1999
Morgan	Morgan	3	3	2002
Morgan County	Morgan	4	4	2001
Murray	Salt Lake	2	2	2000
North Ogden	Weber	4	4	1999
North Salt Lake	Salt Lake	4	4	1997
Ogden	Weber	3	3	1999
Plain City	Weber	5	5	2003
Riverton	Salt Lake	5	5	2000
Roy	Weber	4	4	2000
South Jordan	Salt Lake	5	5	1999
South Ogden	Weber	3	3	2000
South Salt Lake	Salt Lake	3	3	2002
South Weber	Davis	4	4	1998
Salt Lake City	Salt Lake	3	3	2002
Salt Lake County	Salt Lake	4	4	1998
Sandy	Salt Lake	3	3	1999
Stockton	Tooele	99	99	1999
Syracuse	Davis	4	4	1999
Taylorsville	Salt Lake	4	4	1998
Tooele	Tooele	3	3	2003
Tooele County	Tooele	2	2	2003
Uintah	Weber	3	3	2003
West Bountiful	Davis	99	99	1999
West Jordan	Salt Lake	3	3	2000
West Point	Davis	6	6	1998
West Valley City	Salt Lake	4	4	1999
Washington Terrace	Weber	3	3	1999
Weber County	Weber	5	5	2000
Wendover	Tooele	3	3	1997
Woods Cross	Davis	99	99	2002

Zoning Ordinances

Zoning ordinances usually follow closely the recommendations of nature. Zoning ordinances designate the use of land and structures for the purpose of protecting the health, safety, and welfare of the jurisdiction's

residents and businesses. A zoning ordinance divides all land within a jurisdiction into zones or related uses. The zoning ordinance is comprised of two parts, the text and the zoning map. Specific zones are usually created for residential, commercial, industrial, and government uses. The map defines the boundaries of these zones and the text provides the regulations for the various uses that are permitted to exist in each of the zones.

Subdivision Ordinance
These ordinances regulate all divisions and improvements of property. Included in this ordinance is the division of land involving the dedications of new streets and roads or a change in existing streets/ roads.

The subdivision ordinance along with the "Flood Damage Prevention Ordinance" prevents flood losses and minimizes the adverse effects that development will have on stormwater drainage through impervious surface requirements, sedimentation, and erosion control. Subdivision ordinances designate the treatment of sensitive soils, emergency access, wildlife considerations, etc.

Floodplain Ordinances
These ordinances prevent building in special flood hazard areas and provide flood loss reduction measures to new and existing development. Floodplain management ordinances help to provide insurance to home and business owners through the National Flood Insurance Program.

Community Ranking System
Communities that regulate development in floodplain are able to participate in the National Flood Insurance Program (NFIP). In return, the NFIP makes federally backed flood insurance policies available for properties in the community. The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes. Class 1 requires the most credit points and gives the largest premium reduction. Class 10 receives no premium reduction. Refer to Table 5-7 for a list of the participating communities.

Table 5-7 Community Ranking System Scores for WFRC

Community Name	Entry Date	Effective Date	Class
Bountiful, city of	10/01/91	10/01/91	9
Centerville, city of	05/01/02	05/01/02	9
North Ogden, city of	10/01/93	05/01/03	8
West Bountiful, city of	10/01/96	10/01/96	9

5. Legal Authority
Local governments play an essential role in implementing effective mitigation. Each local government will review all present or potential damages, losses, and related impacts associated with natural hazards to determine the need or requirement for mitigation action and planning. In the counties and cities making up the WFRC the local executive responsible for carrying out plans and policies are the County Commissioners and city or town Mayors. Local governments must be prepared to participate in the post disaster Hazard Mitigation Team process and the pre-mitigation planning as outlined in this document. The cities and counties of Utah have the authority, through policing, to protect the health, welfare, and safety of their residents.

6. Political Willpower
Officials of the Wasatch Front region have shown support for pre-disaster planning in the following ways:

Community Development Documents
Elected officials have adopted updated community development documents to reduce the risk of disasters. Each county and most cities have updated Emergency Operation Plans, Land Use Management Codes, International Building Codes, and General Plans that include pre-disaster planning. In addition residents support the Wasatch Front Regional Council's recently adopted Wasatch Front Regional Open Space Plan.

In the Wasatch Front Regional Open Space Plan, property with higher probability to disaster is recommended for open space or lower intensity uses.

Emergency Planning Courses

Wasatch Front region residents have supported emergency planning courses sponsored by the State of Utah's Division of Emergency Services and Homeland Security and local governments such as: CERT (Certified Emergency Response Team), LEPC, HAZMAT, Site Plans and Ordinances, Real Estate Requirements, and Hazard Mitigation.

Part VI. Risk Assessment

A. Hazard Identification

The first step in risk assessment is identifying the hazards that could affect the Wasatch Front region. Hazard identification addresses the geographic extent and intensity / magnitude of a hazard as well as the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Planning Team
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Department of Emergency Services and Homeland Security
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in the table below have the possibility of affecting each county within the Wasatch Front region. The identification process for each county and participating jurisdictions utilized those natural hazards that consistently affected each county prior to and during the planning process based on history of occurrences, future probability, and risk (Table 6-1). Table 6-1-1 identifies those hazards on a county level for easy reference.

The Wasatch Front Regional Council with the help from local officials, created maps that identified the location of critical facilities and the municipalities affected by each identified hazard. Initial data from this study was also used to determine those hazards that presented the greatest risk to each of the counties. The geographic extent is identified in the maps at the end of every county section. The hazard intensity/ magnitude and probability is also profiled in each county section.

County jurisdiction's contributed to the risk assessment analyses performed for the county when located within an identified hazard boundary (See Section E). Drought and Severe Weather are considered regional hazards and have been profiled as such. Please refer to Annex 1 Regional Hazards for more information.

Table 6-1 Hazard Identification

Hazard	How Identified	Why Identified
Mapped Hazards		
Earthquake	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers, USGS, UGS, Utah DESHS, and community members	• Utah has a 1/5 chance, of experiencing a large earthquake within the next fifty years. • Numerous faults throughout Utah including the Intermountain Seismic Zone. • Utah experiences approximately 13 earthquakes a year with a magnitude over 3.0. • Can create fire, flooding, hazardous materials incident, transportation, and communication limitations. • The Wasatch Front has recorded large earthquakes in the past and is expected to experience a large earthquake in the future. • Can create fire, flooding, hazardous materials incident, transportation and communication

		limitations.
Landslide	• Input from City and County Emergency Operations Managers, USGS, UGS, NCDC, Utah DESHS, and community members	• Have caused damage in the past to residential and commercial infrastructure. • Can be life threatening. • Generally occur in known historical locations, therefore risks exist throughout much of the Wasatch Front. • Would like to increase community awareness.
Wildland Fire	• Review of County Emergency Operations Plans • Review of Community Wildfire Plans • Input from County Emergency Managers, Utah DESHS, Utah FFSL, Utah FS, NWS, FEMA, and local community members	• Serious threat to life and property. • Increasing threat due to urban sprawl in URWIN areas. • Secondary threat associated with flooding, drought, and earthquake. • Most of Utah is at risk including the growing counties of the Wasatch Front region. • Additional funding and resources offered by local and state agencies to reduce risk. • Would like to increase community awareness.
Problem Soils	• Review of County Emergency Operations Plans • Input from community members, Utah, DESHS, and UGS • Researched historical data	• Related to subsequent effects from earthquakes. • Have affected infrastructure and local economy in the past.
Dam Failure	• Review of County Emergency Operations Plans • Input from community members, Utah DWS, Dam Safety Section, Utah DESHS • Review of inundation maps	• Can cause serious damage to life and property and have subsequent effects such as flooding, fire, debris flow, etc. • Many reservoirs located in the five county region of the Wasatch Front. • Threat to downhill communities. • Subsequent effects include flooding, fire, and debris flows. • Would like to increase community awareness. • Would like to incorporate mitigation measures into existing plans to help serve local residents.
Unmapped Hazards		
Flood/ Flash Flood	• Review of past disaster declarations • Input from City and County Emergency Operations Managers, Utah DWS, UGS, Utah Army Corps of Engineers, Utah DESHS, and community members • Review of Flood Insurance Studies,	• Several previous incidents have caused severe damage and loss of life. • Many of the rivers and streams are located near neighborhoods. • Many neighborhoods are located on floodplains, alluvial fans. • Due to Utah's geology and climate cloudburst storms and heavy precipitation cause flash flooding throughout most of the Wasatch Front.

	Floodplain maps, and Flood Insurance Rate Maps	
Drought	• Review of County Emergency Operations Plans • Input from community members, Utah DESHS, NWS, NCC, and NCDC	• Affects local economy and residents. • Affects water reservoirs levels and therefore culinary, irrigation, and municipal water. • Currently in a drought period. • Secondary threat associated with wildfire. • Utah is the nations second driest state. • Can result in loss of life to farming and livestock.
Infestation	• Review of County Emergency Operations Plans • Input from community members, Utah FFSL, Utah State University Extension Service, Idaho Forest Health Protection Agency, Boise State Foresters, and Utah Dept. of Agriculture	• Consistently affects this region. • Declined forest health and agriculture losses. • Previous experiences have affected the residents of the Wasatch Front. • Affects local economy. • Destruction can be severe and is very costly to mitigate. • Need a better understanding of ways to mitigate and prepare. • Secondary threat of drought.
Severe Weather	• Review of County Emergency Operations Plans • Review of past disaster declarations • Input from City and County Emergency Operations Managers, Utah Avalanche, Forecast Center, Utah Department of Transportation, and community members	• Damage to communities, homes, infrastructure, roads, ski areas, and people. • Can cause property damage and loss of life. • Affects local economy and vegetation. • Lightning number one death in Utah. • Can be costly to recover from. • Affects the young and old more severely.

Table 6-1-1 County Hazard Identification

	Davis County	**Morgan County**	**Salt Lake County**	**Tooele County**	**Weber County**
Earthquake	X	X	X	X	X
Landslide	X		X		X
Wildland Fire	X	X	X	X	X
Problem Soils					
Dam Failure		X	X		X
Flood/ Flash Flood	X	X	X		X

Drought		X	X	X	
Infestation				X	
Severe Weather	X	X	X	X	X

The hazard identification process was aided through the use of FEMA How to Guidance documents, FEMA 386-1,2,3,7 FEMA Post Disaster Hazard Mitigation Planning Guidance DAP-12, Disaster Mitigation Act of 2000, 44 CFR Parts 201 and 206, Interim Final Rule, and FEMA Region VIII Crosswalk. The risk assessment process also utilized assistance from local Wasatch Front region GIS departments using the best available data.

B. Hazard Profile

This section describes the causes and characteristics of each identified hazard including it's severity or magnitude (as it relates to the percentage of the jurisdiction that can be affected), probability, conditions that make the area prone to the hazard, a hazard history, and a map of the hazard's geographic location or extent. The hazards were profiled based on history of occurrence, local input, county emergency operations plan's, and county master or general plans, scientific reports, historical evidence, and hazard analysis plans. A risk assessment "Hazard Profile" table was created that highlights the above-mentioned materials in each of the county portions of the plan introducing each identified hazard.

In determining hazard magnitude a scale was used to identify the level of damage on a countywide basis from Catastrophic to Negligible (Table 6-2).

Table 6-2 Hazard Profile

	Jurisdiction Affected	**Risk**
Catastrophic	More than 50%	Extreme or High
Critical	25-50 %	Moderate
Limited	10-25%	Moderate
Negligible	Less than 10%	Low

The probability of a hazard event was determined through the amount of risk to the county. The probability or likelihood of an occurrence is categorized into four categories: Highly Likely, Likely, Possible, and Unlikely.

The geographical extent or location of the community that would be affected has been identified in the mapping portion of each county when plausible.

Hazard history has been identified and recorded and is located in Section F of each county section.

Maps were created using GIS software to identify the location and extent of each identified hazard area. Drought, Flood, Infestation, and Severe Weather maps were unable to be created due to the lack of data, or the nature and geographic extent of these hazards, therefore, hazard profiles will be in narrative form only.

The following Risk Assessment maps were created for each County:

- Earthquake Epicenters and Fault Zones
- Landslide
- Wildfire
- Dam/ Reservoir Sites

C. Vulnerability Analysis

The vulnerability analysis is based on asset identification and potential loss estimates for those jurisdictions located within identified hazard areas.

Asset Identification

The vulnerability analysis combines the data from each of the hazard profiles and merges it with community asset information to analyze and quantify potential damages from future hazard events. The asset inventory identifies buildings, roads, and critical facilities that can be damaged or affected by the hazard events. Critical facilities are of particular concern because of the essential products and services to the general public they provide. These critical facilities can also fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities identified in this plan include hospitals, police and fire stations, schools, communication facilities, utility companies, water and wastewater treatment plants. In order to assess where and to what extent the identified hazards will affect the assets of each County the locations of assets were identified and intersected with the mapped hazards using GIS software (Appendix D).

Potential Loss Estimates

Potential dollar loss estimates were identified using this same method and therefore estimates were completed for existing infrastructure only. When data permitted, structure, content, and function of the identified vulnerable infrastructure was incorporated into the vulnerability assessments. Describing the vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets.

Future planned development was unable to be analyzed due to the lack of data available in GIS format. However, countywide development trends have been identified and are addressed within Part IV Regional Data.

The core planning team and local planning team members estimated potential losses for the identified hazards by using the methodology explained in the FEMA document Understanding Your Risks: Identifying Hazards and Estimating Losses, Utah DESHS historical data and GIS data.

The information sources used to complete the vulnerability assessment portion of this plan include; Utah DESHS, County GIS departments, County Assessors Office, HAZUS MH data, and the Utah Automated Geographic Reference Center (AGRC). Parcel Data, and Census 2000 data were used to identify household types and numbers as well as the number of residents within the identified hazard boundary. This data was compiled into GIS layers that were used as overlays to identify critical facilities, municipalities, roads, and residents. Utah DOT provided the base map layer to aid in the risk assessment. The assets that have been identified are based on the best available data during the development of this plan in GIS form.

Methodology

Geographic Information System (GIS) software was used as the basic analysis tool to complete the hazard analysis for the WFRC Pre-disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and census 2000 demographic information. In Salt Lake, Davis, and Weber Counties parcel data was used to determine the number and value of residential structures vulnerable to each hazard. Statewide digital data was obtained from Utah Automated Geographic Reference Center (AGRC) for the following hazards; landslides, problem soils, quaternary faults, wildfire, dam locations, and epicenter locations. The vulnerability assessment for each county estimates the number of homes, business, infrastructure and population vulnerable to each hazard and assigns a replacement dollar value to residential structures and infrastructure in each hazard area. The value of residential housing was calculated using estimated average residential housing values for Tooele and Morgan counties, as parcel data was unavailable. All the analysis takes place within the spatial context of a GIS. With the information available in spatial form, it is a simple task to overlay the natural hazards with census data to extract the desired information.

The methodology used to determined vulnerability for earthquakes, problem soils landslides and wildfire within the study area was almost identical. The number of households and population vulnerable to each hazard was determined using Block Data from the 2000 Census data, or parcel data where available. The Block Data from the 2000 Census database or parcel data was intersected with each of the mapped hazard layers in order to determine the number and location of residential housing units and population at risk from hazards. The methodology used, assumes and even distribution of residential housing units and population across each census block. Point data from HAZUS MH was used to determine the number of business, and the annual sales of each business in each hazard area. Dam failure inundation maps were available for Salt Lake County only. The vulnerability analysis for the Salt Lake County Dam failure was completed in the same manner a described above using GIS, parcel data and 2000 Census block data.

The number of acres of extreme, high, and moderate wildfire, acres of historically active landslides, acres within earthquake fault zones, and acres of problem soils were determined for each city and the unincorporated county. Once and acre total was identified it was overlaid on the Census Block data or parcel data to determine the total number of homes impacted. In Morgan and Tooele counties the number of homes impacted was then multiplied by the average housing value as reported by the County assessors office, to determine the total value of potential loss. The average house value used for Morgan County was $187,780, and $125,268 for Tooele County. In the case of wildfire and earthquake the value of the land (20% of total) was subtracted from the totals reported in the vulnerability tables. This was done because wildfires and earthquakes do not usually render the land useless as landslides often do. Additionally content values are not included, which would raise the potential loss numbers for housing by approximately 50%.

In addition to the above methodology, earthquake was profiled using HAZUS MH, which is shorthand for Hazards United States. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses.

Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more.

The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage.

Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well.

The HAZUS Model estimates building losses, numbers of shelters required for displaced households, amounts of debris generated, and numbers of causalities. A HAZUS report was completed for each of the counties covered in this plan.

The potential impact of natural hazards on transportation and utilities was determined in a similar method as described above. Roads and utilities were overlaid on the hazard areas and the impacted utility and road segments were inventories. Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS MH and the Utah Department of Transportation. These costs include:

Item	**Cost per Mile**
Local Roads	2,000,000
State Highways	2,413,500
US Highways	2,413,500
US Interstates	3,600,000
Power Lines	48,280
Gas Lines	241,390

In addition to the linear features, point data from HAZUS MH including critical facilities, dams, care facilities, schools, power generation facilities, and substations were analyzed to determine if the feature was within a hazard area.

Limited availability of digital data presented a problem in completing the vulnerability assessment. Potential loss numbers were only determined for earthquakes, landslides, problem soils and wildfires in this plan. Additional limitations to the above described analysis method includes:

- Assuming random distribution
- Limited data sets for water, gas, electrical, resulting in, incomplete numbers for these features.
- Lack of digital parcels data for Morgan and Tooele Counties.
- No digital data for dam failure inundation, flood plains, or infestation.
- Relied on state wide data not intended for manipulation at the scale it was used.
- Data was not field checked, resulting in an analysis wholly dependent on accuracy of data.
- Meta data was lacking on some of the used data sets.

In terms of hazard mapping presentation in this document, simple maps were created to provide a graphical illustration of location. These maps are done at a scale, which allows them to fit on a standard letter sized page. Larger maps can be plotted out upon request. Data manipulation and maps were created as a planning tool, to be used, by interested persons within the WFRC and the jurisdictions the AOG serves. This information should not take the place of accurate field verified mapping from which ordinances need to be based off of.

Effort to analyze hazards related to potential future development areas was also addressed where applicable. This proved to be a very difficult exercise and at best can only identify areas, which need additional research before development should be allowed. No viable source of data exists for this study area to facilitate analysis of future development. Limited zoning data was available but this data does not necessarily indicate which, areas will be developed and which will not.

D. Mitigation Goals, Objectives, Actions

Using the findings from the risk assessment and the capabilities assessment as a guide several mitigation actions were identified that would benefit each jurisdiction. Each action has been formalized and placed into this plan in each of the county mitigation sections. These actions were identified in the planning group meetings, which included input from the core planning team, local planning team, state and local agencies, county government, and city and county residents.

Goals and objectives were developed in a working session between the above-mentioned figures with a period provided for comment and revision.

Each of the jurisdictions identified mitigation actions based on the identified goals and objectives. These actions are included in every county portion of this plan Section G. The mitigation actions identify the responsible agency, the funding source, timeline, background, and their priority. Actions were selected using the information obtained from the capabilities assessment, which identified existing programs and shortfalls related to mitigation activities. The actions were prioritized based on the STAPLEE method identified in the FEMA How to Guides. Prioritization emphasized the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each of the actions were judged and ranked against these criteria and assigned the priority of High, Medium, or Low.

E. Hazard Description

Each of the natural hazards that could affect Utah, including the Southeast region, have been described below. These are general descriptions about each hazard to give an idea of what, why, when, and how the hazards occur.

1. Earthquake

According to Sandra Eldridge, (Utah Natural Hazards Handbook 4-15), an earthquake is the result of "…sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface"(5). The energy that is released is abrupt shaking, trembling or sudden motion in the earth and rocks that break along faults or zone of weakness along which the rocks slip. Seismic waves are then transmitted outward and also produce ground shaking or vibrations in the earth. The Richter scale measures the magnitude of earthquakes on a seismograph. A Richter magnitude 6 earthquake is 30 times more powerful than a Richter magnitude 5. A Richter magnitude 7 is 1000 times more powerful than a Richter magnitude 5. In order for humans to feel an earthquake is usually needs to be at least a magnitude 2.0. In order for significant damage to occur an earthquake needs to be at least a magnitude of 5.5 or greater. The amount of damage that occurs from an earthquake depends on soil type, rock type, ground-water depth, and topography. Other factors include the type of construction in an area and the population density. The Utah region records approximately 700 earthquakes a year, and an average of 13 of those are of magnitude 3.0 or greater. A magnitude 5.5 to 6.5 earthquake occurs in Utah every 7 years (4-5).

Locations and Activity: Faulting can be evident on the earth's surface or not evident at all, therefore earthquakes are believed to be able to occur anywhere in Utah (6-8). The earthquake history of WFRC is complicated by the fact that we have not had a large recorded earthquake during recorded historical time. The geographic area comprising WFRC last produced a major earthquake, approximately 1,350 years before present. Yet, when looking at the region, the potential for a large earthquake exists when one considers that "since 1850 at least 16 earthquakes (excluding aftershocks) of magnitude 6.0 or greater have occurred within the ISB" (Eldredge 6). The greatest earthquake hazard is considered to be in the areas surrounding the Wasatch, East Cache, East Bear Lake, Bear River, Hansel Valley, Northern Oquirrh, West Valley, and East Great Salt Lake fault zones. Other areas of significant hazard along the southern portion of the ISB include Hurricane, Paragonah, and Sevier faults. The other significant hazard areas in Central Utah are the Stansbury, Joes Valley, and Gunnison faults (7). On the Wasatch fault, the segments between Brigham City and Nephi the "composite recurrence interval for large surface-faulting earthquakes (magnitude 7.0 to 7.5) is 395 ± 60 years.

Average number of earthquakes occurring in Utah

Magnitude	Frequency
≥ 3.0	6 per year
≥ 4.0	1 per year
≥ 5.0	1 every 4 yrs
≥ 5.5	1 every 10 yrs
≥ 6.0	1 every 20 yrs
≥ 6.5	1 every 50 yrs
≥ 7.0	1 every 150 yrs

≥ = greater than or equal to

(Source University of Utah Seismograph Stations

Chart 1.1 Average number of earthquake occurring in Utah.

The most recent surface-faulting earthquake on the Wasatch fault occurred 400 years ago on the Nephi segment" (Eldredge 7). The two largest historical earthquakes to occur in Utah were the Richfield earthquake of 1901, with a magnitude of 6.5 and the Hansel Valley earthquake of 1934 with a magnitude of 6.6.

The Hansel Valley earthquake produced MM intensities of VIII in Salt Lake City, with numerous reports of broken windows, toppled chimneys, and structures twisted on their foundations. A clock mechanism weighing more than 2 tons fell from the main tower of the Salt Lake City County Building and "crashed through the building" The only death that occurred during the event was caused when the walls of an excavation collapsed on a public-works employee south of downtown Salt Lake City (Qtd. in Lund 20).

Utah's most damaging earthquake was of a smaller magnitude (5.7), which occurred near Richmond within Cache Valley during 1962. This earthquake damaged over 75 percent of the houses in Richmond, as well as roads and various other structures. The total damage in 1962 dollars was about one million dollars.

The Utah Seismograph Stations records about 700 earthquakes each year; only about 13 of these have a magnitude of 3.0 or larger.

"*Earthquakes in 1909, 1914, and 1943 produced MM intensities in Salt Lake City of up to VI, and earthquakes in 1910, 1949, and 1962 had MM intensities of VII in Salt Lake City. Damage produced by*

these events included broken windows, cracked walls, fallen plaster, toppled chimneys, and buildings shifted on their foundations. The 1949 earthquake also ruptured a water main causing loss of water to a portion of the city" (Qtd. in Lund 20).

On average a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) occurs in Utah every 7 years. The history of seismic activity in Utah and along the Wasatch Front suggests that it is not a matter of "if" but when an earthquake will occur.

Secondary Hazards: Associated earthquake hazards include ground shaking, surface fault rupture and tectonic subsidence, soil liquefaction, flooding, snow avalanches, dam failure, fire, and slope failure.

Ground Shaking: Ground shaking is caused by the passage of seismic waves generated by an earthquake. Shaking can vary in intensity but is the greatest secondary hazard because it affects large areas and stimulates many of the other hazards associated with earthquakes. The waves move the earth's surface laterally and horizontally and vary in frequency and amplitude. High frequency, small amplitude waves cause more damage to short, stiff buildings. Low frequency, large amplitude waves have a greater effect on high-rise buildings. The intensity depends on geologic features such as bedrock and rock type, topography, and the location and magnitude of the earthquake. Other significant factors include ground water depth, basin shape, thickness of sediment, and the degree of sediment consolidation. Moderate to large earthquake events generally produce trembling for about 10 to 30 seconds. But aftershocks can occur erratically for weeks or even months after the main earthquake event (7-8).

Surface Fault Rupture and Tectonic Subsidence**:** Surface fault rupture or down dropping and tilting associated with tectonic subsidence can rupture the ground surface and in Utah the result is the formation of scarps or steep breaks in the slope. The Hansel Valley (1934) earthquake resulted in a surface displacement of approximately 1.6 feet. Surface faulting in the central segments of the Wasatch fault are expected to have the highest potential. Also earthquakes having a magnitude of 6.5 or greater could result in surface faulting of 16 to 20 foot high and 12 to 44 mile long break segments. Surface displacement generally occurs over a zone of hundreds of feet wide called the zone of deformation. Tectonic subsidence generally depends on the amount of surface fault displacement. The greatest amount will be at the fault and will gradually diminish out into the valley (8-10).

Soil Liquefaction**:** Liquefaction occurs when there is a sudden large decrease in shear strength of sandy soils caused by the collapse of the soils structure, in which the soil loses its bearing capacity, and also by a temporary increase in pore-water pressure, or water saturation during earthquake ground shaking. Liquefaction is common in areas of shallow ground water and sandy or silty sediments. Two conditions must be met in order for soils to liquefy; (1) the soils must be susceptible to liquefaction (sandy, loose, water-saturated, soils typically between 0 and 30 feet below the ground surface) (2) ground shaking must be strong enough to cause susceptible soils to liquefy (Lips). The result is soils that will flow even on the gentlest of slopes. Lateral spreading is a type of failure that results in surficial soil layers breaking up and moving, up to 3 feet or more, independently over the liquefied layer. On slopes more than 5 percent, flow failures can move miles up to 10s of miles per hour. On slopes less than 0.5 percent the bearing capacity will lessen and can cause buildings to settle or tip. No matter the slope percent ground cracking and differential settlement will occur. Liquefaction can also cause foundation materials to liquefy and fail and/or cause sand boils. Sand boils are deposits of sandy sediment ejected to the surface during an earthquake along fissures. Liquefaction can occur during earthquakes of magnitude 5.0 or greater (10-11).

Slope Failure**:** Ground shaking can cause rock falls and landslides in mountainous or canyon areas. Rock falls are the most common slope failure and can occur up to 50 miles away from a 6.0 magnitude earthquake. Landslides occur along benches in wet unconsolidated materials. During a 6.0 magnitude earthquake, landslides may occur within 25 miles of the source (11).

Flooding: "Flooding can happen due to tectonic subsidence and tilting, dam failure, seiches (waves generated in standing bodies of water) in lakes and reservoirs, surface-water diversion or disruption, and increased ground-water discharge", According to the Natural Hazards Handbook 11.

Snow Avalanches: Avalanches could be triggered because of the associated ground movement. The most vulnerable areas include those that have steep terrain, high precipitation, high earthquake potential, and high population density. An example of this area in Utah would be the Wasatch Front (11-12).

Sensitive Clays: Sensitive clays are a soil type that losses strength when disturbed and result in liquefaction or collapse. The resulting type of ground failure is similar to liquefaction (12).

Subsidence: A settling or sinking of the earth's crust in loose granular materials such as and gravel that do not contain clay. Western Utah is subject to this type of ground settlement (12).

Figures 6-1-1, 6-1-2, and 6-1-3 identify earthquakes with a Richter magnitude of 3.0 or higher and where in the County they are located between 1962 and 1993, courtesy of Kory Iman.

Figure 6-1-1

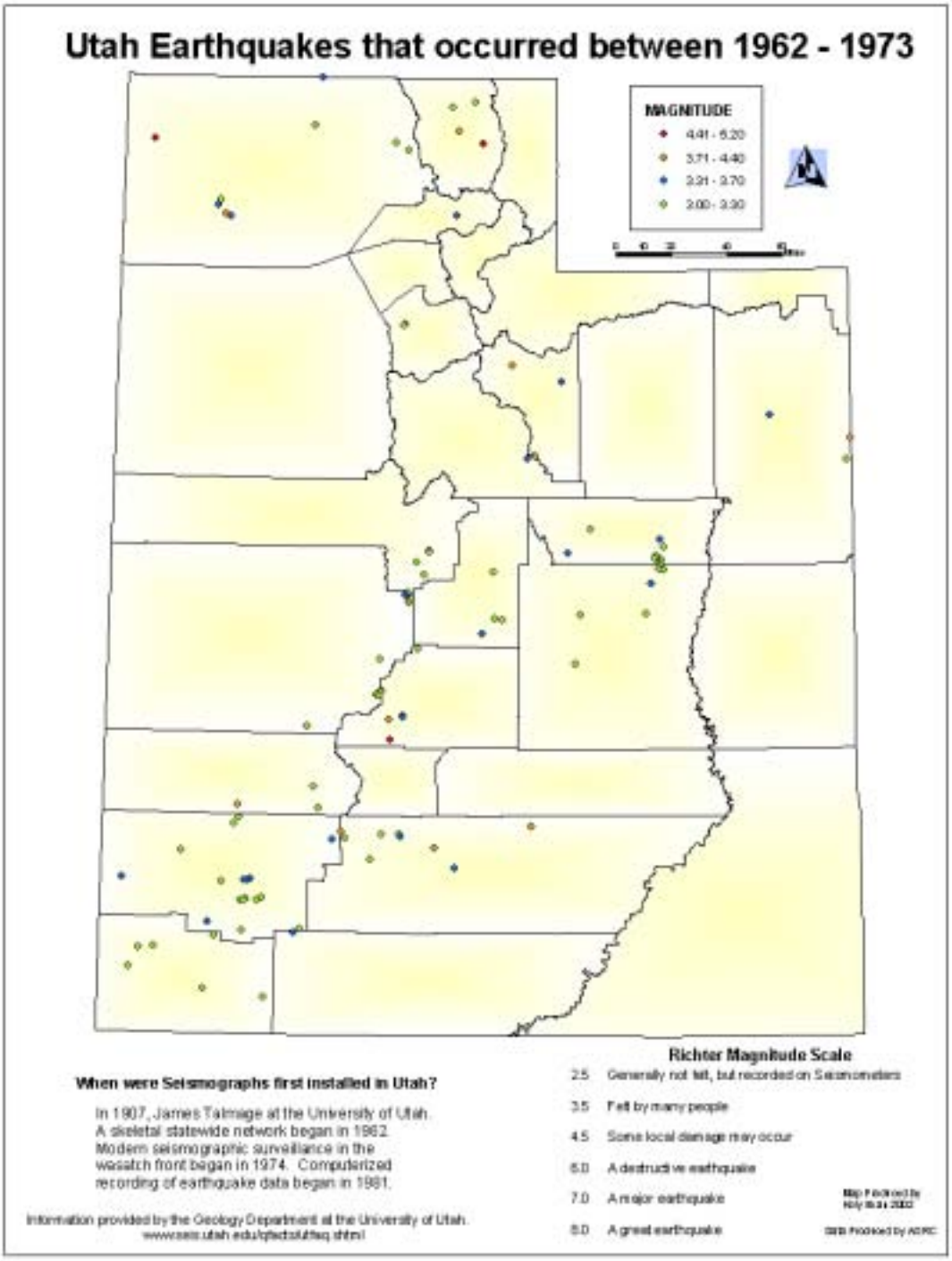

Utah Earthquakes that occurred between 1962 - 1973
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.21 - 3.70
2.00 - 3.20
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake

Figure 6-1-2

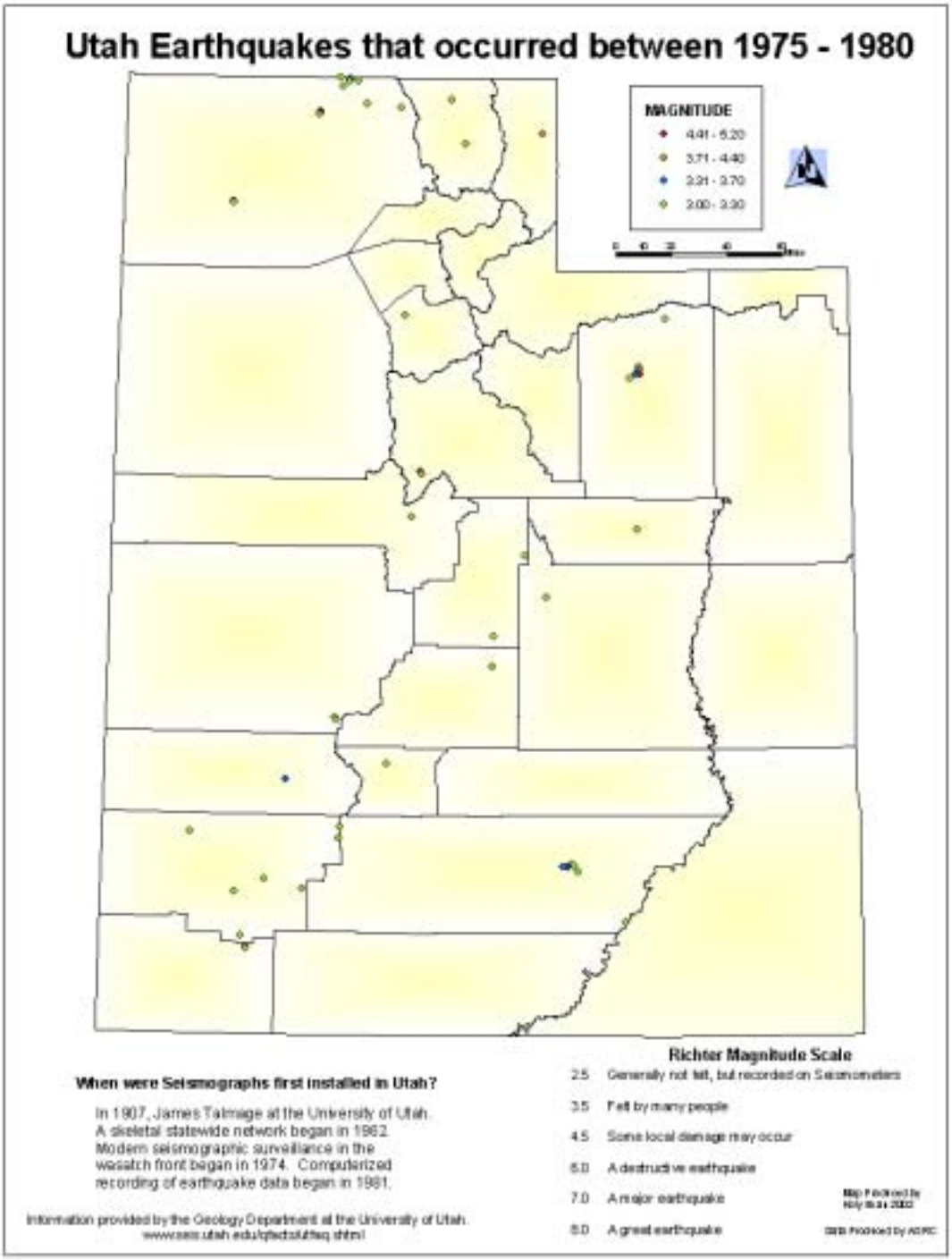
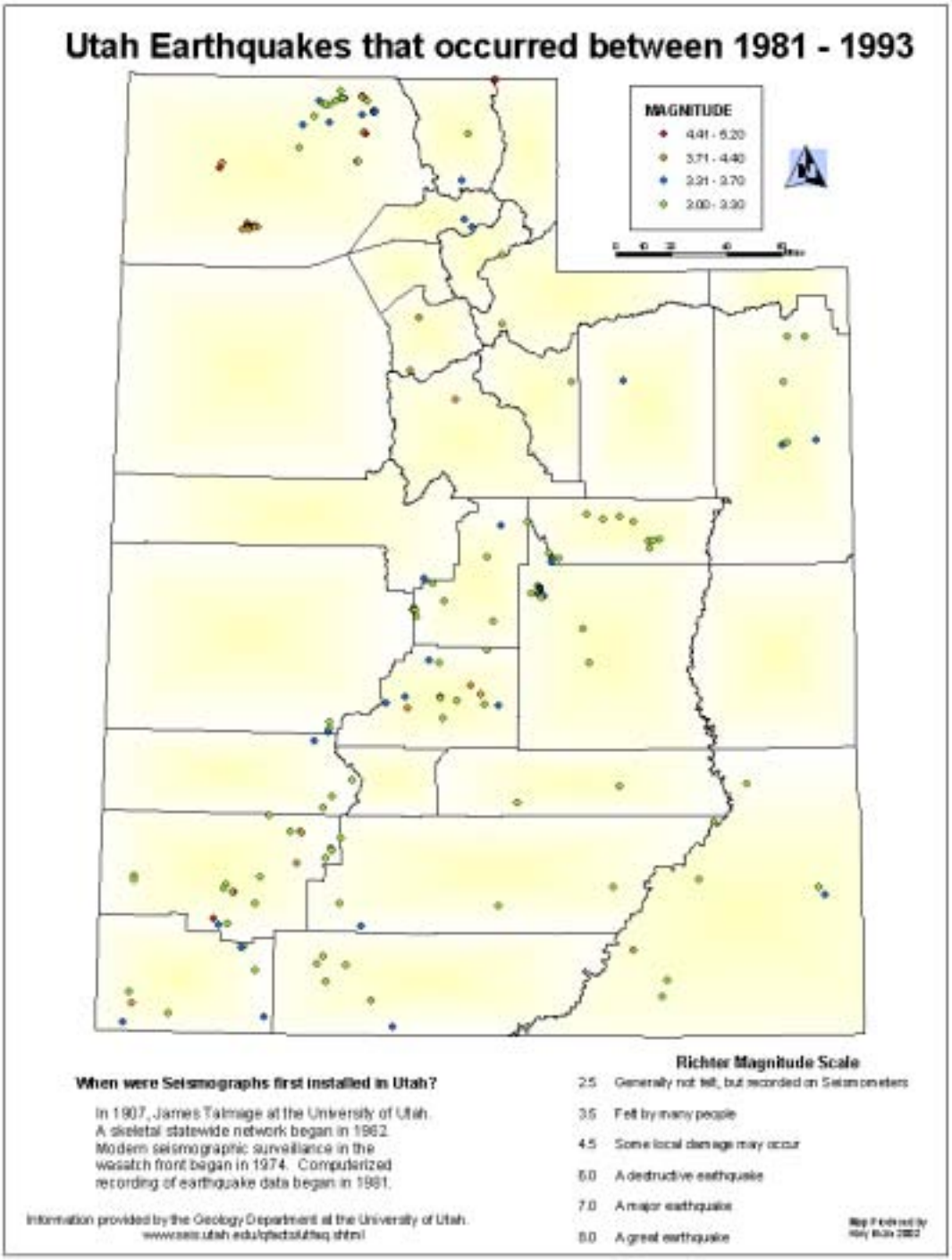

Utah Earthquakes that occurred between 1975 - 1980
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.21 - 3.70
2.00 - 3.20
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfaq/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake

Figure 6-1-3


Utah Earthquakes that occurred between 1981 - 1993
MAGNITUDE
4.41 - 5.20
3.71 - 4.40
3.21 - 3.70
2.00 - 3.20
When were Seismographs first installed in Utah?
In 1907, James Talmage at the University of Utah.
A skeletal statewide network began in 1962.
Modern seismographic surveillance in the
wasatch front began in 1974. Computerized
recording of earthquake data began in 1981.
Information provided by the Geology Department at the University of Utah.
www.seis.utah.edu/qfaq/utfaq.shtml
Richter Magnitude Scale
2.5 Generally not felt, but recorded on Seismometers
3.5 Felt by many people
4.5 Some local damage may occur
6.0 A destructive earthquake
7.0 A major earthquake
8.0 A great earthquake

2. Flood

It is important to note that flooding is a natural event for rivers and streams. Flood is determined to be the overflow of water onto land that is normally dry. Floods are related to an excess of snowmelt, rainfall, or failure of natural or engineered impoundments onto the banks and adjacent floodplains. Floodplains are lowland areas near river, lakes, reservoirs, oceans, and low terrain urban areas that are subject to recurring floods. Flooding occurs when the peak discharge, or rate of flow in cubic feet per second, is larger than the channel of the river or the storm sewer capacity in a city. The peak discharge for a stream is associated with a probability of occurrence. The probability of occurrence can be stated in terms of recurrence intervals or return periods. For example, a probability of occurrence of 10 percent would be a flood expected to occur once in 10 years or 10 times in a 100 years. Flooding damage includes saturation of land and property, erosion from water, deposition of mud and debris, and the fast flowing waters from the flood itself. Most injuries and deaths occur from the fast moving floodwaters and most of the property damage results from the inundation by sediment-filled water. Flash flood conditions result from intense rainfall over a short period of time (Utah Natural Hazards Handbook 42-45).

Snowmelt floods occur from the rapid snowmelt in the mountains. These floods generally happen in April, May and June. Warm air masses with mostly sunny skies melt the mountain watershed snowpack. The large accumulations of water generally last several days and the magnitude depends on the amount of snowpack and the warm weather. Snowmelt flood risk is reduced when the snowpack is below normal and/or the weather changes from winter to spring and summer gradually without an abrupt warming trend (43).

Rainfall floods result from large amounts of precipitation. Short duration local storms such as cloudburst or thunderstorms with a high intensity rainfall as well as the general storm that last several days with a less intense rainfall can produce a flooding event (43).

Areas prone to flooding, according to the Utah Natural Hazards Handbook, include lake and reservoir shorelines, which may flood when the flow of water into the lakes or reservoirs is greater than the outflow capacity. The Great Salt Lake and Sevier Lake are known as terminal lakes, which mean they do not have an outlet. These types of lakes are subject to considerable variations in water levels because the only outflow is by evaporation. Successive wet or dry periods that last several years result in a large change in size in terminal lakes. Development near this type of lake during a dry period is risky and certain to get flooded during wet periods (44).

River and creek floodplain areas range from narrow zones to extensive lowlands extending great distances from a natural drainage area. Construction in floodplains is also dangerous because of the high flood risk.

Urban areas are also prone to flooding because of the decrease in vegetation of the natural watershed. Houses, driveways, parking lots, buildings, and streets are all replacing the vegetative cover that is so important in lessening the potential for flood. This type of development prevents water infiltration into the soil and greatly increases the runoff. In some areas undersized piping and channels are used which may cause flooding. Manmade drainage ways can also play a role in flooding, trash and debris can obstruct passageways (44).

3. Landslide

Utah ranked third in the nation in terms of largest total landslide damage cost and cost per person between 1973 and 1983. Utah's landslide hazard rating is "severe" which is the highest level of five hazard classes given by the Geological Survey. The three main contributing factors to slope failure include areas with moderate to steep slopes, conducive geology, and high precipitation. The main elements that cause slope failure include precipitation events, topography and vegetation (Utah Natural Hazards Handbook 16-22).

Landslide distribution in Utah is associated with topography and physiographic provinces. The two physiographic regions that are conducive to landslides in Utah are the Middle Rocky Mountains province and the High Plateaus subdivision of the Colorado Plateau physiographic province.

Landslides are also known as slope failure and are classified according to the type of movement and the material involved. The five types of movement include falls, topples, slides, lateral spreads, and flows. The types of materials include rocks, debris (course-grained soil), and earth (fine-grained soil). Slope failure types are identified as rock falls, rock topples, rock slides, debris flows, debris topples, debris slides, slumps, and earth flows (17-18).

Rock Falls and Rock Topples occur when loosened blocks or boulders from an area of bedrock move down slope. Rock falls and topples generally occur along steep canyons, cliffs, and steep road cuts. Rock fall damage usually affects roads, railroad tracks, and utilities.

Debris Slides and Debris Flows generally occur in mountainous areas and involve the relatively rapid, viscous flow of course-grained soil, rock, and other surficial materials. Debris flows generally occur in mountainous areas and are considered a flow rather than a slide because of the high water content coupled with the debris. Debris flows are typically more dangerous because of the high speeds under which they form and travel. Debris flows generally remain in stream channels but can flow out from canyon mouths for a considerable distance. Debris flows and slides can damage anything in their path including buildings, roads, railroad tracks, life lines/utilities, and reservoirs.

Slumps are common along road embankments and river terraces. They slip or slide along a curved failure plane away from the upper part of a slope leaving a scarp (a relatively steeper slope separating two more gentle slopes). Slumps generally do not move very far from the source area.

Earth Flows are slumps with the addition of water that slump away from the top or upper part of a slope, leaving a scarp. These can range in size from very small to flows involving hundreds of tons of material and result in a bulging toe that can block streams and cause flooding, and damage buildings or other structures.

Causes of landslides are the result of hillside instability. Slope makeup, slope gradient, and slope weight all play a role. Other important factors of slope instability include rock type and structure, topography, water content, vegetative cover, and slope aspect. Debris flows, for example, occur when these elements are modified by natural processes or by human created processes.

Natural processes that can induce slope failure include ground shaking, wind and water weathering and erosion.

Human created processes involve lawn watering and irrigation. Excess water is the leading cause of landslides because water adds weight to the strength of the material and raises the pore pressure leading to a loss of shear strength. Water can also change the consistency of the slope material reducing cohesion leading to an unstable mixture. Rock types containing clay, mudstone, shale, or weakly cemented units, which, are strongly affected by weathering and erosion are particularly prone to landsliding because of the expansive and lubricating properties. Other processes include the removal or addition of slope materials during construction. Vegetation is very important in the stabilization of slopes because it prevents rainfall from impacting the soil directly and helps protect from erosion by retaining water and decreasing surface

runoff. The roots systems serve as slope-stabilizing elements by binding the soil together or binding the soil to the bedrock. Increase in slope gradient such as placing heavy loads at the top of a slope and /or the removal of material at the toe of a slope all affect the equilibrium and result in slope failure because of slope instability.

4. Wildfire

The Urban Rural Wildland Interface (URWIN) area, or I-Zone, is where residential areas meet wildland areas. It is known as the interface zone and presents a serious fire threat to people and property. The urban aspect includes homes, schools, storage areas, recreational facilities, transmission lines, and commercial buildings. Wildland refers to unincorporated areas including hills, benches, plateaus, and forests. Homes are built on the benches adjacent to wildland areas. Wildfires remove vegetation, which results in slope failure, erosion, water runoff and depletion of wildlife resources. The three conditions that affect fire behavior are topography, vegetation and weather (Utah Natural Hazards Handbook 23-28).

Topography includes such factors as slope, aspect, and elevation. Fires spread faster upslope because the fuels are closer to the flames on the upslope. The heat from a fire moves uphill and dries fuels in front of the fire allowing for easier ignition. The aspect of slope dictates moisture content. In other words, the sun dries out fuels on south and west facing slopes more than on north and east facing slopes. Elevation and weather are interrelated because, generally, higher elevations result in cooler temperatures and a higher relative humidity. Elevation also determines the types of vegetation present (24).

Vegetation plays a major role in the speed of a fire. Light grasses burn rapidly and heavy dense fuels burn slowly but with a greater intensity. The five major fuel types in Utah's vegetation include grass/sagebrush, pinion-juniper, mountain bush, hardwoods, and softwoods. The grass/sagebrush area poses a serious threat because people under-estimate the danger of wildfires in this area. These fires burn across thousands of acres rapidly and pose a serious threat to not only property but also life. Pinion-juniper fuel does not normally burn much, except when conditions are hot, dry, and windy. When a fire does happen here it will burn intensely and spread rapidly. Mountain brush is commonly found in Utah's foothills and if moderate to extreme fire conditions are present this type of fuel will burn hot and fast. Hardwood-forest and softwood (deciduous) fuel types are generally less risky (24).

Size, continuity and compactness all affect the fuel's rate of spread. Large fuels do not burn as readily as smaller fuels and need more heat to ignite. Small fuels on the other hand ignite easier, and a fire will spread more rapidly through them. Continuity is described by how fuel is arranged horizontally. Fuels that are broken up burn unevenly and usually slower than uniform fuels. Compactness is how fuel is arranged vertically. Tall, deep fuels have more oxygen available so they burn more rapidly. Less oxygen is available to compact fuels such as leaf litter and stacked logs therefore they burn slower (24).

Weather, is made up of a few different factors namely temperature, humidity, precipitation, and wind. Weather affects the ease with which a fuel ignites, the intensity at which it burns, and how easy the control may be. High temperatures increase fire danger because they heat fuels and reduce water content, which increases flammability. Humidity influences fuel ignition and how intensely fuel burns. A decrease in relative humidity causes the fuel to become drier and will ignite easier and burn more intensely. Wind can increase burning in the direction that it is moving. Wind carries heat from a fire into unburned fuels drying them out and causing them to ignite easier. The wind may also blow burning embers into unburned areas ahead of the main fires starting spot fires (25).

Fire protection in these areas is difficult because the tactics used for wildland-fire suppression cannot be used for structure protection and suppression. The energy that is emitted from a wildland-fire is very dangerous to firefighters and homeowners and makes protection of homes almost impossible. One third of all firefighter deaths occur fighting wildfires. Many believe that URWIN areas increase the risks to firefighters significantly. Legally federal wildland protection agencies seldom have the responsibility to protect structures, and the legal responsibility for protecting structures on non-federal wildlands varies widely among state forestry agencies (26).

5. Dam Failure

Dams serve various functions and are built by different agencies and entities. Such agencies and entities include The Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, cities, counties, and even the private sector. Dams are built for uses such as hydroelectric power generation, flood control, recreation, water storage for irrigation, as well as municipal and industrial uses. Because of Utah's dry summers, it is critical that the winter snowfall is stored for uses all year round. 84% of Utah's stored water is behind federal dams, 650 non-federal dams hold more than 1.2 million acre-feet of water. Dam placement is important and needs to be in an area where they can collect and distribute the greatest amount of water. Dam sites with strong impermeable bedrock are the best in terms of strength. Other materials can be used to construct a dam such as earthen fill, concrete, roller compacted concrete, and rocks and mine tailings. Other dams are created by the enlargement or addition of existing lakes (Utah Natural Hazards Handbook 47-48).

"Rainy Day failures occur when floodwaters overstress the dam, spillway, and outlet capacities. The floodwater flows over the top of the dam and eventually erodes the structure from the top down. At this point the floodwater meets with the floodwaters from the rainstorm and a very destructive, powerful flood is created" (47).

Sunny Day failures are the most dangerous because they happen without any warning. Downstream residents or inhabitants have no time to prepare or even evacuate the area; the results are generally very catastrophic. Sunny day failures occur from seepage or erosion inside the dam. This erosion removes fine materials creating a large void that can cause the dam to collapse, or overtop and wash a way. Earthquake ground shaking or liquefaction can also create structure problems. Ground shaking will cause the dam to start piping, slumping, settling, or experience a slope failure similar to a landslide. The dam would than fail internally or overtop and wash away. Other sunny day failures occur when vegetation or rodents get into a dam and leave holes or tunnels that can lead to failure. Not all dam failures are catastrophic; sometimes a dam can fail and be drained and repaired without a damaging flow of floodwaters (47).

"Hazard ratings are determined by downstream uses, size, height, volume and incremental risk/damage assessments. The hazard ratings are: Low- insignificant property loss; Moderate- significant property loss; and High- possible loss of life" (48). Over two hundred of Utah dams are rated as high-hazard dams.

6. Drought

According to the Drought Hazard Mitigation Plan, drought originates from a shortage of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. “Drought could be considered relative to some long-term average condition of balance between precipitation and evapotranspiration in a particular area”. Drought is also related to the timing and effectiveness of the rains. Drought is a normal, recurrent feature of weather and climate but is a particular concern to all affected because of its devastating outcome. It occurs in almost all climatic zones with varying characteristics. “Drought is a temporary aberration and differs from aridity since aridity is restricted to low rainfall regions and is a permanent feature of climate”. Drought is a dry progression through the winter, spring, and summer months that could end in a year or last for many years. The number of dry years correlates with those affected, usually a one to two year drought affects only agriculture, while a three-year drought typically results in impacts on culinary water in the local areas and communities (13-15).

Conceptual definitions of drought help people understand the idea of a drought.

Operational definitions define the process of drought. This is usually done by comparing the current situation to the historical average, often based on a 30-year period of record. It is hard to develop a singular operational definition of drought because of the striking differences throughout the world (Defining Drought).

Meteorological drought is defined by the degree of dryness in comparison to an average amount and the duration of the dry period. Meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region (13-15).

Hydrological drought refers to the precipitation decline in the surface and subsurface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale (13-15).

Agricultural drought occurs when there is not enough water available for a crop to grow. This drought links various characteristics of meteorological or hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced ground water or reservoir levels (13-15).

Socioeconomic drought occurs when the physical water shortage begins to affect people (16-20).

When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface and subsurface water are usually the last to be affected. Ground water users are often the last to be affected by drought during its onset but may be the last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates (18-19).

Measuring Drought:

Palmer Drought Severity Index (PDSI): Wayne Palmer developed the PDSI in 1965. The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions used by government agencies and states to trigger drought relief programs. The PDSI provides a measurement of moisture conditions that were “standardized” so that comparisons using the index could be made between locations and between months. This is the oldest index for measuring drought and is less well suited for mountainous land or areas of frequent climatic extremes and does not include man-made changes. The PDSI is calculated based on precipitation and temperature data as well as local available water content of the soil. This scale is given as

monthly values and is the most effective in determining long-term drought. The index ranges from –4 to 4 with negative values denoting dry spells and positive values indicating wet spells. The values 0 to -.5 equal normal, -0.5 to –1.0 equal incipient drought, -1.0 to –2.0 equal mild drought, -2.0 to –3.0 equal moderate drought, -3.0 to –4.0 equal severe drought, greater than –4.0 equals extreme drought. The wet spells use the same adjectives in the positive values (What is Drought).

Surface Water Supply Index (SWSI): Shafer and Defman developed the SWSI in 1982. This index uses the same basic classifications as the Palmer Drought Index and is designed to complement the Palmer in the western states. The SWSI is more of an indicator of surface water conditions and described as "mountain water dependent", in which mountain snowpack is a major component; calculated by river basin, based on snowpack, stream flow, precipitation, and reservoir storage. The objective of the SWSI was to incorporate both hydrological and climatological features into a single standardized index value. The pros and cons of the SWSI is that the index is unique to each basin. The SWSI is centered on 0 and has a range between –4.2 (extremely dry) and 4.2 (abundant supply). The index is calculated by combining pre-runoff reservoir storage with forecasts of spring and summer stream flow that is based on hydrologic variables (What is Drought).

Standardized Precipitation Index (SPI): T.B. McKee, N.J. Doesken, and J. Kleist of the Colorado State University, Colorado Climate Center formulated the SPI in 1993. The Standardized Precipitation Index was designed to quantify the precipitation deficit for multiple time scales; basically, the SPI is an index based on the probability of precipitation for any time scale. It assigns a single numeric value to the precipitation that can be compared across regions with different climates. The SPI is calculated by taking the difference of the precipitation from the mean for a particular time scale and dividing by the standard deviation. The SPI is normalized and so the wetter and drier climates can be represented in the same way. The SPI can provide early warning of drought and help assess drought severity yet the values based on preliminary data may change. The SPI values indicate an extremely wet period value at 2.0+, very wet equals 1.5 to 1.99, moderately wet is 1.0 to 1.49, -.99 to .99 is near normal, -1.0 to –1.49 moderately dry, -1.5 to –1.99 is severely dry, -2 and less is extremely dry. The time scales were originally calculated for 3-, 6-, 12-, 24-, and 48- months (What is Drought).

After review of 33 gaging stations, the drought analysis in Utah indicated that a localized drought has occurred on at least one stream every year since 1924. The duration of drought lasts longer in basins where runoff is mainly from snowmelt. The frequency of occurrence is greater for areas in the Wasatch Range than in the Wasatch Plateau, the mountain of southwestern Utah, or the Uintah Mountain range. Because Utah relies on surface water supplies, about 81% of the population relies on offstream water use and 35% of the population relies on surface water supplies, drought severely affects the people and industry of the whole state.

7. Infestation

Infestation has plagued this region since the early 1800's and continues to be a problem. Infestation is known as a parasite that over-populates in numbers or quantities large enough to be destructive, threatening, or obnoxious. Past infestation events have been devastating enough for presidential disaster declarations because of the destruction to food supplies that affect wildlife, livestock, and agricultural lands including alfalfa, wheat, and barley. Crickets, katydids, grasshoppers, and worms tend to be the most damaging and affect the rural areas the most. With the recent drought in the area the predators decrease. The drought also affects the food supplies and so the insects begin to search over a wider area when in search of food.

8. Severe Weather

Avalanche: According to Sandra Eldredge, Utah Geological Survey "a snow avalanche is the rapid down-slope movement of snow, ice, and debris. Snow avalanches occur in the mountains of Utah as the result of snow accumulation and unstable snowpack conditions." Ground shaking, sound, or a person treading in an avalanche area can trigger a slide that can cover a wide area or can be concentrated to a smaller more or narrow path. An avalanche consists of a starting zone, a track, and a runout zone. The starting zone is where the ice or snow breaks loose and starts to slide; this zone can be triggered by human and/ or natural activities. Human induced avalanches can result from snowmobilers, backcountry skiers, or other outdoor recreationalists triggering the avalanche because of ground shaking. The two main natural factors that affect avalanche activity include weather and terrain, large frequent storms combined with steep slopes result in avalanche danger. Other factors that contribute to the stability of the snowpack include the amount of snow, rate of accumulation, moisture content, snow crystal types and the wind speed and direction. The Track is the grade or channel down which an avalanche travels. The runout zone is where an avalanche stops and deposits the snow. For large avalanches, the runout zone can include a powder-or windblast zone that extends far beyond the area of snow deposition. In Utah, avalanches are the number one natural hazards that kill more people and ironically are triggered by the victim. Each winter an average of four people die in Utah due to avalanche activity (Utah Natural Hazards Handbook 50-53).

Weather and terrain conditions affect avalanche conditions. The weather controls the durations and the extent of an avalanche while terrain is the element that determines where, why, and how an avalanche occurred. In Utah, the months of January through April pose the greatest avalanche potential. Weather related aspects that affect the snowpack stability include rate of accumulation, amount of snowfall, moisture content, wind speed and direction, and snow crystal type. Wind can deposit snow 10 times faster than snow falling from a storm without accompanying wind. This affects avalanche potential because the underlying weak layer of snow cannot adjust to the new load. Rain and the melting of snow can almost instantly cause an avalanche because of the added weight 50-51).

Terrain includes such variables as slope, aspect, elevation, roughness and angle. The slope is important in understanding where an avalanche will occur. Slopes greater than 45 degrees are too steep because the snow continually sluffs off, however slopes greater than 20 degrees can produce avalanches. Optimum slope degree is between 30 to 45 degrees, which is also the optimum angle for backcountry skiers. This slope angle is where approximately 99.9 percent of avalanches occur. The slope aspect and elevation affect the snow depth, temperature, and moisture characteristics of the snowpack. Slope aspect, such as north facing or shady slopes usually produce more avalanches and more persistent avalanche hazards occur during mid winter months. In the spring, south facing slopes produce more wet avalanches from the strong sun (Utah Avalanche Center).

Slope shape and roughness correlate with snowpack stability. Roughness identifies boulders, shrubs, and trees that can help slow, or reduce avalanche speed and impact. A bowl shaped slope is more prone to an avalanche than a ridge or cliff.

Dry avalanche is when a cohesive slab of snow that fractures as a unit slides on top of weaker snow and breaks apart as it slides. Dry slab avalanches occur usually because too much additional weight has been

added too quickly, which overloads the buried weak layer, even the weight of a person can add a tremendous stress to a buried weak layer. Dry snow avalanches usually travel between 60-80 miles per hour within 5 seconds of the fracture and are the deadliest form of snow avalanche (Utah Avalanche Center).

Wet Snow avalanches occur for the opposite reason of dry avalanches; percolating water dissolves the bonds between the snow grains on the pre-existing snow, which decrease the strength of the buried weak layer. Strong sun or warm temperatures can melt the snow and create wet avalanches. Wet avalanches usually travel about 20 miles per hour (Utah Avalanche Center).

Avalanches can result in loss of life as well as economic losses. What are at risk are some communities, individual structures, roads, ski areas, snowmobilers, backcountry skiers, snowshoers, snowboarders, and climbers. Avalanches can reach speeds up to 200 miles per hour and release enough force to wipe out everything in its path. One of the major consequences of snow avalanches is the burial of structures, roads, vehicles, and people in the runout zone where tens of feet of debris and snow can be deposited (51).

Severe Storm: Winter storms gain their energy from the collisions of two air masses. In North America a winter storm is usually generated when a cold air mass from dry Canadian air moves south and interacts with a northward moving warm moist air mass from the Gulf of Mexico. The position where a warm and a cold air mass meet is called a front. If cold air is advancing and pushing away the warm air the front is known as a cold front. If the warm air is advancing, it rides up over the cold air mass and the front is known as a warm front. A winter storm will typically begin under what is known as a stationary front. A stationary front is when neither air mass is advancing. The atmosphere will try to even out the pressure difference by generating an area of lower pressure; this creates wind that blows from high pressure towards a low-pressure area. As the air travels toward the center of the low-pressure area it is pushed up into the colder regions of the upper atmosphere because it has nowhere else to go. This causes the water vapor to condense as snow in the northern areas because of the colder temperatures. In the south, if the temperatures are warm enough the water vapor will fall as heavy rain in thunderstorms. Because of the easterlies in Northern America the winter storm moves quickly over the area and generally does not last longer than a day in one area. However, in Utah because of the Great Salt Lake “lake-effect” snowstorms can last for many days. This is because of the amount of moisture from an unfrozen body of water. When a strong cold wind blows over a larger area of water, the air can attain a substantial amount of moisture; this moisture turns into heavy snow when it reaches land causing a lake effect snowstorm (All About Winter Storms).

Strong winds often accompany a winter storm creating blizzard conditions; dangerous wind chill, severe drifting and can knock down trees, power lines, and utility poles (Severe Weather Safety).

Extreme Cold: Prolonged exposure to the cold can cause frostbite or hypothermia and can become life threatening (Severe Weather Safety).

Ice Accumulations can bring down electrical wires, telephone poles and lines, trees, and communication towers. Ice can also cause extreme hazards to motorists and pedestrians (Severe Weather Safety).

Heavy Snow can stop a region by stranding commuters, stopping the flow of supplies, disrupting emergency and medical services, close infrastructure and services (Severe Weather Safety).

Severe Thunderstorm usually last around 30 minutes and are typically only 15 miles in diameter. But they all produce lightning. They can also lead to flash flooding from heavy rainfall, strong winds, hail and tornadoes may also accompany a thunderstorm (Severe Weather Safety).

Extreme Heat: Heat-related illnesses affect people, this happens when their bodies are unable to compensate and properly cool themselves. Usually a body will sweat to cool itself, however under some conditions, sweating isn’t enough and a person’s body temperature will rise that can cause damage to the brain or other vital organs. This can happen when the humidity is high, sweat will not evaporate as quickly, preventing the body from releasing heat quickly; other conditions include age generally the elderly and young, obesity, fever, dehydration, heart disease, mental illness, poor circulation, sunburn, and prescription

drug use and alcohol use (Extreme Heat). Extreme heat can manifest in several ways including sunburn, heat exhaustion, heat stroke, and heat cramps (Severe Weather Safety).

Waterspouts are weak tornadoes that form over warm water and in Utah they can occur with cold late fall or with late winter storms (Tornadoes).

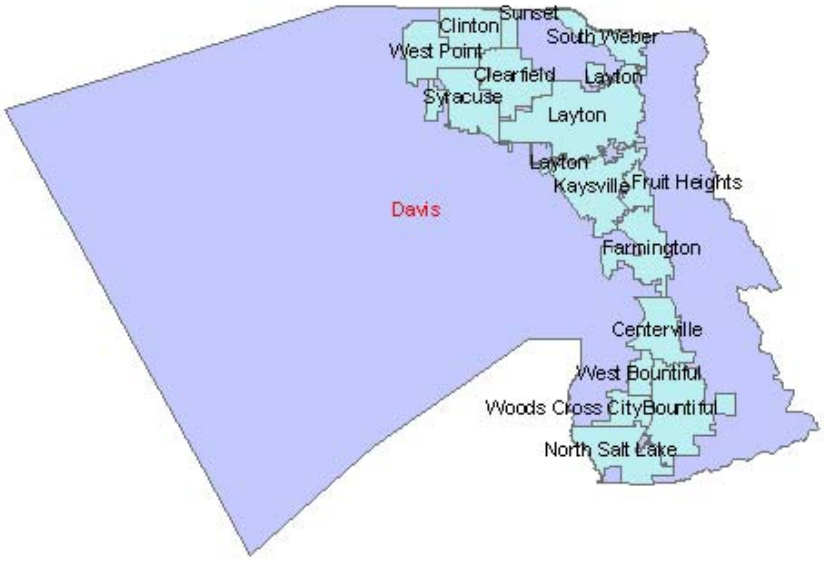
Tornado: Expressed as a violently rotating column of air extending from a thunderstorm to the ground. A tornado is often on the edge of the updraft or next to the air that's coming down from the thunderstorm. The tornado's vortex is a low-pressure area and as air rushes into the vortex, its pressure lowers and cools the air. This cooler air condenses into water vapor in the funnel cloud, known as the vortex, and doesn't touch the ground. The swirling winds of the tornado pick up dust, dirt, and debris from the ground, which turns the funnel cloud darker. Some tornadoes can have wind speeds up to 250 miles per hour or more with a damage zone of 50 miles long and 1 mile wide. But most tornados have winds less than 112 miles per hour, are less than 100 feet wide, and generally do not last longer than 10 minutes. They generally move along the ground 20-50 miles per hour. While a tornado can happen anytime, for the northern parts of the state tornadoes happen more frequently during the summer (Tornadoes). A change in wind direction and an increase in wind speed along with increasing height create an invisible, horizontal spinning effect in the lower atmosphere form a tornado while the rising air within the thunderstorm updraft tilts the rotating air vertically resulting in what we call a tornado. The area of rotation is generally 2-6 miles wide and extends through much of the storm (Tornadoes).

Scale: Tornadoes are classified by wind damage using the Fujita Scale that was accepted for use by the National Weather Service in 1973. The scale uses numbers from 0 through 5 with the ratings based on the amount and type of wind damage (Tornado Safety).

Fujita Scale
F-0: Winds up to 72 mph, Light damage, down tree branches, chimney damage
F-1: Winds 73-112 mph, Moderate damage, mobile home damage
F-2: Winds 113-157 mph, Considerable damage, mobile home demolished, trees uprooted
F-3: Winds 158-206 mph, severe damage, roofs and walls torn down, trains overturned, cars thrown
F-4: Winds 207-260 mph, Devastating damage, well-constructed walls leveled
F-5: Winds over 261 mph, incredible damage, homes lifted off foundation and carried, autos thrown as far as 100.

Part VII. Davis County

Davis County includes 15 municipalities: City of Bountiful, Centerville City, Clearfield City, Clinton City, Farmington City, Fruit Heights City, Kaysville City, Layton City, City of North Salt Lake, South Weber City, Sunset City, Syracuse City, West Bountiful City, West Point City, and Woods Cross City. Davis County is located in Northern Utah.



A. Demographics and Population Growth

The following information involving Population Estimates, Average Annual Rate of Change, and Population and Development Trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. Davis County population can be identified by reviewing Census 2000 data in the table below (Table 7-1).

Table 7-1. Davis County Population Growth

Census Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Davis County	187,941	238,994	51,053	27.2%	2.4	3	3	13	13

Population by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
Wasatch Front	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Davis County	146,540	187,941	238,994	262,241	292,201	323,992	347,412	386,672	1.62%

Households by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Davis County	39,994	53,643	71,201	82,149	95,281	108,371	119,094	138,092	2.23%

Average Household Size by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Davis County	3.58	3.44	3.31	3.15	3.03	2.95	2.88	2.76	-0.60%

Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Davis County	10.03%	10.91%	10.70%	10.64%	10.48%	10.36%	10.31%	10.25%	-0.14%

Household Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Davis County	8.92%	9.99%	10.15%	10.36%	10.42%	10.42%	10.42%	10.44%	0.09%

Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.

B. Economy

Grazing and agriculture were the first types of industry in the County. Many of the crops that were produced were sugar beets, tomatoes, alfalfa, grain, corn, potatoes, onions, and extensive fruit orchards. Dairy farming was also a leading industry.

Commercial and industrial companies are also located within the County including the Freeport Center, which is the largest distribution center in the United States. The Hill Air Force Base is also located in the County. Hill Air Force Base has been the economic backbone of Davis County for many years and is a fundamental economic component of the community. The economy is spread out between different entities namely, manufacturing, trade, services, and government. Some of the largest employers include Hill Air Force Base, Davis County School District, Lifetime Products Inc., Fred Meyer, Albertson's, and Davis County. Davis County is large and growing and the housing and community demands are high. Total personal income in millions in 2001 was $6114.6 up from $5790.3 in 2000. 2001 per capita income was $24,973 and the average monthly nonfarm wage was $2,392.

C. Transportation and Commuting Patterns

Davis County transportation patterns were completed with the help of the UDOT Daily Annual Average Traffic Analysis of 2000. There are only two major highways within the county, Interstate 15 (I-15) and Interstate 84 (I-84). I-15 travels from the northern border of the county through the eastern portion into Salt Lake County to the south. I-15 connects the major cities in the county and experiences about 152,000 commuters each day. I-84 just enters the top eastern portion of the county and exits at the northeastern border. The average daily traffic traveling east west is about 10,405. Highway 89 travels north south from I-84 at the northern border of the county and connects with I-15. The daily traffic on this road is approximately 32,665. There are also four major State Routes namely, SR 272, SR 106, SR 225, and SR 277. SR 272 and SR 106 travel north south and together experience about 34,745 average daily trips. The combined daily use of SR 225 and SR 277 is approximately 12,505 average daily trips.

D. Land Use

Davis County consists of 630 square miles with only 223 square miles actual usable land. Antelope Island is part of Davis County and adds another 42 square miles to the land area with the remaining portion part of the Great Salt Lake. Davis County is the third most populated county in the state with roughly 933 people per square mile. The percent of land ownership within the county is 10.9% Federal, 12.0% State, 24.9% Private and Local Government, and 52.2% under Water.

Davis County's population will continue to grow in the eastern and southern potions of the county where new development is occurring due to housing and land values that are slightly lower than nearby Salt Lake County. The Wasatch Mountain Range and the Great Salt Lake restrain development in Davis County. Therefore new development is located along the I-15 corridor and in the foothills. Other development is occurring where farmland and agricultural lands used to be.

Those portions of the county that are near the Great Salt Lake are subject to high liquefaction in the event of an earthquake and therefore pose a risk to incoming residents and new structures. One way for the county to mitigate the earthquake threat and its secondary risks is to continue to establish zoning ordinances and building codes that will recognize the threat and reduce it.

Wildfire risk is most severe in the foothills of northern Davis County. These areas known as URWIN zones are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. A couple ways to mitigation this threat is to encourage communities to become "Fire Wise Communities", continue to require building and zoning codes, and increase the public's awareness.

Landslide/ slope failure is another threat near the foothills of the Wasatch Mountain Range. Zoning ordinances and landslide studies will decrease the likelihood of a slope failure damaging property and the risk to life.

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Davis County can be found in Section G.

E. Risk Assessment

The risk assessment process revealed the following for the identified hazards of Earthquake, Flood, Wildland Fire, Landslide/ Slope Failure, and Severe Weather. Severe Weather is considered to be a regional hazard and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 130 identified critical facilities within Davis County, for the complete list refer to Appendix D.

1. Earthquake

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Eastern areas of Bountiful, Centerville, Farmington, Fruit Heights, and Layton along the western portion of the Intermountain Seismic Belt. Ground shaking will be felt throughout the entire County. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in the high to moderate areas, from the foothill to the western portion of the county near the Great Salt Lake. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential is greatest near the Great Salt Lake along the low-lying areas of the county, in soils that are comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

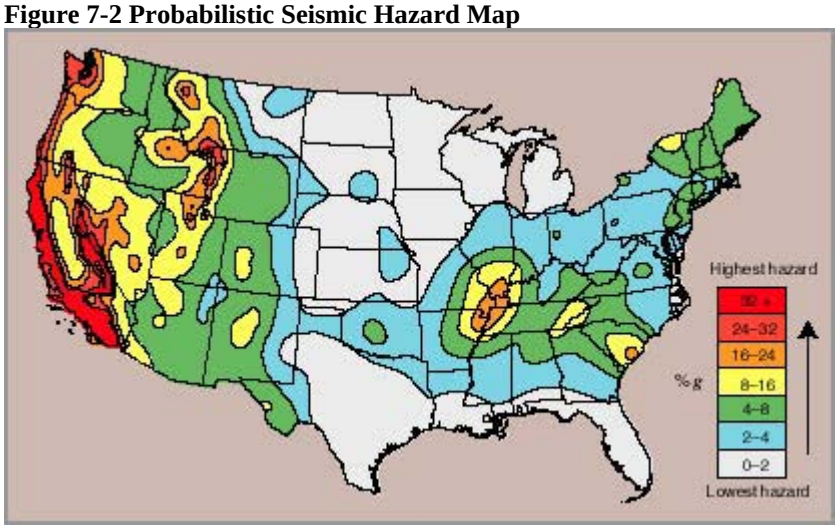
In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years.

Davis County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment. The Weber Segment runs from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years, making it one of the most active fault segments. The Weber County segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county.

The Salt Lake Segment underlies the Salt Lake valley. The combined average repeat time for large earthquakes on any of the five central segments (Brigham city, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. The last earthquakes on the five central segment range from 620-2120 years ago. On the Salt Lake City segment the probability may be as high as 57 percent in 100 years.

According to the County Emergency Operations Plan Davis County contains the highest density of faults in the entire state of Utah. Davis County has felt earthquakes in the past but few earthquakes have had their epicenters within the county boundary.

Figure 7-2 Probabilistic Seismic Hazard Map



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Davis County (Table 7-2). This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years.

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 39.70000 Lat and –69.39999 Long

For a more detailed explanation of values used and metadata refer to the USGS Earthquake Hazards Program website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The cities of Anchorage, Arsenal, Fruit Heights, Kanesville, and Layton coordinate systems were unable to be identified for earthquake probabilistic hazard values. The United States Geological Survey produced a seismic hazard map for the entire country; Utah according to the map is ranked towards the higher hazard values (Figure 7-2).

Table 7-2 Earthquake Probabilistic Hazard- Ground Motion Values

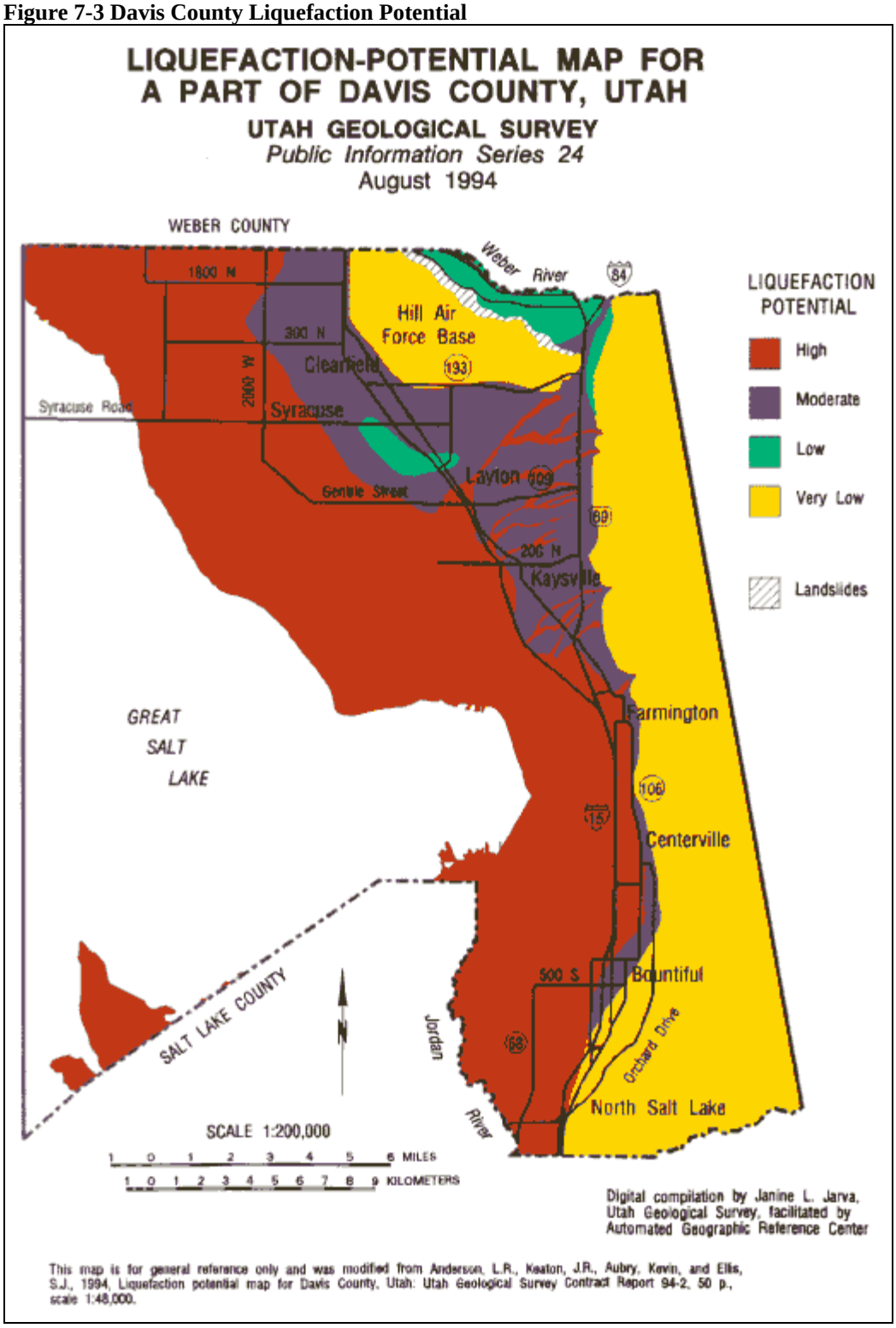
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
Farmington 40:59:19 111:53:42			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773

South Weber 41:08:02 Lat 111:56:06 Long			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
Sunset 41:14:91 Lat 112:03:305 Long			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
Bountiful 40:52:34 Lat 111:51:55 Long			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773
Syracuse 41:05:46 Lat 112:03:27 Long			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
Centerville 40:55:36 Lat 111:53:10 Long			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773
Kaysville 41:01:50 Lat 111:56:40 Long			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
West Bountiful 40:90:03 Lat 111:90:22 Long			
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
1.0 sec SA	0.7160503	1.267426	2.563773

Clearfield 41:06:16 Lat 112:01:21 Long			
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
1.0 sec SA	0.8321668	1.549357	2.842664
Layton 41:04:41 Lat 111:57:16 Long			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307
West Point 41:07:17 Lat 112:05:49 Long			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
Clinton 41:08:28 Lat 112:03:45 Long			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8111448	1.283803	2.234921
0.2 sec SA	2.131721	3.373687	5.580474
0.3 sec SA	1.922413	3.134943	5.357137
Woods Cross 40:52:25 Lat 111:54:43 Long			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486
North Salt Lake 40:50:40 Lat 111:55:22 Long			
	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.6607647	1.051340	1.815637
0.2 sec SA	1.687429	2.739522	4.802052
0.3 sec SA	1.591127	2.518233	4.610486

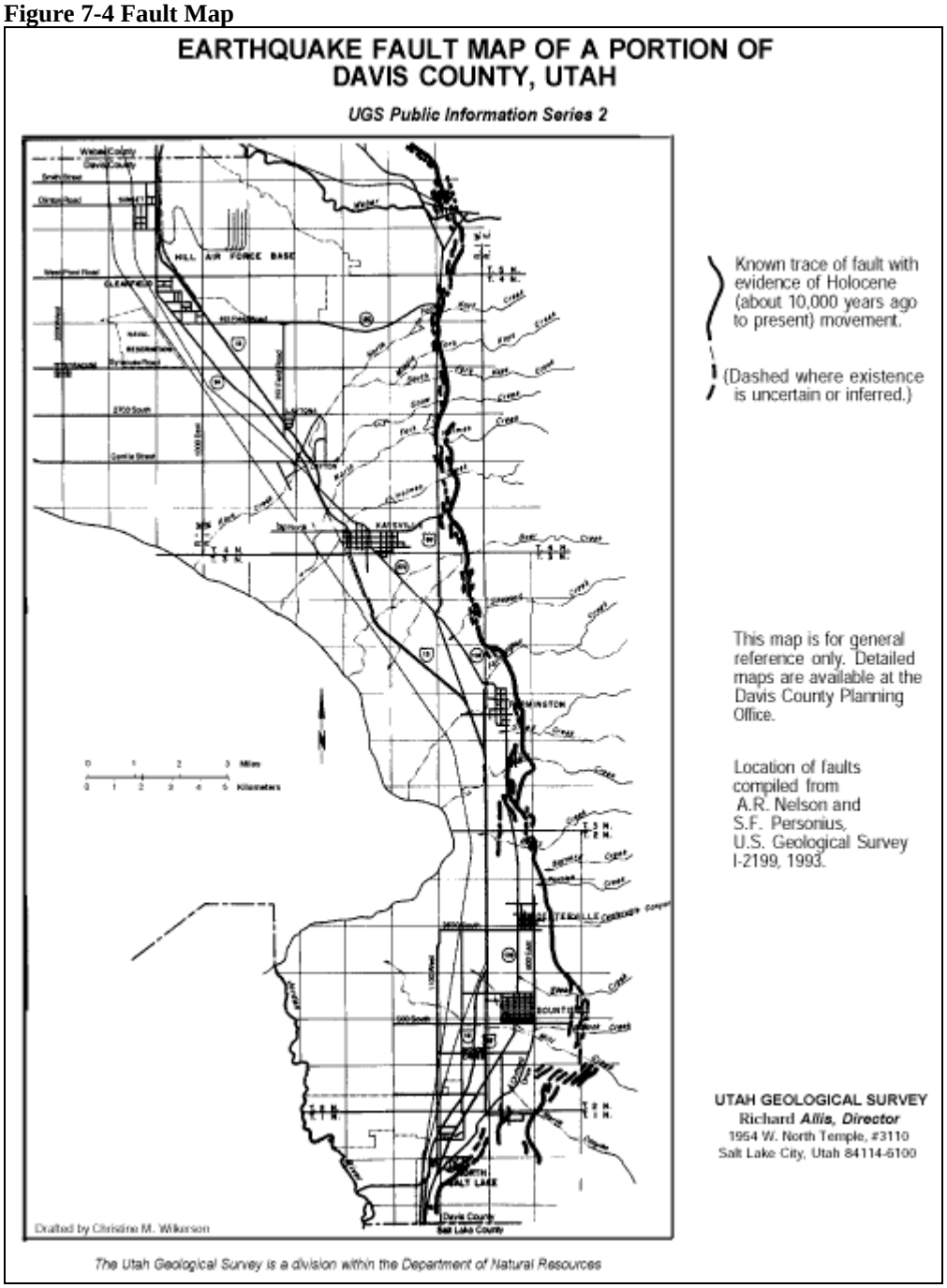
Liquefaction Potential is one of the secondary hazards associated with an earthquake and affects nearly the entire county. Davis County is located atop an ancient lakebed, Lake Bonneville, which is made up of unconsolidated sandy soils. The area is also subject to shallow ground water and a relatively high earthquake threat. For a further explanation of liquefaction see Figure 7-3 Davis County Liquefaction Potential. The regional hazard identification section also explains liquefaction in a narrative form. Figures 7-5 and 7-6 recognize the fault zones within Davis County.

Figure 7-3 Davis County Liquefaction Potential



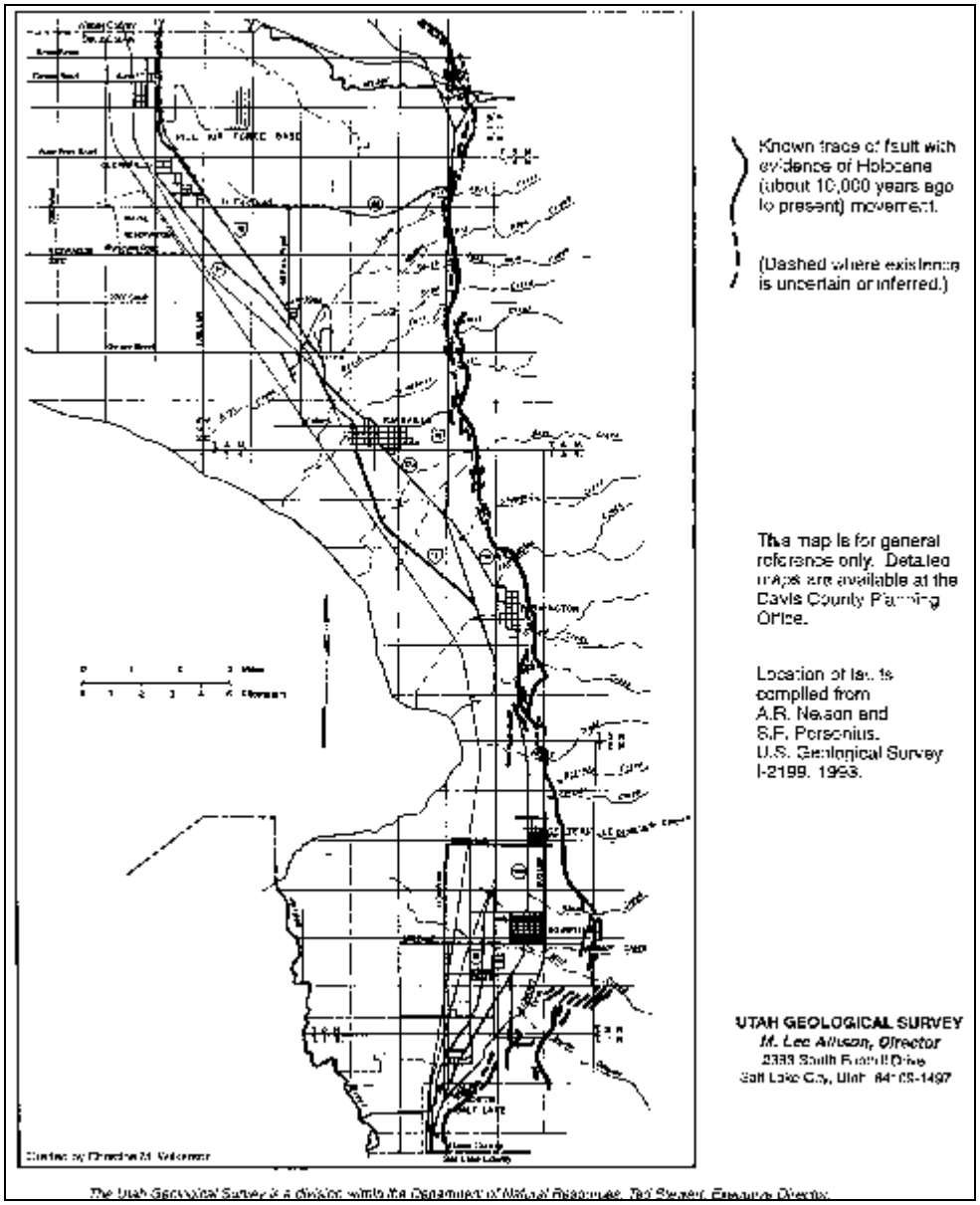
Source: Utah Geological Survey. Geologic Hazards- Liquefaction. 2003. State of Utah <http://geology.utah.gov/online/images/pi-27.gif>.

Figure 7-4 Fault Map



Source: Earthquake Fault Map of a Portion of Davis County. Utah Geological Survey. Public Information Series 2. Richard Alfs. 2003. < http://geology.utah.gov/online/images/pi-2.gif>. 1997.

Figure 7-5 Fault Map 2



Source: Davis County Fault Map. University of Utah Seismograph Station. Utah Geological Survey. M. Lee Allison. 2003. < http://geology.utah.gov/online/images/pi-2.gif>. 1993.

Vulnerability Analysis

The vulnerability analysis includes the type and number of residential, commercial, and critical facilities located in the earthquake hazard area (Tables 7-3, 7-4, 7-5 7-6, 7-7).

Table 7-3 Vulnerability Assessment for Earthquake

City Name	City Area	Acres in Fault Zone	Acres in Lique-faction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Residential/ Value	Commercial /Annual Sales	Residential/ Value	Commercial /Annual Sales	Earthquake	Liquefaction
Bountiful City	8,014	1345	817	2,113 / $335,385,291	87/ $53,900,000	2,387 / $243,576,110	1,516/ $1,534,200,000	6,659	8,264
Centerville City	3,796	95	3,092	136 / $21,707,622	3/ $800,000	4,315 / $505,598,880	449/ $503,400,000	431	12,799
Clearfield City	4,778	0	4,358	0	0	9,802 / $1,188,913,986	519/ $660,400,000	0	29,407
Clinton City	3,574	0	3,574	0	0	4,433 / $743,266,060	147/ $169,200,000	0	13,965
Farmington City	4,891	3,016	4,343	1,801 / $285,875,794	137/ $316,100,000	4,279 / $495,122,610	310/ $438,300,000	5,676	12,007
Fruit Heights	1,423	15	1,206	0	0	1,985 / $337,556,250	69/ $57,600,000	0	6,354
Kaysville	6,397	375	6,361	31 / $5,154,095	1/ $500,000	7,905 / $1,304,325,000	595/ $639,200,000	100	23,715
Layton	13,243	596	11,410	732 / $118,956,518	14/ $7,700,000	17,326 / $2,750,455,556	1,693/ $2,586,100,000	2,308	55,444
North Salt Lake	5,282	1,403	3,176	139 / $22,250,192	130/ $574,100,000	621 / $33,875,220	584/ $1,505,300,000	439	2,236
South Weber	3,045	537	256	420 / $67,105,363	8/ $3,900,000	156 / $16,339,020	79/ $82,100,000	1,324	732
Sunset City	930	0	776	0	0	1,623 / $272,575,150	136/ $122,200,000	0	5,195
Syracuse City	5,432	0	5,432	0	0	3,190 / 534,963,000	170/ $201,500,000	0	9,889
West Bountiful	1,399	0	1,399	0	0	1,474 / $150,053,160	215/ $218,000,000	0	4,988
West Point	4,368	0	4,368	0	0	2,474 / $417,971,180	258/ $517,400,000	0	7,424
Woods Cross	2,194	1,254	1,916	604 / $96,451,289	111/ $125,300,000	2,144 / $192,654,120	295/ $389,200,000	1,903	5,119

*Liquefaction for high to moderate zones.
*City Area includes the total number of acres.
*Value is replacement value.
*0 indicates no information at this time to due lack of data or no known risk.

Table 7-4 Critical Facilities within Fault Zones

Name	City
Oil Facilities	
Big West Oil Company	N Salt Lake
Chevron USA Products Company	Salt Lake City
Fire Stations	
South Davis Fire District	North Salt Lake
Farmington City Fire Dept	Farmington
Police Stations	
North Salt Lake City Police	North Salt Lake
Centerville Police Dept	Centerville
Farmington Police Dept	Farmington
Schools	
Layton Christian Academy	Layton
Achiever Preschool/Kindergarten	Bountiful
Kinder Care	Centerville
Sunrise Montessori	Bountiful
Adelaide School	Bountiful
H C Burton School	Kaysville
Centerville Jr High	Centerville
Centerville School	Centerville
Farmington School	Farmington
Holbrook School	Bountiful
J A Taylor School	Centerville
Leo J Muir School	Bountiful
Monte Vista School	Farmington
Oak Hills School	Bountiful
Orchard School	North Salt Lake
Tolman School	Bountiful
Transition High	Farmington
Weber Basin Job Corps	Ogden
Stewart School	Centerville
Morgan School	Kaysville
East Layton School	East Layton
Farmington Jr High	Farmington
Mueller Park Jr High	Bountiful
Reading School	Centerville

Table 7-5 Critical Facilities in Liquefaction Areas

Name	City
Communication Facility	
KANN 1120	Roy
KWLW 700	North Salt Lake City
KWLW 700	North Salt Lake City
KSGO 1600	Centerville
Waste Water Facility	
Central Davis County Sewer District	Kaysville
North Davis County Sewer District	Syracuse
South Davis Sewer Improvement District N	West Bountiful
Oil Facility	
Big West Oil Company	N Salt Lake
Chevron USA Products Company	Salt Lake City
Cowboy Asphalt Terminal	Woods Cross
K West Formerly Golden Eagle Refinery	Woods Cross
Phillips 66 Company	Woods Cross
Silver Eagle Refining-Woods Cross Inc	Woods Cross
Electric Power Facility	
Bountiful City Light & Power	Bountiful
Medical Facility	
Davis Hospital & Medical Ctr	Layton
Benchmark Behavioral Systems	Woods Cross
Fire Station	
Syracuse City Fire Dept	Syracuse
Clinton City Fire Dept	Clearfield
Layton Fire Dept	Layton
West Point Fire Dept	Clearfield
Farmington City Fire Dept	Farmington
Sunset Fire Dept	Clearfield
Clearfield Fire Dept	Clearfield
Police Station	
Woods Cross Police	Woods Cross
Syracuse City Police Dept	Syracuse
Clinton City Police Dept	Clearfield
Centerville Police Dept	Centerville
Clearfield Police Dept	Clearfield
West Bountiful Police Dept	Woods Cross
Kaysville Police Dept	Kaysville

West Point City Police Dept	Farmington
Farmington Police Dept	Farmington
Sunset Police Dept	Clearfield
Schools	
Benchmark School	Woods Cross
Kinder Care	Centerville
School Of St Peter	Clearfield
T.L.C. Preschool And Kindergarten	Layton
Northridge High	Layton
Bountiful Jr High	Bountiful
H C Burton School	Kaysville
Centerville Jr High	Centerville
Centerville School	Centerville
Central Davis Jr High	Layton
Clearfield High	Clearfield
Clinton School	Clinton
Crestview School	Layton
Davis High	Kaysville
Pioneer Adult Rehab Center	Clearfield
Doxey School	Sunset
King School	Layton
Farmington School	Farmington
Fremont School	Sunset
Hill Field School	Clearfield
J A Taylor School	Centerville
Kaysville Jr High	Kaysville
Kaysville School	Kaysville
Layton High	Layton
Layton School	Layton
Lincoln School	Layton
Meadowbrook School	Bountiful
Monte Vista School	Farmington
North Davis Jr High	Clearfield
North Layton Jr High	Layton
Woods Cross School	Woods Cross
South Clearfield School	Clearfield
Sunset Jr High	Sunset
Sunset School	Sunset
Syracuse School	Syracuse
Tolman School	Bountiful
Viewmont High	Bountiful
Wasatch School	Clearfield
West Bountiful School	West Bountiful
West Point School	West Point
Whitesides School	Layton

Fairfield Jr High	Kaysville
Windridge School	Kaysville
Lifeline	N Salt Lake
Davis Jr High	Kaysville
Farmington Bay Youth Ctr	Farmington
Transition High	Farmington
Clearfield Job Corps	Clearfield
Trident School (Drug & Alcohol)	Layton
Arrow High (Yic)	Clearfield
Creekside School	Kaysville
Bluff Ridge School	Syracuse
Lakeside School	West Point
Stewart School	Centerville
Quest Program (Yic)	Layton
Cook School	Syracuse
Morgan School	Kaysville
East Layton School	East Layton
Holt School	Clearfield
Knowlton School	Farmington
Columbia School	Kaysville
Farmington Jr High	Farmington
Adams School	Layton
Reading School	Centerville
Mountain High	Kaysville
Young Parents	Kaysville
Syracuse Jr High	Syracuse
Antelope School	Clearfield
West Clinton School	Clinton
Emergency Center	
Civil Defense	Farmington

Table 7-6 Infrastructure in Earthquake Area

Item	**Length (Miles)**	**Replacement Cost**
Local Roads	5.31	$10,617,200
State Highways	14.84	$35,811,996
US Highways	10.10	$24,373,695
US Interstates	9.68	$34,863,840
Power Lines	26.24	$1,266,867
Gas Lines	15.03	$3,628,092

Table 7-7 Infrastructure in Liquefaction Area

Item	Length (Miles)	Replacement Cost
Local Roads	18.03	$36,060,000
State Highways	64.77	$156,320,464
US Highways	9.56	$23,068,233
US Interstates	25.55	$91,962,000
Power Lines	265.51	$12,818,823
Gas Lines	41.89	$10,111,827

HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 7-8 identifies the probable casualties during an earthquake.

Table 7-8 Casualties

Casualties	Nighttime –Minor	3,402
	Nighttime –Major	95
	Nighttime -Fatalities	183
	Daytime –Minor	3,718
	Daytime –Major	146
	Daytime- Fatalities	281
	Commute –Minor	3,549
	Commute –Major	129
	Commute-Fatalities	243

Building Damage by Count
Building damage is classified by HAZUS in five damage states: none, slight, moderate, extensive and complete. Table 7-9 lists the number of buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 7-10 identifies the critical facilities that would be affected by an earthquake.

Table 7-9 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	4,343
Commercial	485
Industrial	62
Totals	44,344*

*****Includes all building categories with moderate to complete damage

Table 7-10 Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	3	3	0	0
Schools	91	86	0	0
EOCs	1	0	0	1
Police Stations	14	12	0	0
Fire Stations	11	9	0	0

Debris Removal
Table 7-11 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 7-11 Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	2
Loads (25 tons per load)	80,000

Fire Following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 7-12 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 7-12 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	26
People Displaced	698
Value Exposed (mill. $)	34

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

Please refer to Map 7.1.1 titled, Davis County Earthquake Hazard located in section H. This map identifies earthquake epicenter and fault zone locations atop a shaded relief base map to help distinguish topography. Map 7.1.2 identifies liquefaction potential for Davis County and is also found in section H.

2. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

Description of Location and Extent

Historically, the greatest flood risk within Davis County has been associated with cloudburst storms that generally result in flash flooding in localized areas. Heavy rain and rapid snowpack melt can also result in unusually heavy water, and/ or mud and debris flows. Davis County's precipitation is associated with the Wasatch Mountain Range, which is where most of the County's surface water originates. All of the streams originate in canyons and pass along alluvial fans, across the eastern portion of the county into the Great Salt Lake.

The two major rivers that pose a flood threat include the Weber and Jordan Rivers. The Weber River acts as a partial northern county boundary, while the Jordan River is the southern boundary. Many smaller tributaries also pose a flood threat, however, they are not mapped through the NFIP. Many channels within the county can pose a threat due to channel constrictions from debris and could result in residential flooding. All of the alluvial fans in the county have been well developed or on being developed and therefore potential residential and commercial flooding is imminent. Flood can also pose a threat to the agricultural lands that are on the lower portions of the alluvial fans.

A little more than 50% of the county is under the Great Salt Lake. This results in a very high ground water table for the county and poses a flooding threat to the shorelines and in some cases to agricultural lands and roads. Flooding in wetlands areas, along the shores of the Great Salt Lake, also threatens urban development.

High stream flows and velocity can affect the residential, commercial, and recreational development on Farmington Creek, Kays Creek, Ricks Creek, and Steeds Creek. Roads can be affected from high stream flows on Barton Creek, and Holmes Creek. The primary threatened utilities are power substations and water treatment plant located on Stone Creek, Farmington Creek, Holmes Creek, and Millcreek. In 1983 Rudd Creek experienced a debris flow that put the city of Farmington on the contaminated water supply list.

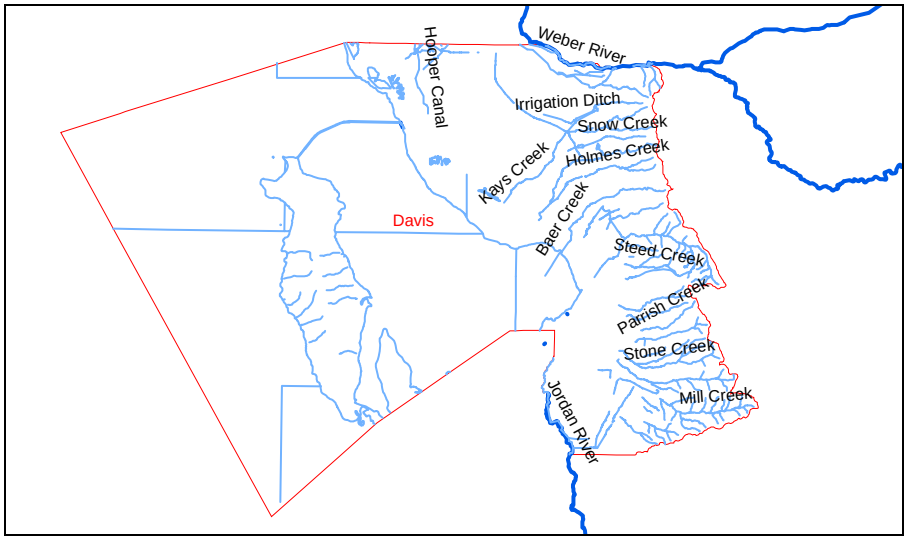
County flood control has a number of projects in progress and planned for the next few years. These are in existing creek beds throughout the county. They spend over $1 million yearly in maintenance and new projects.

Vulnerability Assessment

At this time, a Vulnerability Assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county.

However, current mapping projects are being completed by the State that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included. A Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003, this study can be found in Appendix G. Also, refer to the "Centerville City Pre-Disaster Flood Hazard Mitigation Plan" for an idea of the flood hazard issues and mitigation activities for Centerville City.

Figure 7-6



3. Wildfire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

Potential wildfire hazard within Davis County is growing as population growth is spreading into wildland areas known as URWIN zone where the threat is most severe. Over the past 30 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property. Most fires can be contained in a quarter-acre to one-acre area if they have not traveled into the wildland zones higher in the mountains, which are harder to fight due to steep mountain terrain.

The wildfire threat in Davis County in the past has had a significant affect on the watersheds, including slope failure, debris flows, and other forms of erosion. State and local agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect watersheds.

Wildfire maps were created using GIS and can be viewed in Section H Map 7.3.1Davis County Wildfire Risk. The map layers were provided by DESHS and show five categories of wildfire risk:

- Extreme
- High
- Medium
- Low
- Very Low

These ratings cover all of Davis County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included (Table 7-13). There are no critical facilities in Davis County that are located in the Wildfire risk areas of extreme, high, or medium. Table 7-14 lists infrastructure affected by wildfire, and Table 7-15 lists historical wildfires in Davis County.

Table 7-13 Structures and Population in Wildfire Area

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres in Moderate	Number of Structures within Wildfire Risk Area		Population in Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	
Bountiful City	8,014	53	123	2,330	148/ $123,900,000	1,398/ $310,808,250	2,860
Centerville City	3,796	7	20	51	7 / $4,000,000	79 / $16,551,180	252
Clearfield City	4,778	0	0	0	0	0	0
Clinton City	3,574	0	0	0	0	0	0
Farmington City	4,891	21	41	173	2/ $200,000	270 / $41,131,950	617
Fruit Heights	1,423	0	39	60	2/ $9,000,000	17 / $4,527,910	61
Kaysville	6,397	0	68	139	1 / $100,000	65 / $10,853,180	195
Layton	13,243	75	54	413	55 / $78,800,000	333/ $58,199,490	1,569
North Salt Lake	5,282	12	127	748	37 / $19,300,000	1137 / $227,959,440	3,124
South Weber	3,045	0	120	308	61/ $56,000,000	18 / $2,130,660	69
Sunset City	930	0	0	0	0	0	0
Syracuse City	5,432	0	0	0	0	0	0
West Bountiful	1,399	0	0	0	0	0	0
West Point	4,368	0	0	0	0	0	0
Woods Cross	2,194	0	0	0	0	0	0

Table 7-14 Infrastructure in Wildfire Area

Item	Length (Miles)	Replacement Cost
Local Roads	1.17	$2,330,600
State Highways	1.03	$2,488,319
US Highways	1.81	$4,372,538
US Interstates	3.61	$12,990,600
Power Lines	7.94	$383,343
Gas Lines	9.29	$2,242,513

Table 7-15 Wildfire History

Date	Fire Name	Cause	Size
6/14/84	Antelope # 1	Lightning	300 – 999 Acres
6/9/90	Antelope Island # 1	Lightning	1000 – 4999 Acres
6/24/90	Antelope Island # 2	Lightning	>5000 Acres
7/14/91	Antelope # 1	Lightning	1000 – 4999 Acres
6/4/94	Buffalo Point	Incendiary	1000 – 4999 Acres
7/6/01	Aisp4	Lightning	1000 – 4999 Acres

4. Landslide/ Slope Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

Future landslide areas are usually located in the areas of historical landslides, which are well defined, localized areas. Historically landslides have been one of the most naturally re-occurring hazards within Davis County found along canyon benches. The homes in these areas have the greatest risk of rockfalls, debris flows, landslides, and other types of slope failure.

Debris flows associated with ground saturation and runoff has been a major problem in Davis County. Many of the alluvial fans at the mouths of Davis County's fifteen canyons have been developed. This development is vulnerable due to the debris flows and flash flooding associated with the alluvial fans. Ten of the fifteen canyons have enforced structural mitigation through the use of debris and detention basins. The protected canyons include Mill Creek- 2 debris basins, Barton Creek -1 debris basin, Stone Creek – 1 debris basin, Parish Creek –1 debris basin, Ricks Creek -1 debris basin, Steed Creek –1 debris basin, Farmington Creek -1 debris basin, Shepherd Creek -1 debris basin, Baer Canyon - 1debris basin, South Fork of Holmes Creek - 1debris basin. The unprotected canyons include Deuel Creek, Barnard Creek, Davis Creek, Snow Canyon, North, South, and Middle Forks of Kays Creeks. Many homes are built on alluvial fans and the need for more detention basins and the upgrade of existing basins is needed.

Davis County and local jurisdictions recognized the need to protect alluvial fans from slope failure. Davis County has made progress in the past by becoming Utah's first Project Impact Community to help mitigate the Centerville Canyon alluvial fan and Barnyard Creek alluvial fan.

Landslide in Layton. Picture provided by American Geological Institute.

Vulnerability Assessment
The number of residential structures contained within the landslide hazard risk may capture more or less structures than are actually at risk from landslides. In order to accurately capture landslide risks in these areas an assessment has been conducted using parcel data that identifies the people and property at risk including critical facilities (Table 7-16 and 7-17). Table 7-18 lists infrastructure affected by landslide and includes estimated replacement costs.

Refer to the Landslide Map 7.4.1 titled, Davis County Landslide Hazard at the end of this section for historical events and locations.

Table 7-16 Inventory of Properties Located in High Landslide Risk Areas

City Name	City Area (Acres)	Within Landslide Area		Number of property structures within Landslide Area	
		Acres	Population	Commercial/ Annual Sales	Residential/ Replacement Value
Bountiful City	8,014	1,345	6,659	87 / $53,900,000	1,925 / $338,578,680
Centerville City	3,796	95	431	3 / $800,000	67 / $8,073,230
Clearfield City	4,778	0	0	0	0
Clinton City	3,574	0	0	0	0
Farmington City	4,891	3,016	5,676	137 / $316,100,000	1,666 / $199,841,910
Fruit Heights	1,423	15	0	0	0
Kaysville	6,397	375	100	1 / $500,000	25 / $3,824,930
Layton	13,243	596	2,308	14 / $7,700,000	252 / $36,184,640
North Salt Lake	5,282	1,403	439	130/ $574,100,000	103 / $15,856,120
South Weber	3,045	537	1,324	8 / $3,900,000	18 / $2,188,590
Sunset City	930	0	0	0	0
Syracuse City	5,432	0	0	0	0
West Bountiful	1,399	0	21	0	0
West Point	4,368	0	0	0	0
Woods Cross	2,194	1,254	1,903	111 / $125,300,000	994 / $95,600,220

Table 7-17 Critical Facilities within Landslide Risk Areas

Name	City
Oil Facility	
Cowboy Asphalt Terminal	Woods Cross
K West Formerly Golden Eagle Refinery	Woods Cross
Police Department	
West Point City Police Department	West Point
Schools	
Centerville School	Centerville
Farmington School	Farmington
Oak Hills School	Bountiful
Farmington Bay Youth Ctr	Farmington
Knowlton School	Farmington
Mueller Park Jr High	Bountiful
Emergency Center	
Civil Defense Emergency Center	Farmington

Table 7-18 Infrastructure and Landslide Area

Item	Length (Miles)	Replacement Cost
Local Roads	0.80	$1,600,200
State Highways	9.37	$22,611,599
US Highways	2.32	$5,597,631
US Interstates	2.71	$9,744,840
Power Lines	5.40	$260,712
Gas Lines	11.95	$2,884,611

F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Included in Table 7-19 are hazard events with as much relevant information as was available including date, location, area impacted, and damage costs.

Table 7-19 Hazard History

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Avalanche	01/25/1860	Centerville Canyon		One death
Flooding	08/13/1923	Farmington Canyon	Lagoon Resort was flooded. Farmington Canyon road was destroyed.	Farming land was destroyed, residential property and roads covered in mud
Avalanche	01/01/1939	Farmington Canyon		One death
Avalanche	01/31/1939	Farmington Canyon		One death
Tornado	05/27/1941		Farmington Canyon towards Morgan County	F2. $4,000-$5,000 in damage.
Flooding	08/05/1948	Bountiful	Flooding in business and residential areas.	Thousands of dollars of residential damage.
Tornado	06/05/1953			F1
Flooding	08/1-2/1953	Clearfield	Streets and homes flooded	
Flooding	08/04/1954	Bountiful		Damage to residential property.
Earthquake	05/12/1955	Centerville		Richter magnitude 4.3
Flooding	05/20/1957	Bountiful/ Farmington	Stone Creek	Homes flooded from high water.
Flooding	08/25/1961	Bountiful	US 91 covered with water and debris.	Streets and homes flooded.
Flooding	06/01/1963	Farmington		Cloudburst storm flooded homes and streets.
Tornado	06/03/1963	Bountiful		F2. At least $20,000 in damage.
Earthquake	06/20/1963	Kaysville		Richter magnitude 3.0
Flooding	06/24/1969	Bountiful		Business losses and orchard losses.
Tornado	06/10/1970		Between Centerville and Farmington	F1
Lightning	07/11/1976	Hill Air Force Base		One death.

Flooding	1983-1984	Statewide		Major damage to all infrastructure.
Waterspout	08/15/1987			
Tornado	05/11/1989		Runway of Hill Air Force Base	F0
Waterspout	11/26/1989			
Tornado	09/23/1992	Syracuse		F1. $1500 in damage.
Tornado	06/02/1993	North Salt Lake		F1. Two injuries. $15000 in damage.
Tornado	07/29/1995	Centerville		F0. More than $10000 in damage.
Tornado	05/29/1996	Syracuse		F0. Minor residential damage.
Tornado	05/21/1998	West Point		F0. No injuries.
Tornado	06/04/1998	Layton		F1. Over $25000 in damage.
Landslide	2001	Heather Drive		Destroyed six homes. Over $1 million in damage.

G. Mitigation Goals, Objectives, Actions

Davis County Emergency Management
Brian Law
Emergency Services Coordinator

County: Davis
Address: 20 East State Street
City: Farmington
Zip Code: 84025

Point of Contact: Sgt. Brian Law
Email: brianlaw@co.davis.ut.us

Signature: _____
County/Tribal Emergency Management Director

Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group

Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name: Brian Law Title: County Emergency Services Coordinator
Name: Dave Adamson Title: Public Works Director – Davis County
Name: Dustin Lewis Title: Centerville City Emergency Services
Name: John Thacker Title: Kaysville City Manager
Name: Walt Hokanson Title: Farmington City Public Works
Name: Norm Whitaker Title: West Point City Public Works
Name: Anne Blankenship Title: Woods Cross City Emergency Services
Name: Farrell Cook Title: West Point City Councilman
Name: John Massengale Title: South Weber City Councilman
Name: Jim Mason Title: Layton City Emergency Services

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s)

Attach additional information as needed.

Date: 11-20-2003
Time: 1000 hours
Place: Davis County Sheriff's Office

Purpose of Meeting:
Determine Projects for Pre-Disaster Mitigation in Davis County

Name: Brian Law Title: County Emergency Services Coordinator
Name: Floyd Peterson Title: Fire Chief – Clinton City
Name: Larry Gregory Title: Fire Chief – Farmington City
Name: Lt. Kirk Middaugh Title: Section 3 Commander – DPS/UHP
Name: Dave Adamson Title: Public Works Director – Davis County
Name: Lt. Paul Child Title: Centerville City Emergency Services
Name: Dustin Lewis Title: Centerville City Emergency Services

Name: John Thacker	Title: Kaysville City Manager
Name: Walt Hokanson	Title: Farmington City Public Works
Name: Bret Millburn	Title: Red Cross
Name: Norm Whitaker	Title: West Point City Public Works
Name: John Mabey	Title: Utah – Amateur Radio Emergency Services
Name: Anne Blankenship	Title: Woods Cross City Emergency Services
Name: Farrell Cook	Title: West Point City Councilman
Name: John Massengale	Title: South Weber City Councilman
Name: Jim Mason	Title: Layton City Emergency Services

Summary of Meeting:
The five hazard areas determined to require most mitigation at this time are: Earthquake, Wildfire, Flooding, Landslide, and Severe Weather. Ideas were given as to projects that could be launched to mitigate loss of life and property within each of these areas. General goals were established for each category.

Outcome(s) of Meeting:
A pre-disaster mitigation plan will be established using the information obtained from the meeting mentioned above. When funding allows, projects will be ensued.

Develop Mitigation Goals and Objectives

Developing strong mitigation goals and objectives are crucial in the planning process and future mitigation project funding. In coordination with the Regional AOG planner(s), and your County/Tribal PDM Working Group, list your County's/Tribal/Region mitigation strategies using the following format:

Note: Countywide in this document refers to a mitigation strategy benefiting the cities of: Bountiful, Centerville, Clearfield, Clinton, Farmington, Fruit Heights, Kaysville, Layton, North Salt Lake, South Weber, Sunset, Syracuse, West Bountiful, West Point, and Woods Cross.

Hazard: Earthquake

Problem Identification:
Davis County is located in the heart of the Wasatch Fault between the shores of the Great Salt Lake and the foothills of the Wasatch Mountain Range. The majority of the population lives within 5 miles of the fault. The only major traffic artery running north and south, and numerous water and petroleum pipelines either cross over or run within ½ mile of the fault. 5 moderately sized petroleum refineries located in the south end of the county are subject to severe damage from ground movement and liquefaction. A major earthquake in the area would result in 100's of millions of dollars in damage to residential structures, industry, and of critical infrastructure, not to mention some loss of life.

Goal #1:
Reduce loss of life and limit damage to property.

Objective 1.1: Priority HIGH
Provide education on seismic hazards and mitigation, to Davis County residents and homeowners.

Action:
Public Education
Time Frame: Immediate
Funding: LEPC
Estimated Cost: $2500.00
Staff: LEPC Membership
Jurisdictions: Countywide
Background: Provide information to residents and business owners to encourage them to take appropriate measures to make homes and businesses less susceptible to damage from

ground shaking. Education pertaining to earthquakes will be part of a holistic natural hazards education program, including wildfires, flooding, sever weather, and landslides.

Objective 1.2: Priority MEDIUM
Increase quality and quantity of available natural hazards data to facilitate better decision-making.

Action:
Update fault zone and liquefaction maps for the county
Time frame: Two years
Funding: Undetermined, potentially USGS or UGS
Estimated Cost: Minimal
Staff: USGS Staff
Jurisdictions: Countywide
Background: Provide updated, detailed maps to city and county planning groups, emergency managers, and public to assist them in making educated decisions by understanding earthquake danger zones.

Problem Identification:
A number of critical structures, which contain fire apparatus within the county do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. These building exist in Clinton, South Weber and Layton.

Goal #2:
Protect emergency response capabilities and critical facilities.

Objective 2.1: Priority HIGH
Provide fire department with building that meet current construction codes, ensuring response capability of fire apparatus and personnel after an earthquake.

Action:
Retrofit or construct new fire department buildings
Time Frame: 4 Years
Funding: Grants and city budgets
Estimated Cost: $8 million
Staff: Contract
Jurisdictions: Countywide, targeting Clinton City, South Weber, and Layton City.
Background: Refer to "Clinton City Fire Station Structural Analysis" for more information regarding the vulnerability assessment of the Clinton City fire station.

Hazard: Wildland Fire

Problem Identification:
Much of the inhabitable land within Davis County is on the east bench. Numerous homes and subdivisions have been and are being constructed in these areas. Many of these structures border the Forest Service boundary or are in areas of old scrub oak growth. The potential for catastrophic damage from wildfire increases yearly.

Goal #1
Reduce or eliminate the threat of a wildfire, resulting in loss of life and property.

Objective 1.1: Priority HIGH
Increase the level of wildfire knowledge for home and business owners in the Urban Wildland Interface area.

Action:

Public awareness and education

Time Frame: Immediate
Funding: LEPC
Estimated Cost: $0
Staff: LEPC membership, UFFSL, National Forest Service
Jurisdictions: Targeting county URWIN communities
Background: This project is part of a holistic natural hazard education campaign within Davis County. Wildfire education will instruct on the principles of defensible space in coordination with the Utah Living With Fire Committee. Homeowners in the foothills abutting the Wasatch National Forest, along with other identified URWIN communities will be targeted.

Action:
Provide wildfire training to city and county planning and zoning officials and staff.

Time frame: Immediate
Funding: LEPC
Estimated Cost: $0
Staff: LEPC membership, UFFSL, DES, National Forest Service.
Jurisdictions: Countywide
Background: City and county planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.

Problem Identification:
In much of the county, there is little, if any, natural break between wildland Forest Service areas and residential areas. There are some old roads and "fire breaks" that are in ill repair, or have not been maintained for years. They have become ineffective as fire breaks and hazardous to fire apparatus.

Goal #2
Fuel modification within prioritized watersheds.

Objective 2.1: Priority HIGH
Re-establish effective firebreaks.

Action:
Widen and stabilize the firebreak between Farmington Canyon and Bountiful.

Time Frame: Immediate
Funding: Grant, County budget, and Forest Service
Estimated Cost: $200,000
Staff: County Public Works, Wasatch National Forest staff
Jurisdictions: Farmington, Bountiful, Centerville and unincorporated county developments along the Wasatch National Forest Boundary.
Background: This project is already in the planning stage. As funding is confirmed the project will commence.

Action:
Widen and stabilize the firebreak north of Farmington Canyon to the Weber River.

Time frame: 2 Years
Funding: Grants, County Budget, and Forest Service
Estimated Cost: $500,000
Staff: County Public Works, Wasatch National Forest staff.
Jurisdictions: Farmington, Fruit Heights, and unincorporated county development along the Wasatch National Forest Boundary.
Background: This area is considerably longer, but is almost entirely within existing forest service boundaries. This may result in a less aggressive project; however, some widening and stabilization can be accomplished.

Hazard: Flooding

Problem Identification:
The potential for flooding due to spring runoff, and especially from summer thunderstorms, is high in certain areas of the county. Existing flood plain maps do not indicate areas of flooding potential that exist, in large part due to development, that are not near creeks and the Great Salt Lake. Also not addressed is are the Weber Basin Irrigation Water Aqueduct and canals that are a potential source of flooding.

Goal #1
Reduce or eliminate loss of life and property damage due to flooding.

Objective 1.1: Priority HIGH
Increase the level of understanding in homeowners through education programs.

Action:
Public education and awareness.
Time Frame: Immediate
Funding: LEPC
Estimated Cost: $0
Staff: LEPC Membership
Jurisdictions: Countywide
Background: This information and awareness campaign will be part of a holistic education campaign addressing the all-natural hazards, which will include all Davis County residents.

Objective 2.1: Priority HIGH
Reduce loss of life and property damage due to flooding by providing current building code and NFIP maps to cities.

Action:
Encourage city planners to update building codes.
Time Frame: Immediate
Funding: None
Estimated Cost: 0
Staff: LEPC members
Jurisdictions: Countywide
Background: There is evidence that not all cities in the county use updated code information concerning building of home and other structures in areas prone to flooding.

Action:
Update the county flood plain maps and include contour lines.
Time frame: One year
Funding: Federal Grants
Estimated Cost: Unknown
Staff: State DES, county personnel
Jurisdictions: Countywide
Background: Based on federal funding State DES in planning to start a flood plain map revision and update process this coming year. With cooperation from the county, we will request contour lines be added to these maps to give a realistic idea of where flooding may occur in other than historically flooded areas.

Objective 2.2: Priority MEDIUM
Lessen the impacts of flood damage caused by irrigation canal failure.

Action:
Inspect irrigation canals.
Time frame: 3 Years
Funding: Weber Basin Water District, Federal Grants
Estimated Cost:
Staff: Weber Basin Water District, Contractors
Jurisdictions: Communities with in Davis County down slope from Weber Basin Irrigation pipeline
Background: Aging agriculture irrigation canals are prevalent throughout Davis county. As farming lands is converted to residential and businesses the farming infrastructure remains, supplying water to remaining farmers. The canals can break inundating down slope property.

Hazard: Landslide
Problem Identification:
The east bench of Davis County is home to numerous canyons, large and small. They were, of course, formed over thousands of years by debris flows and mudslides. Now, many hundreds of homes and other structures, pipeline, power lines, and roadways have been constructed on top of or through the alluvial fans produced by these events. Nature is not done constructing these canyons. Landslides and debris flows will continue to occur over time, thus threatening residents and critical infrastructure.

Goal 1
Avoid risk or exposure to landslides through informed planning and zoning decisions.

Objective 1.1: Priority HIGH
Educating planning commissions.

Action:
Provide city-planning commissions with information concerning landslides and debris flows.
Time Frame: One Year
Funding: None
Estimated Cost: 0
Staff: LEPC members
Jurisdictions: Countywide

Action:
Encourage cities to adopt a standard of requiring geo-technical studies in identified landslide and debris flow areas.
Time frame: One Year
Funding: None
Estimated Cost: 0
Staff: LEPC members
Jurisdictions: Countywide
Background: The Utah Geologic Survey will review geology reports submitted to counties and cities when requested. Additional the UGS can aid in writing geologic hazard ordinances. The city of Layton in Davis County has adopted geologic ordinances.

Problem Identification:
There are a number of canyons that do not currently have debris basin constructed to contain debris flows. Others are insufficient in size. These need to be built or reconstructed in order to provide protection to residents. In addition, Weber Basin Water District maintains a large irrigation pipeline running from the mouth of Weber Canyon to east Bountiful. Any event that caused a break in the line would result in massive flooding due to the fact that there are no valves in the system.

Goal 2
Reduce or eliminate landslide damage due to debris flows.

Objective 2.1: Priority MEDIUM
Reduce loss of life and damage to property by providing a means to control debris and water from debris flows.

Action:
Construct additional Debris Basins and retrofit others.
Time Frame: 5 Years
Funding: Federal grants, County funding, City funding
Estimated Cost: $10 million
Staff: County public works, city public works, contractors
Jurisdictions: Countywide developments and future developments on alluvial fans in Davis County.
Background: Barnard Creek and other projects yet to be determined.

Objective 2.2: Priority MEDIUM
Lessen the impacts of flood damage caused by irrigation canal failure.

Action:
Place check valves in the Weber Basin irrigation pipeline.
Time frame: 3 Years
Funding: Weber Basin Water District, Federal Grants
Estimated Cost: $400,000
Staff: Weber Basin Water District, Contractors
Jurisdictions: Communities with in Davis County down slope from Weber Basin Irrigation pipeline
Background: Placing valves at strategic locations that can be automatically shut in the event of a break would result in less flood damage.

Hazard: Severe Weather

Problem Identification:
Most presidential disaster declarations are the result to severe weather. Davis County is prone to the affects of severe weather as are many other counties in the state. These are usually thunderstorms and snowstorms. However, we are also prone to extremely severe wind events referred to as "East Winds." Historically, Davis County has experienced gusts of over 110 mph and sustained winds of 80+ mph. These can result in millions of dollars in damage. On average we experience at least one every year. Severe storms result in secondary and tertiary problems mostly dealing with power, heating and travel. Davis County has only one main north/south roadway thru the county. Severe weather has resulted and will continue to result in serious travel problems, as well as power and heating difficulties.

Goal 1
Assist residents protect themselves from the affects of severe weather.

Objective 1.1: Priority HIGH

Action:
Have all cities in the county participate in the Storm Ready program.
Time Frame: 1Year
Funding: City and county budgets
Estimated Cost: 1000.00
Staff: City and county Emergency Managers
Jurisdictions: Countywide

Background: Set up within the county emergency management and encourage all cities to participate, all requirements of the National Weather Service Storm Ready program.

Action:
Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Davis County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Problem Identification:
As mentioned above, high winds can result in serious problems throughout the county. Communications for emergency responders have been severely hampered in the past by damage to communication infrastructure.

Goal 2
Ensure severe weather communication

Objective 2.1: Priority MEDIUM
Harden communications capabilities to ensure post event functionality.

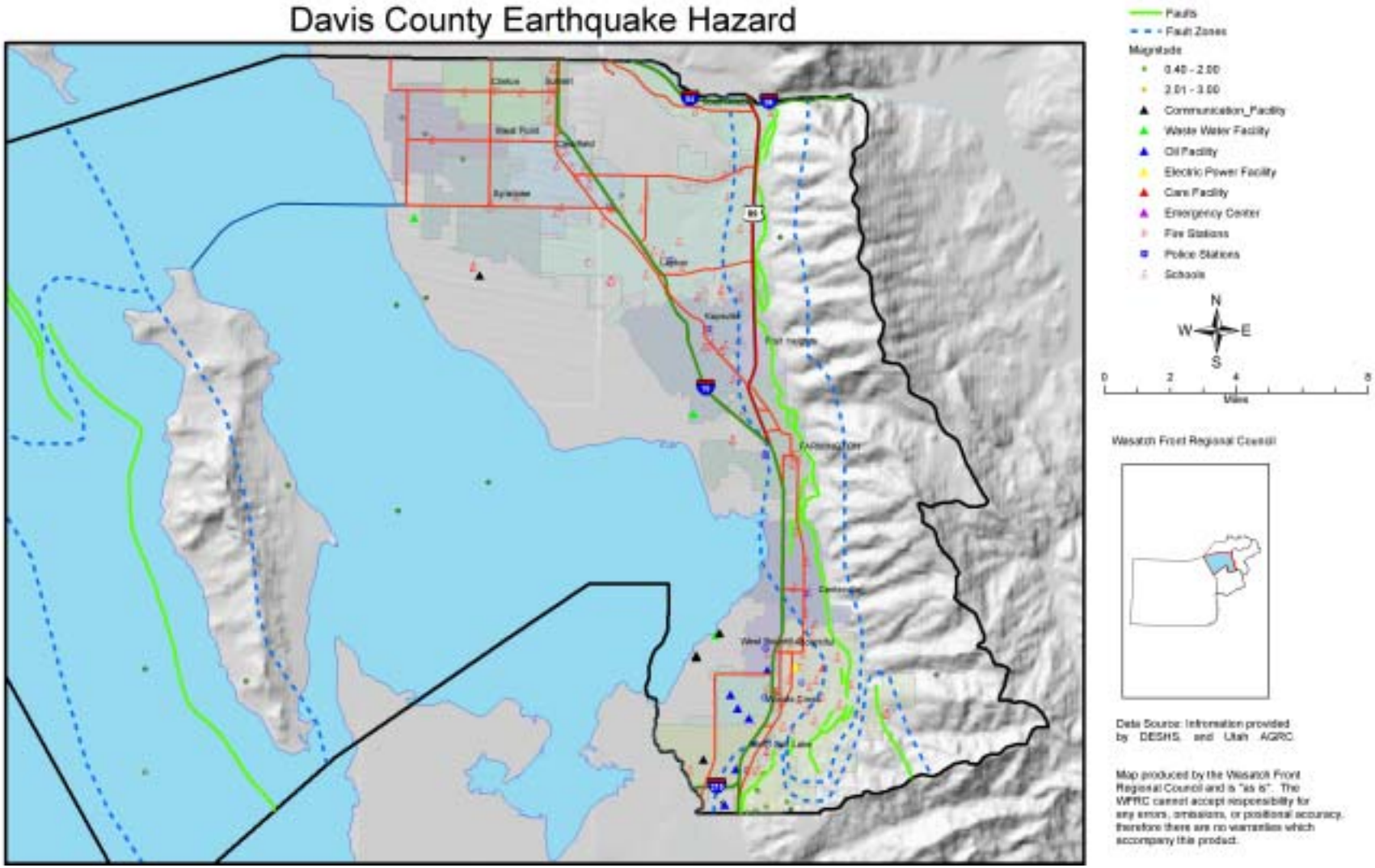
Action:
Reinforce towers and infrastructure
Time Frame: 2 Years
Funding: To be determined
Estimated Cost: To be determined
Staff: UCAN, city and county personnel
Jurisdictions: Countywide

Action:
Establish alert and notification procedures/system to notify emergency responders, flood control, and emergency managers.
Time frame: 1 Year
Funding: None
Estimated Cost: 0
Staff: Emergency Management
Jurisdictions: Countywide
Background: Set up alert and notification groups within UNIS and City Watch.

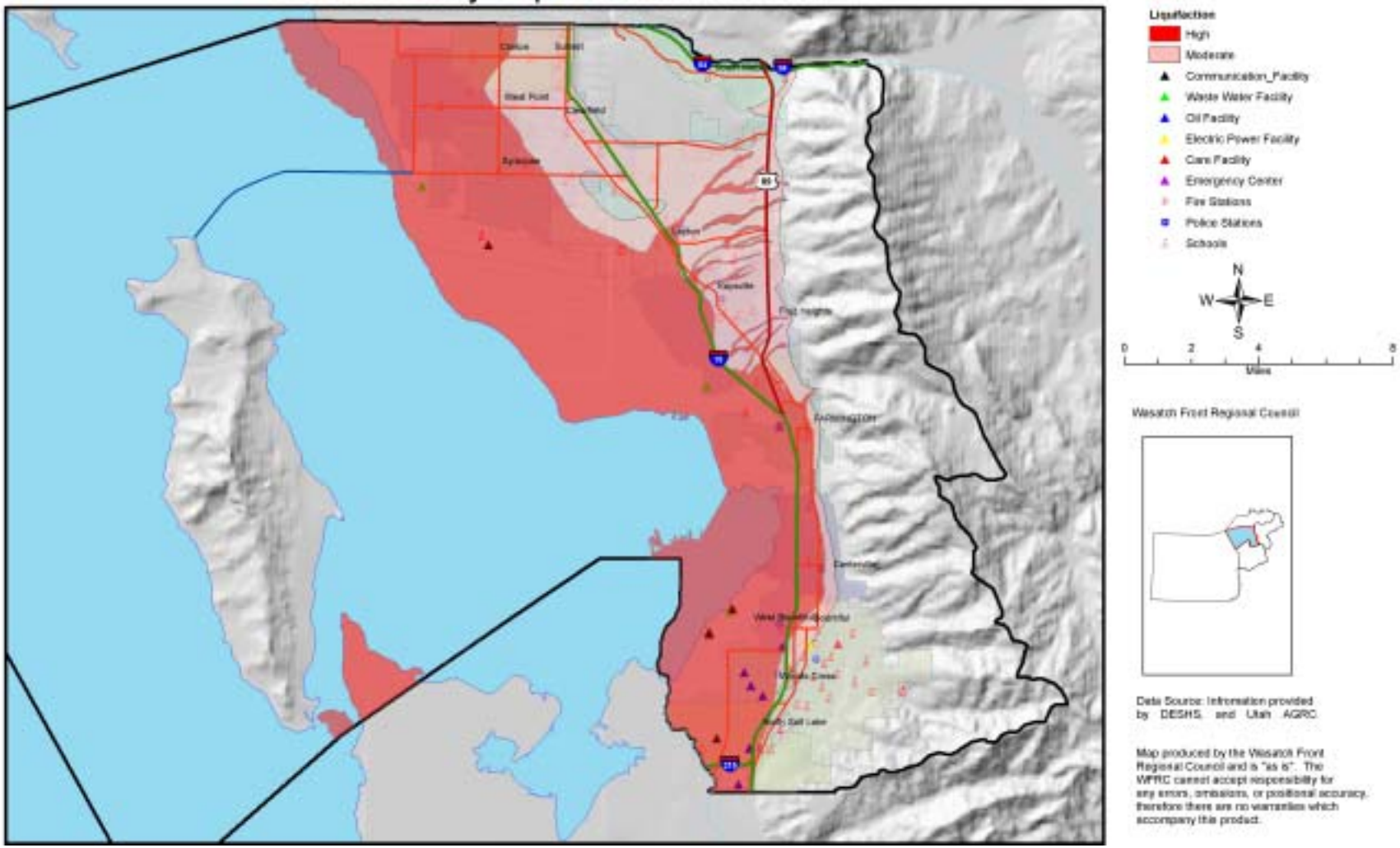
H. Mapping

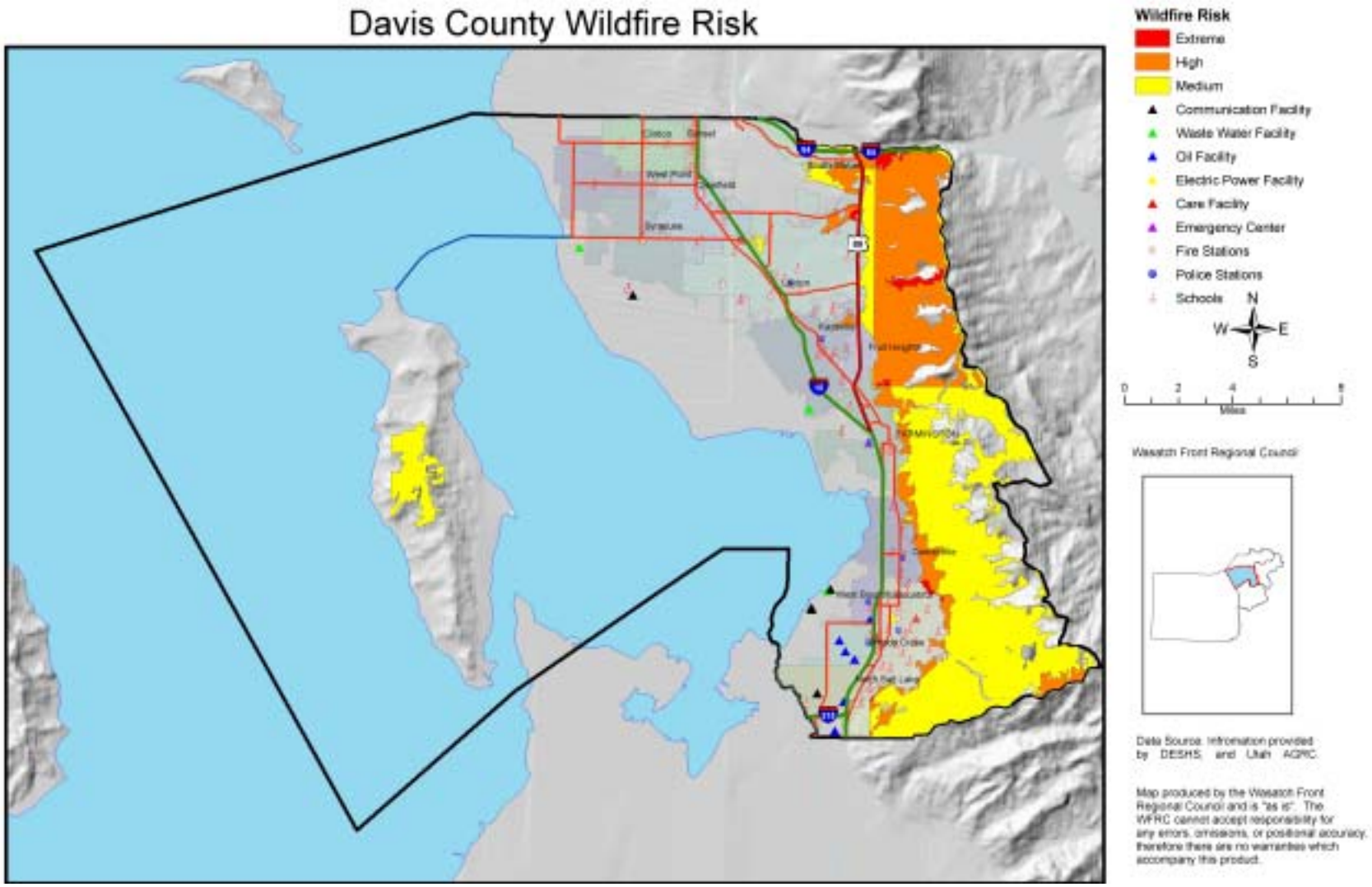
All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.
Map 7.1.1 Davis County Earthquake Hazard

Map 7.1.2 Davis County Liquefaction Potential
Map 7.3.1 Davis County Wildfire Risk
Map 7.4.1 Davis County Landslide Hazard

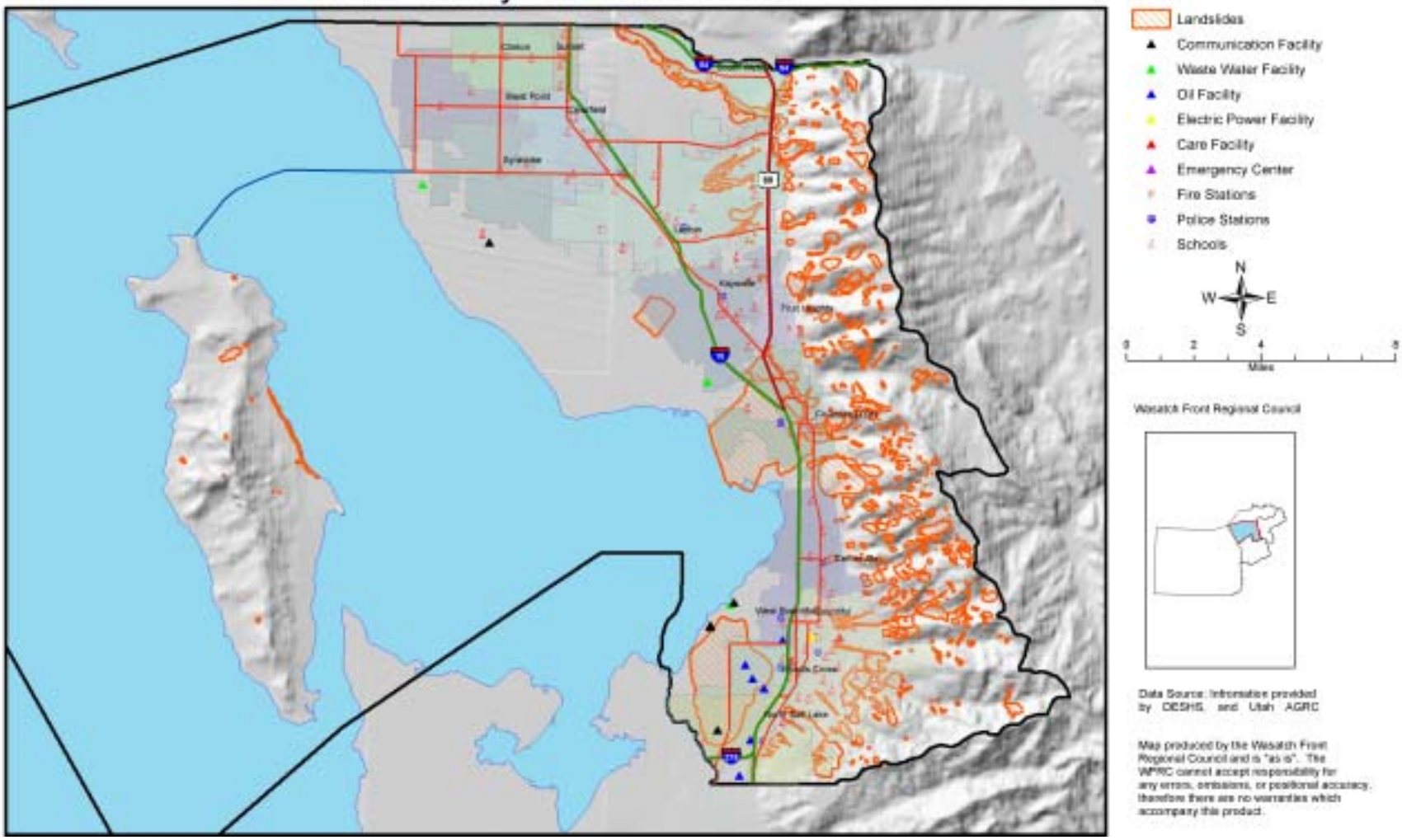

Davis County Earthquake Hazard
Faults
Fault Zones
Magnitude
0.40 - 2.00
2.01 - 3.00
Communication_Facility
Waste Water Facility
Oil Facility
Electric Power Facility
Care Facility
Emergency Center
Fire Stations
Police Stations
Schools
N
W
E
S
0
2
4
8
Miles
Wasatch Front Regional Council
Data Source: Information provided by DESHS and Utah AGRC.
Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Davis County Liquefaction Potential




Davis County Wildfire Risk
Wildfire Risk
Extreme
High
Medium
Communication Facility
Waste Water Facility
Oil Facility
Electric Power Facility
Care Facility
Emergency Center
Fire Stations
Police Stations
Schools
N
W
E
S
0
2
4
8
Miles
Wasatch Front Regional Council
Data Source: Information provided by DESHS and Utah AGRC.
Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Davis County Landslide Hazard



Part VIII. Morgan County

Morgan County includes one municipality Morgan City, the county seat, and thirteen unincorporated areas, Como Springs, Croydon, Devils Slide, Enterprise, Littleton, Milton, Mountain Green, Peterson, Porterville, Richville, Stoddard, Taggarts, and Whites Crossing. The main entrance into the county is through Weber Canyon, which opens on both the east and northwest sides of the county. Thirteen tributaries flow into the Weber River from east to west in Weber Canyon. Two dams are located within the county boundaries, East Canyon and Lost Creek. Morgan County is the third smallest county in Utah with 610 square miles. The landscape is made up of high mountains, steppe valleys, one main river valley, the Weber River, and two smaller river valleys, East Canyon and Lost Creek, as well as farming and grazing lands. Morgan City and Mountain Green are the most populated areas. Elevation ranges from 4,895 feet above sea level at Mountain Green to 5,052 feet above sea level at Morgan City to Durst Mountain in the north with 9,284 feet above sea level and Francis Peak to the west with 9,547 above sea level (Morgan County Emergency Operations Plan). The highest point is Thursten Peak at 9,706 feet above sea level.

A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. An overview of Morgan counties population from Census 2000 data is presented in the table below (Table 8-1).

Table 8-1 Morgan County Population Growth

Census Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Morgan County	5,528	7,129	1,601	29.0%	2.6	22	19	11	11

Population by County and Multi-County

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
Wasatch Front	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Morgan County	4,917	5,528	7,129	7,506	8,329	9,250	9,981	11,312	1.55%

Households by County and Multi-County

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Morgan County	1,355	1,555	2,046	2,258	2,679	3,100	3,437	4,037	2.29%

Average Household Size by County and Multi-County District

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Morgan County	3.63	3.55	3.48	3.32	3.11	2.98	2.90	2.80	-0.72%

Percent of State Total by County and Multi-County District

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Morgan County	0.34%	0.32%	0.32%	0.30%	0.30%	0.30%	0.30%	0.30%	-0.21%

Household Percent of State Total by County and Multi-County District

MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Morgan County	0.30%	0.29%	0.29%	0.28%	0.29%	0.30%	0.30%	0.31%	0.15%

Source: Bureau of the Census, 2002 Baseline Projections, and Utah Population Estimates Committee. Governor's Office of Planning and Budget. 1980 and 1990 populations are April 1 U.S. Census modified age, race and sex (MARS) populations; 2000 populations, household sizes and households are April 1 U.S. Census summary file 1 (SF1) populations; all others are July 1 populations. Note AARC is average annual rate of change.

B. Economy

Agriculture, mainly livestock and crop productions, has been the main type of economic activity in Morgan County, along with producing mink pelts. Recently, manufacturing, trade, government, and construction have begun to diversify the economy. Because of Morgan County's close proximity to Salt Lake and Davis County the population is increasing rapidly. The principle employer is Hill Air Force Base (Morgan County Emergency Operations Plan). Some of the largest employers include Morgan County School District, Holnam, Inc., Browning, IGA Grocery, Morgan County, and Wilkinson Construction Company.

The 2001 labor force totaled 3,580 with 3,450 employed and 130 unemployed. In 2001 the per capita income was $22,708 and the average monthly non-farm wage was $2,133 and non-farm jobs were $1,636. In 2001 the top labor force entities included Government, Trade/ Transportation/ Utilities, Construction, and Manufacturing. Total wages in 2001 for the county was $41.9 million. Total personal income in 2001 was $165.7 million.

C. Transportation and Commuting Patterns

Interstate 84 (I-84) is the major east-west highway that passes through the middle part of the county. Year 2000 average daily traffic volume on I-84 was 10,881. State Route 167 is a minor artery that runs north-south along the western portion of the county. In year 2000 SR. 167 had an average daily traffic volume of 1,620. State Rout 65 runs north-south form Henefer thru the southwestern edge of the county into Salt Lake County and has 1,045 average daily traffic users. Other north-south routes include Route 1972 with average daily traffic volume of 4,130, and State Route 66 with an average daily traffic volume of 1,795. Route 3978 in western Morgan is a highly used short route with the average daily traffic volume of 4,120.

D. Land Use

Morgan County consists of 609 square miles of with the following ownership categories; 90% private, 5% federal, 3% state, .27% underwater. Morgan County has the largest percentage of privately owned land in the state. The Wasatch National Forest extends into the north side of the county. Summit County is on the eastern border and Davis County is on the western border.

Morgan County's population is expected to continue to grow along the Interstate 84 corridor, with the highest concentration of new development being in the southern portion of the county. Development is occurring in areas that once were agricultural or farmland. Morgan County prides itself in its rural setting and the county codes and ordinances for planned development recognize that.

Wildfire risk is most severe in the forested areas of the county. These areas known as URWIN zones are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. A couple ways to mitigation this threat is to encourage communities to become "Fire Wise Communities", continue to require building and zoning codes, and increase the public's awareness.

Flooding is another threat near several rivers that run through the county. Special attention should be given to new and existing development in these areas where the potential for flooding is high.

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Morgan County can be found in Section G

E. Risk Assessment

The risk assessment process revealed the following for the identified hazards of earthquake, flood, dam failure, wildland fire, severe weather, and drought. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and are included at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 8 critical facilities in Morgan County, none of which are located within the hazard boundaries of the mapped hazards. Refer to Appendix D for the complete list of critical facilities for the county.

1. Earthquake

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Western Portion along the Intermountain Seismic Belt will probably be the most affected. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

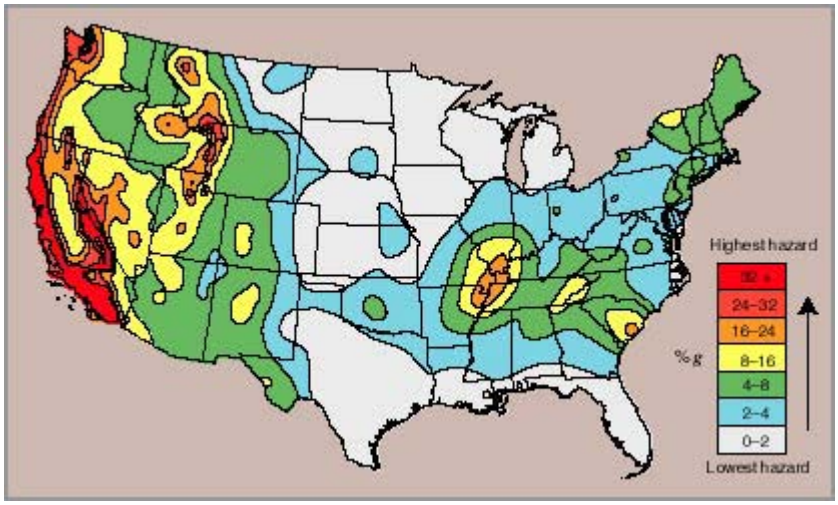
In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. Morgan County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment.

The combined average repeat time for large earthquakes on any of the five central segments (Brigham city, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. Earthquakes on any of the five central segments occurred from 620 to 2120 years ago. On the Salt Lake City segment the probability has been estimated as high as 57 percent in 100 years.

The Weber Segment runs from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years, making it one of the most active fault segments. The Weber County Segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county. The Salt Lake Segment underlies the Salt Lake valley.

Smaller fault zones also pose a threat to Morgan City, which include East Canyon, Devils Slide, and Lost Creek. The seismic hazard expressed by the United States Geological Survey has identified Utah as having a moderate to high hazard rating (Figure 8-3).

Figure 8-3 Probabilistic Seismic Hazard Map



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website. Table 8-2 identifies ground motion hazard values and Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These are expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years.

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 40.70000 Lat and –69.3999 Long

For a more detailed explanation of values used and metadata refer to the USGS Earthquake Hazards Program website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage.

Table 8-2 Earthquake Probabilistic Hazard- Ground Motion Values

	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
Morgan City 41:02:33 Lat 111:40:58 Long			
PGA	1.185282	1.876706	3.364873
0.2 sec SA	3.071537	4.911353	8.239317
0.3 sec SA	2.615407	4.318761	7.573781
1.0 sec SA	1.136439	1.954272	3.781307

Vulnerability Analysis

The vulnerability analysis for Morgan County identifies the number of people and property that could be affected by an Earthquake including property type and numbers, building values, and infrastructure. These values are presented in Table 8-3, and 8-4.

Table 8-3 Inventory of Properties Located within Earthquake Fault Zones

City Name	City Area	Acres in Fault Zone	Population within Fault Zone	Number of property structures within Fault Zones	
				Residential /Replacement Value	Commercial /Annual Sales
Morgan City	1,935	499	359	122/ $22,909,160	8/ $1,200,000
Unincorporated Morgan County	387,825	13,486	453	100/ $187,780,000	4/ $1,000,000

Table 8-4 Infrastructure affected by earthquake

Item	Length (Miles)	Replacement Cost
Local Roads	7.04	$14,084,000
State Highways	4.79	$11,551,735
US Highways	0.00	$0
US Interstates	2.04	$7,327,440
Power Lines	9.91	$478,455
Gas Lines	1.73	$417,605

HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 8-5 identifies the probable casualties during an earthquake.

Table 8-5 Casualties

Casualties	Nighttime –Minor	38
	Nighttime –Major	1
	Nighttime -Fatalities	2
	Daytime –Minor	40
	Daytime –Major	1
	Daytime- Fatalities	3
	Commute –Minor	44
	Commute –Major	1
	Commute-Fatalities	3

Building Damage by Count
HAZUS MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 8-6 lists the number of buildings by occupancy, which are estimated to have moderate to complete levels of damage. Table 8-7 identifies the critical facilities that would be damaged.

Table 8-6 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	47
Commercial	8
Industrial	4
Totals	828*

*****Includes all building categories with moderate to complete damage

Table 8-7 Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	0	0	0	0
Schools	3	0	0	0
Emergency Operations Centers	0	0	0	0
Police Stations	1	0	0	1
Fire Stations	2	0	0	0

Debris Removal
Table 8-8 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 8-8 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	33
Loads (25 tons per load)	1,320

Fire following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 8-9 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 8-9 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	1
People Displaced	0
Value Exposed (mill. $)	0

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

Please refer to Map 8.1.1 titled Morgan County Earthquake Hazard located in Section H that displays earthquake epicenter and fault zone locations atop a shaded relief base map to help distinguish topography.

2. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Weber River and its tributaries.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

Description of Location and Extent

Flooding in Morgan County has been mainly associated with heavy rainfall from cloudburst storms; however rapid snowpack melt can cause flooding and flash flooding in the county as well. Historical events suggest that these events would pose the most threat to the county.

Precipitation in Morgan County is mainly attributed to the Wasatch Front Mountain Range. Unusually heavy rain and snowpack can result in flooding, mud, debris flows, and avalanches on steep slopes near the foothills.

The Weber River and its tributaries (East Canyon Creek, Lost Creek, Hardscrabble, Deep Creek, and Peterson Creek) pose the most significant flood threat to the county (Figure 8-4). Lost Creek has experienced flooding in the past due mainly to bridges obstructed with debris. Gordon Creek has also experienced flooding in the past. The problem at Gordon Creek is due to the perched channel that causes surface flooding. Sewer and water lines cross the Weber River and the spring flooding of 1983 caused the sewer line to break. The sewer line is now encased with concrete so should not pose a problem in the future. If Morgan County experienced another flood event similar to the one of 1952 and 1983-1984 the Como Bridge could potentially fail due to age. If a 50 or 100 year flood event were to occur, Deep Creek would experience overbank flooding. Agricultural flooding is also of concern because of the amount of farmlands.

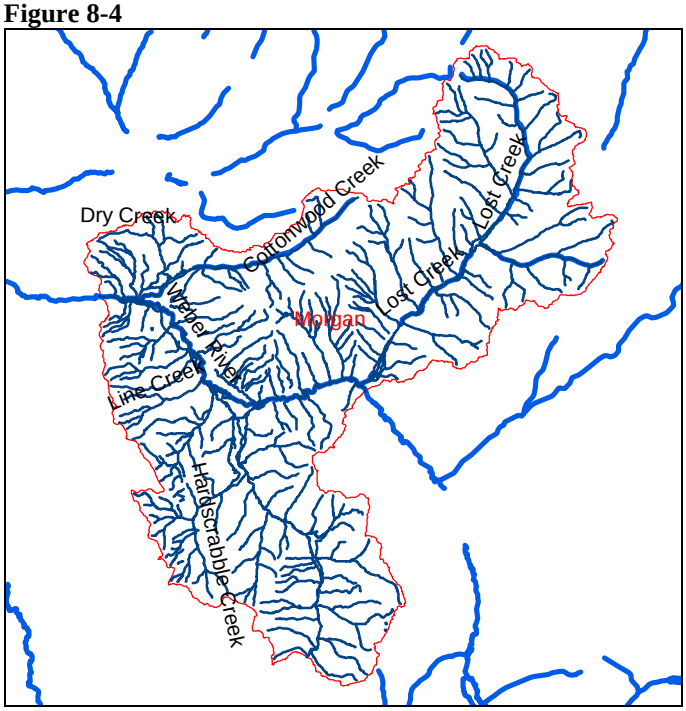
Island Road along East Canyon Creek, Richfield, Highlands, and Mountain Green between I-84 and the old highway could experience residential and commercial flooding. Morgan High, Junior, Middle and Morgan County Elementary Schools are all located in the floodplain, as is the entire city of Morgan.

Vulnerability Assessment

At this time, a vulnerability assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county. The lack of digital data combined with the large population inhibited flood vulnerability losses. While there is a flood risk in Morgan County the planning team felt that the time required to complete a flood vulnerability assessment could be better utilized. However, current mapping projects are being completed by the state that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included and can be found in Appendix C.

As a result of the lack of digitized data and flood maps the flood portion of this plan is deficient. A way to help with this deficiency the WFRC contracted with the Utah Army Corps of Engineers to complete a flood hazard identification study for the unmapped county or those areas mapped as a zone D, this study can be found in Appendix G.

Figure 8-4



3. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the southeastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

Description of Location and Extent

Twenty-one dams are located in Morgan County. Four of which are listed as a high hazard threat, meaning if they fail they have a high probability of causing loss of life and extensive economic loss. Three dams are listed as a moderate hazard threat meaning if they fail they have a low probability of causing loss of life but would cause appreciable property damage and mitigation efforts should be developed and pursued. Twelve dams have a low hazard threat, if they were to fail there would be a minimal threat to life and economic losses would be minor and the damage would be limited to the owner of the dam, however they should still be monitored.

It should be noted that Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Vulnerability Assessment

A vulnerability assessment for dam failure was difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. Some of the critical facilities were identified that were within the inundation areas for each of the high hazard dams and these facilities are listed in Table 8-10. However, due to the lack of digitized dam inundation maps potential loss estimates were unable to be identified. Refer to map 8.4.1 Morgan County Dam Hazard for dam locations and geographic extent.

Table 8-10 High Hazard Dam Inventory

East Canyon	
Owner	Department of Interior, Bureau of Reclamation
River	East Canyon Creek
Near City/ Distance	Morgan City/ 10.1
Year Completed	1966
Dam Length	436 ft
Dam Height	185 ft
Max Discharge	6200 cfs
Max Storage	58,350

Normal Storage	51,200
Surface Area	747
Drainage Area	145
Spill Type/ Width/ Volume	U/ 50/ 35,716
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	Portersville is downstream town, 7miles away. No digital copy of the EAP.

Wilkinson	
Owner	Max Wilkinson
River	Bohman Wash
Near City/ Distance	
Year Completed	1957
Dam Length	524
Dam Height	53
Max Discharge	1,384
Max Storage	353
Normal Storage	285
Surface Area	18
Drainage Area	3
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	Homes below dam. No identifiable critical facility in inundation zone

Northwest	
Owner	Northwest Irrigation Co
River	Cottonwood Creek
Near City/ Distance	Mountain Green/ 2
Year Completed	1940
Dam Length	800
Dam Height	36
Max Discharge	30
Max Storage	603
Normal Storage	523
Surface Area	25
Drainage Area	0
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

Lost Creek	
Owner	Department of Interior, Bureau of Reclamation
River	Lost Creek
Near City/ Distance	Devils Slide/ 12
Year Completed	1966
Dam Length	1,110 ft
Dam Height	173 ft
Max Discharge	2,455 cfs
Max Storage	26,760
Normal Storage	22,510
Surface Area	415
Drainage Area	123
Spill Type/ Width/ Volume	U/ 18/ 1,832,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No digital copy of the EAP.

4. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

Wildfire threat within the county is most considerable in the private rangeland and open farmland areas. The county does not have a serious URWIN threat because of lower resident numbers living in the foothills. However, this could change due to increased residential development.

Wildfire maps were created using GIS and can be viewed in Section H Map 8.4.1 Morgan County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Morgan County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed, and direction are not considered in this risk assessment.

Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included. Please refer to Table 8-11, 8-12,and 8-13 for population, structures, and infrastructure in wildfire areas.

There are no critical facilities located in extreme, high or moderate wildfire risk areas in Morgan County.

Table 8-11 Morgan City Wildfire Hazard

Morgan City				
Total Area of Municipality	**1935 Acres**	**Population in Hazard Area**	**Number of Structures in Hazard Area**	
			Residential/Replacement Cost	**Commercial/Annual Sales**
Acres Extreme	112	32	12 / $7,886,760	1 / $400,000
Acres High	156	100	30 / 563,340	No Known Risk
Acres Moderate	1	0	No Known Risk	No Known Risk

Table 8-12 Unincorporated Morgan County Wildfire Hazard

Unincorporated Morgan County (Total area 387,825 acres)				
	Acres	**Population in Hazard Area**	**Number of Structures in Hazard Area**	
			Residential/ Replacement Cost	**Commercial/ Annual Sales**
Acres Extreme	2,188	285	67 / $12,581,260	No Known Risk
Acres High	13,635	246	77 / 14,459,060	8 / $3,600,000
Acres Moderate	23,001	1,359	459 / $86,191,020	16 / $14,300,000

Table 8-13 Infrastructure affected by Wildfire

Item	**Length (Miles)**	**Replacement Cost**
Local Roads	4.66	$9,320,000
State Highways	4.74	$11,440,955
US Highways	0.00	$0
US Interstates	10.36	$37,312,560
Power Lines	36.65	$1,769,462
Gas Lines	0.00	$0

F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Hazard history events are listed in Table 8-14, and include as much relevant information as was available including date, location, areas impacted, and damage costs.

Table 8-14 Hazard History

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Tornado	June 5, 1953			F1. No injuries or deaths.
Flash Flood	July 18, 1954		Richville	Damage to farm equipment and property.
Earthquake	June 25, 1955	Morgan		Richter magnitude 3.7
Flood	August 16, 1958	Weber Canyon	Yence Hollow above Round Valley	10 inches in 1 hour. Damage to property in the northern portion of the town and to US 30-5.
Earthquake	May 11, 1965		12 miles NE of Morgan	Richter 4.1
Earthquake	September 2, 1967		South of Huntsville	Richter 3.0
Earthquake	April 16, 1972		Near Devil's Slide	Richter 3.5
Lightning	July 24, 1981	Morgan City	Near golf course.	1death.
Wildfire	July 26, 1988		"Blue Fork Range" fire	Caused by lightning. 300-999 Acres.
Wildfire	July 4, 1992		"Redrock Canyon" fire	Caused by campfire. 1000-4999 Acres.
Wildfire	July 23, 1992		"Pioneer" fire	Caused by campfire. 1000-4999 Acres.
Wildfire	August 1, 1992		"Deseret/ Spring Canyon" fire	Caused by lightning. 1000-4999 Acres.
Wildfire	July 28, 1994		"Trappers Loop" fire	Caused by lightning. 300-999 Acres.
Wildfire	September 6, 1994		"Lost Creek Dam Camp" fire	Caused by lighting. 300-999 Acres.
Wildfire	August 28, 1996		"Mormon Trail" fire	Caused by equipment. 300-999 Acres.
Wildfire	August 30, 1997		"Cottonwood Fire"	Caused by Incendiary. 300-999 Acres.

G. Mitigation Goals, Objectives, and Actions

Morgan County's Emergency Management Department
Terry Turner
Emergency Management Director

Attend PDM Planning Meetings with County Planner(s).

Date: 11/14/2003
Time: 1:00 pm
Place: Morgan Fire Station

Purpose of Meeting:
To establish our Mitigation objectives and to begin our worksheets rough draft.

List of Attendees:
Terry Turner
Kimberli Turner

Summary of Meeting:
Established the following objectives (Flood, Earthquake, Severe Storms, Drought, Dam Failure)

Outcome(s) of Meeting:
Finalize worksheets rough draft to have ready for the Regional meeting on November 20th.

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s).

Date: 11/20/2003
Time: 2:30 pm
Place: Morgan Fire Station

Purpose of Meeting:
To Gather More Information On Our Mitigation Objectives.

List of Attendees:
Terry Turner
Kimberli Turner
LaNiece Dustman
Jim Boes

Summary of Meeting:
Went over our rough copy of the Mitigation plan. Discussed more detail on identifying the problem.

Outcome(s) of Meeting:
Have a final meeting with county engineer. Make changes that were suggested. Send in finished copies.

Attend PDM Planning Meetings with County Planner(s).

Date: 12/4/2003
Time: 3:00 pm

Place: County's Engineers' Office

Purpose of Meeting:
To have county engineer have a final check on the Pre-Mitigation Plan

List of Attendees:
Terry Turner
Kent Wilkerson

Summary of Meeting:
Went over final copy of worksheet objectives.

Outcome(s) of Meeting:
He agreed with the workbook and the final objectives.

*The term "countywide" in this document refers to mitigation strategies benefiting the City of Morgan and the communities; Stoddard, Peterson, Croydon, Mt. Green, Enterprise, Milton, Littleton, Richeville, and Porterville.

Hazard: **Flood**

Problem Identification:
Morgan County has two major rivers (East Canyon, Weber) that threaten communities during spring runoff.

Goal #1:
Lessen Impact from flooding.

Objective #1: Priority HIGH
To Reduce Flood Threat To Morgan County

Action #1:
Maintenance of channels and bridge openings
Time Frame: Immediate
Funding: Routine maintenance
Estimated Cost: Minimal
Staff: County Road Dept.
Background: Keep channels free of debris and clear out gravel bars, watch for constriction during high flow.

Action #2:
Work with Weber Basin to increase flood storage area
Time frame: Two-Three years
Funding: Undetermined/Potentially Grants
Estimated Cost: Undetermined dependant upon decided outcome
Staff: Emergency Management /Contract
Background: Work with Weber Basin to increase the percentage of area that is allotted for flood storage.

Action #3:
Advise Residents and Develop Outreach Materials on the Availability of Flood Insurance
Time Frame: Immediate
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management, County and Morgan City Floodplain Administrator, State Floodplain Manager

Background: Inform residents to the potential risk of flooding and advise them that flood insurance is available.

Goal #2:
Reduce threat of unstable canals throughout the county.

Objective #1: Priority MEDIUM
Identify countywide canal systems

Action #1:
Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: County and City Public Works, Canal Companies, County Engineering
Background: Private and Public canals are used for transportation and dispersion of water as well as flood control. They also represent a hazard to structures and infrastructures.

Hazard: Earthquake

Problem Identification:
Critical facilities (public safety, commercial buildings, schools) need to be made less vulnerable from the impact of earthquakes to allow a more timely response, and to decrease the impact to lives.

Goal #1:
Reduce Loss of Life and Damage to Property

Objective #1: Priority HIGH
Decrease the Negative Effect of Earthquakes Within the County

Action #1:
Begin an Earthquake awareness campaign to include awareness of availability of earthquake insurance
Time Frame: One – Two years
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management/Contract
Background: Work in conjunction with National Earthquake Awareness Week to put together a county awareness week.

Action #2:
Facilitate a Pre-Earthquake damage assessment. To evaluate retro fix critical facilities
Time Frame: Immediate – One year
Funding: County/ City
Estimated Cost: Moderate/Extensive
Staff: City – County Engineer's/Contract
Background: Inspect commercial buildings to see which ones are up to earthquake code.

Action #3:
Work with the county's businesses to ensure proper earthquake preparedness training
Time Frame: One – Five years
Funding: County / Grant
Estimated Cost: Minimal
Staff: Emergency Management / Contract

Background: Devise training schedule to ensure that all county businesses are properly trained.

Hazard: Dam Failure

Problem Identification:
Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.

Goal #1:
Reduce loss of life and limit damage to property.

Objective #1: Priority MEDIUM
To Increase Community Awareness of the (Federal, State and Private) Dam's That Will Impact The County

Action #1:
Educate community of evacuation routes
Time Frame: One – Two years
Funding: County
Estimated Cost: Minimal
Staff: Emergency Management
Background: Work with public media to inform the community of proper evacuation routes.

Action #2:
Improve Emergency Notification Systems/Public Awareness Dam Information
Time Frame: Over the next five years
Funding: Bureau of Reclamation
Estimated Cost: High/Extensive
Staff: Emergency Management/Bureau of Reclamation
Background: To work with the Bureau of Reclamation to install an early warning electronic notification system.

Action #3:
Improve Inundation Maps
Time Frame: Immediate
Funding: Bureau of Reclamation
Estimated Cost: Moderate
Staff: Emergency Management/Bureau of Reclamation
Background: Improve current maps and have them digitally formatted

Hazard: Drought

Problem Identification:
The residents' of Morgan County are unaware of the water conservation options that are available to them.

Goal #1:
Decrease the Impact of Drought On The Community.

Objective #1: Priority LOW
Develop and promote water conservation measures.

Action #1:

Promote water conservation utilizing Drought Contingency Plan
Timeframe: Immediate
Funding: County/Grant
Estimated Cost: Minimal
Staff: Emergency Management/Contract/Soil Conservation/Extension
Background: Join with the State's "Slow – The – Flow" campaign

Action #2:
Promote the use of the secondary water system
Timeframe: Immediate
Funding: Secondary Water Board
Estimated Cost: Minimal
Staff: Secondary Water Board / Emergency Management / City
Background: Work with the Secondary Water board and the city to improve the use of the new secondary water system.

Hazard: Severe Weather

Problem Identification:
Snowstorms, Hail, Thunderstorm/Lighting, Heavy Rain, Wind and Avalanche impact Morgan County. This is intensified by Morgan County's remote location.

Goal #1:
Assist residents protect themselves from the affects of severe weather.

Objective#1: Priority MEDIUM
Lessen The Impact of Severe Storms to Resident's and Businesses Within Morgan County

Action #1:
Increase residents' awareness of the need for food storage for use during severe storms.
Time Frame: One – Three years
Funding: County/Grants
Estimated Cost: Minimal
Staff: Emergency Management / Extension
Background: Use public media to increase the resident's awareness of the effect of severe storms and road closures could have on them and their families.

Action #2:
Increase residents' awareness of where emergency shelters are located
Time Frame: One – Three years
Funding: County/Grant
Estimated Cost: Minimal
Staff: Emergency Management/Contract
Background: Use public media to increase awareness of locations of shelters that are available.

Action #3:
Have all cities in the county participate in the Storm Ready program.
Time Frame: 1 Year
Funding: County t
Estimated Cost: Minimal
Staff: County Emergency Management, NWS, and State DESHS
Background: National Weather Service Storm Ready Program is a proven proactive severe weather mitigation activity.

Action #4:
Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: County Emergency Manager, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Morgan County. Most avalanche victims die in avalanches started by themselves or someone in there party. Therefore, education can limit the number of avalanche related searches each year.

Hazard: Wildfire

Problem Identification:
Continuing non-compliance with existing building codes and fire codes.

Goal #1:
Building and Fire Code Compliance

Objective #1: Priority HIGH
Increase compliance with existing building and fire codes.

Action #1:
Develop and enforce current local, state and national codes.

Time Frame: Ongoing
Funding: Local, state and federal grants
Estimated Cost: Unknown
Staff: Local, state and federal agencies
Background: Implement and enforce rules, regulations and codes

Goal #2:
Wildfire Community Education

Objective #1: Priority HIGH
Reduce overall risk from wild fire through education programs. Especially in the Mt. Green, Trappers Loop, area east of Porterville, and East Canyon.

Action #1:
Public awareness through "Fire Wise" programs.

Time Frame: 2-3 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL
Background: Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires, earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County fire department/district in the past have pushed wildland fire prevention and protection

techniques with success. Other fire department/districts have used door hangers discussing defensible space.

Action #2:
Provide wildfire training to city and county planning and zoning officials and staff.
Time frame: Immediate
Funding: Unknown
Estimated Cost: Unknown
Staff: UFFSL, DES, National Forest Service.
Background: County Planners need to understand issues related to wildland fire fighting, such as water and access, in order of properly plan for development of lands in the urban/wildland interface.

Hazard: Landslide

Problem Identification:
Morgan County has a significant threat of landslides. The community of Mt. Green and Trappers Loop Road (Highway 167) as well as critical pipeline routes can be impacted by landslides.

Goal #1:
Avoid risk or exposure to landslides through informed planning and zoning decisions.

Objective #1: Priority LOW
Educating planning commissions

Action #1:
Provide City and County Planning Commissions with information concerning landslides.
Time Frame: One – Two Year
Funding: None
Estimated Cost: None
Staff: County Engineer/UGS
Background: Decision-makers (Elected Officials) are critical in overall planning process and in the support of long-term natural hazard planning efforts.

Objective #2: Priority MEDIUM
Monitor historical landslide areas.

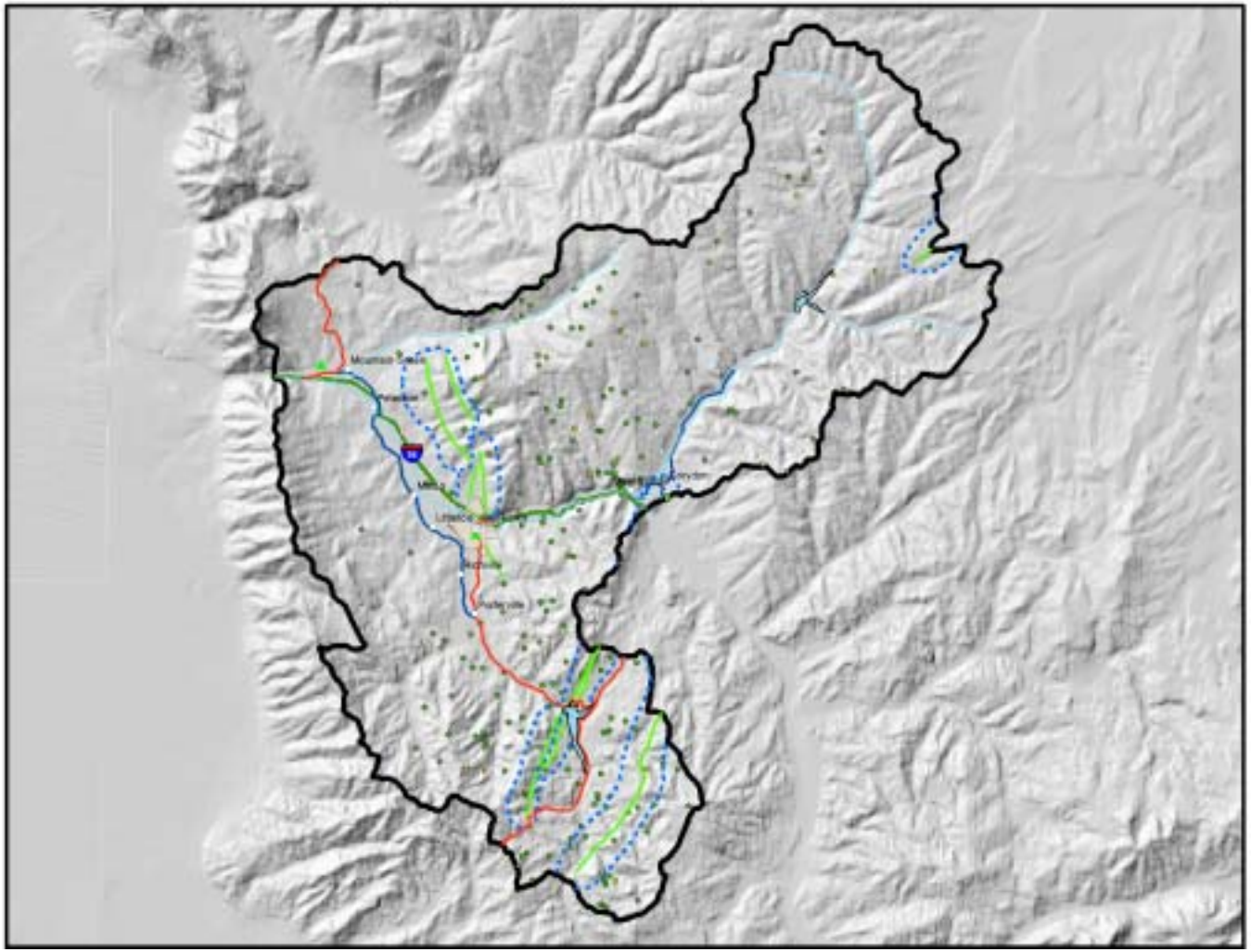
Action #1:
Evaluate current landslide maps to verify accuracy.
Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services, County Engineer, UGS, and USGS
Background: Currently available mapping on active landslides within Morgan County may not reflect accurately the risk on the ground.

H. Mapping

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 8.1.1 Earthquake Hazard
Map 8.4.1 Wildfire Hazard
Map 8.3.1 Dam Hazard

Morgan County Earthquake Hazard



Faults
Fault zones
Epicenters
0.40 - 2.00
2.01 - 3.00
Waste Water Facility
Police Station
Fire Station
School

N
W E
S

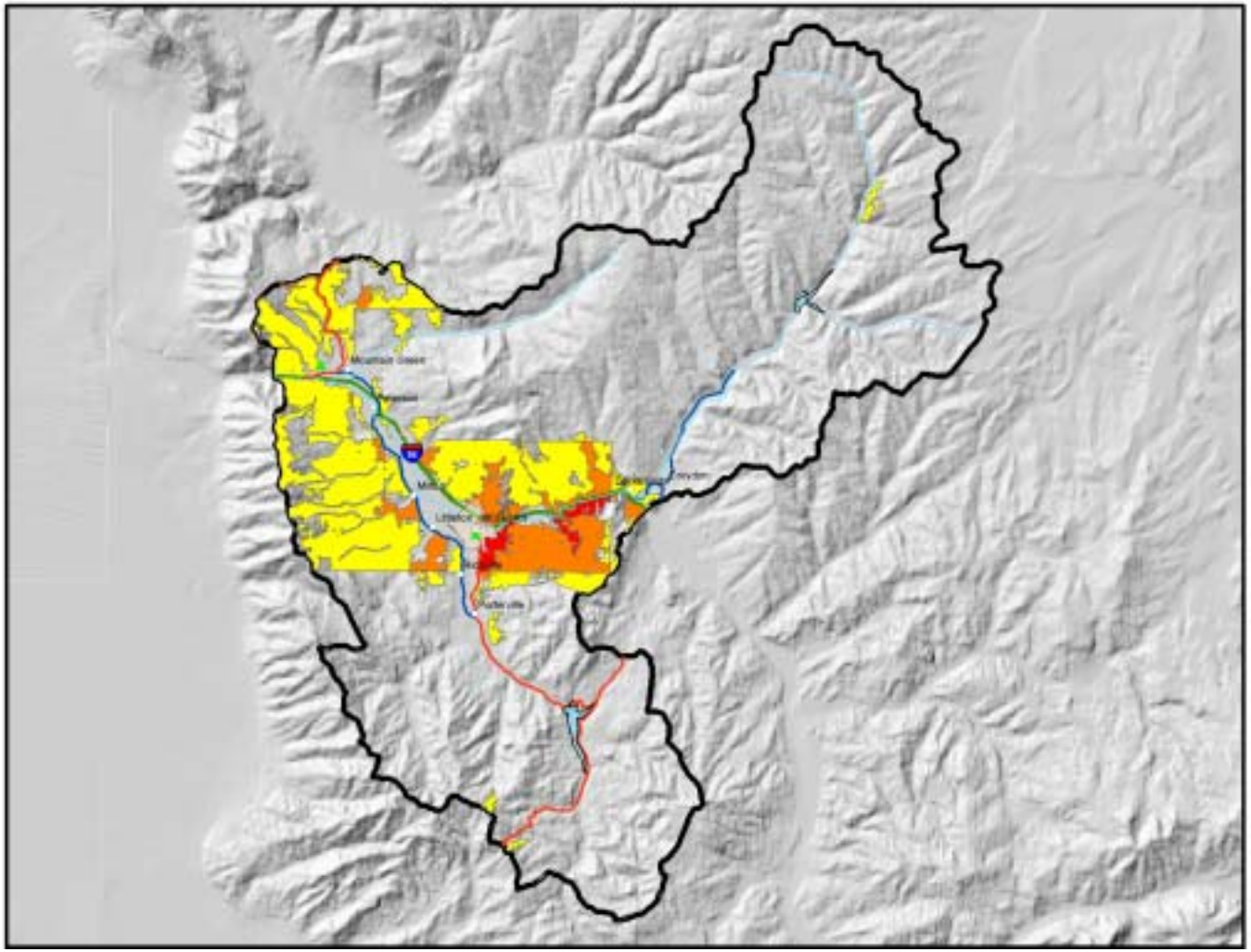
0 2.5 5 10
Miles

Wasatch Front Regional Council

Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Morgan County Wildfire Risk



Wildfire Risk

- Extreme
- High
- Medium
- Waste Water Facility
- Police Station
- Fire Station
- School

N
W E
S

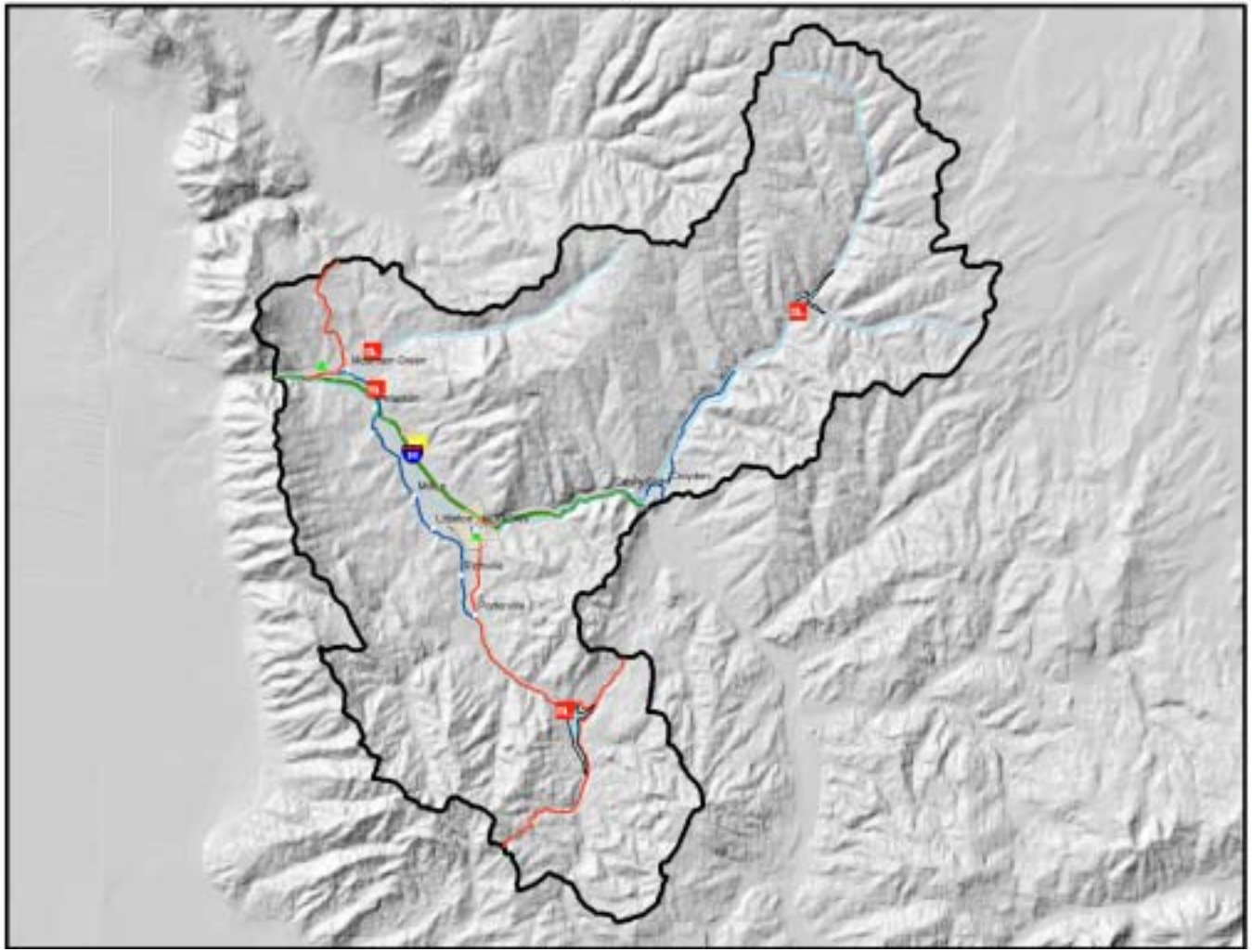
0 2.5 5 10
Miles

Wasatch Front Regional Council

Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Morgan County Dam Hazard



Dam Hazard

- HIGH - Possible loss of life
- MODERATE - Significant property loss
- LOW - Insignificant property loss
- Waste Water Facility
- Police Station
- Fire Station
- School

N
W E
S

0 2.5 5 10
Miles

Wasatch Front Regional Council

Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

Part IX. Salt Lake County

Within Salt Lake County are fifteen municipalities: Town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City.

A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. These figures include population projections into the year 2030 according to Census 2000 data (Table 9-1).

Table 9-1 Population

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Salt Lake County	725,956	898,387	172,431	23.8%	2.2	1	1	16	15

Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Salt Lake County	619,066	725,956	898,387	967,390	1,077,556	1,195,554	1,283,784	1,431,843	1.57%

Households by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Salt Lake County	201,742	240,367	295,141	326,570	371,312	418,735	458,906	528,491	1.96%

Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Salt Lake County	42.37%	42.14%	40.23%	39.25%	38.65%	38.24%	38.08%	37.96%	-0.19%

Household Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Salt Lake County	44.97%	44.74%	42.09%	41.19%	40.61%	40.28%	40.17%	39.95%	-0.17%

Average Household Size by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Salt Lake County	3.03	2.98	3.00	2.92	2.86	2.81	2.75	2.67	-0.39%

Source: Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change.

B. Economy

Salt Lake County is the backbone of Utah's economy making up 50% of the job market. The service's industry is the largest employment division within the county supplying 26% of the area's wages. Trade is the second major component and manufacturing is also an important income industry, almost matching government. The largest number of government-related employees is located in Salt Lake County (Table 9-2). Salt Lake is also a regional finance center, a health care center, and a high tech center. Refer to the following information provided by the Utah Department of Workforce Services (Figure 9-1, 9-2).

Table 9-2 Salt Lake County Employment 2000

Civilian Labor Force	**482,461**
Employed	468,130
Unemployed	14,332
Percent of Labor Force	3.0%
Total non-farm Jobs	**545,044**
Goods Production	94,676
Mining	2,797
Construction	34
Manufacturing	57
Service Production	450,368
Trans. Comm., Utilities	42,709
Trade	127,285
Wholesale	35
Retail	92
Fin., Ins., & Real Estate	40,970
Services	161
Government	77
Federal	8,611
State	33,950
Local	35,342

Figure 9-1 Demographics

Income and Wages

	1998	1999	2000	2001	2002p
Total Personal Income ($Millions)	22,091.0	23,195.2	24,851.7	25,665.7	N/A
Per Capita Income	25,051	26,029	27,587	28,188	N/A
Avg Family Income from IRS Returns	47,908	51,706	54,244	52,798	N/A
Average Monthly Nonfarm Wage	2,433	2,533	2,662	2,740	2,788

Source: U.S. Bureau of Economic Analysis, Utah State Tax Commission, Utah Department of Workforce Services.

Sales and Building

	1998	1999	2000	2001	2002
Gross Taxable Sales ($000s)	14,480,792	15,032,355	15,941,513	15,849,186	15,706,066
Permit Authorized Construction ($000)	1,465,718	1,403,778	1,421,173	1,389,799	1,141,988
New Residential Building Permits	6,416	5,286	4,666	5,429	5,406
Residential Build Permits Value ($000)	653,007	579,376	544,608	628,385	653,464

Source: Utah Tax Commission and University of Utah Bureau of Economic and Business Research.

Labor Force

	1998	1999	2000r	2001r	2002p
Labor Force	466,897	474,708	503,402	508,259	514,614
Employed	*451,165*	*458,549*	*488,550*	*486,456*	*482,260*
Unemployed	*15,732*	*16,159*	*14,852*	*21,803*	*32,354*
Rate	***3.4%***	***3.4%***	***3.0%***	***4.3%***	***6.3%***
Nonfarm Jobs	**519,499**	**531,329**	**545,153**	**544,714**	**533,810**
%Chng Prior Year	***3.0%***	***2.3%***	***2.6%***	***-0.1%***	***-2.0%***
Mining		2,235	2,336	2,171	1,877
Construction		34,199	34,636	33,755	30,552
Manufacturing		55,283	55,342	53,423	49,785
Trade/Trans/Utilities		114,010	118,505	119,204	115,894
Information		19,172	20,664	20,498	18,614
Financial Activities		39,797	41,268	43,764	43,768
Profess/Business Svcs		84,583	88,340	85,400	80,345
Ed/Health/Social Svcs		43,191	41,404	46,302	47,881
Leisure/Hospitality		42,741	43,923	43,821	45,909
Other Services		14,936	15,950	16,896	18,016
Government		81,182	82,785	79,480	81,087
Total Establishments	29,272	29,916	30,840	31,846	32,467
Total Wages ($Millions)	15.168	16.152	17.407	17.322	17,857

Source: Utah Department of Workforce Services, Workforce Information.

Figure 9-2 Salt Lake Counties Largest Employers

Establishment	Type of Business
University of Utah *	State Government
State of Utah	State Government
Granite School District	Local Government
Jordan School District	Local Government
Salt Lake County	Local Government
Novus Services	Credit Services
Delta Airlines	Air Transportation
LDS Hospital	Hospital
Salt Lake City School District	Local Government
Salt Lake City Corporation	Local Government
U.S. Postal Service	Federal Government
Salt Lake Community College	State Government
United Parcel Service	Courier Service
Smith's Food & Drug	Grocery Stores
Zion's First National Bank	Bank
Qwest	Communications
Albertson's	Grocery Stores
Convergys	Telemarketing
Primary Childrens Medical Center	Hospital
Dick Simon Trucking	Trucking
Physicians Network	Doctor's Offices
Unibase Data Entry	Data Processing
Communications & Commerce	Telemarketing
Cottonwood Hospital	Hospital
Snowbird **	Ski Resort
CR England	Trucking
St. Marks Hospital	Hospital
VA Medical Center	Federal Hospital
L3 Communications	Manufacturing
Utah Transit Authority	Transportation
Wal-Mart	Department Stores
SkyWest Airlines	Air Transportation
American Express	Credit Services

*Includes hospital
**Seasonal peak

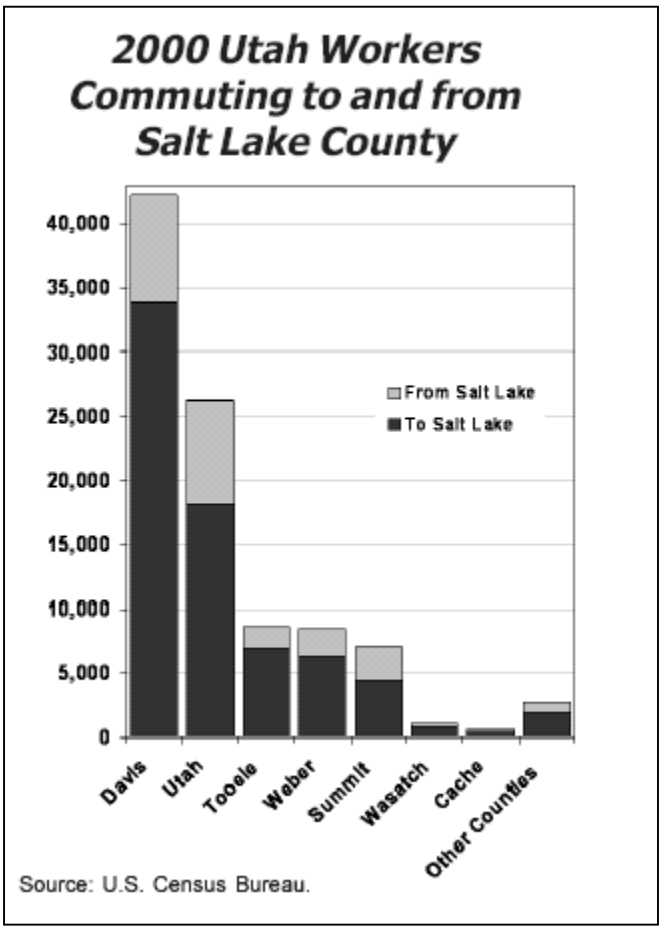
C. Transportation and Commuting Patterns

The main highways in Salt Lake County include Interstate 15, Interstate 80, and Interstate 215 (Table 9-3). The US Census bureau has created a chart that identifies the commuting patterns of the larger urban areas within the State. Most of the workers living outside Salt Lake County but in the surrounding counties of Weber, Davis, Tooele, and Morgan commute into Salt Lake County each day, this totals 73,203 workers (Figure 9-3).

Table 9-3 Major Artery Average Daily Traffic

Artery Name	North-South	Entering	East-West	Exiting
I-15	181,562	Northern Co. Border		Southern Co. Border
I-80			43,182	
I-215 (Total= 1,567,518)	65,278	From I-15	67,240	From I-80

Figure 9-3 Commuters



D. Land Use

Salt Lake County's land ownership is 72.8% Private, 20.4% Federal, 2.3% State, and 4.6% water. The county is ranked second in terms of the amount of private and local government ownership in the State of Utah.

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. According to the projections of the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 are based on individual city and county land use assumptions, a majority of the region is expected to be developed for residential uses. Local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County. Additional, smaller nodes of commercial and retail development are expected to be dispersed throughout urban and rural portions of Salt Lake County.

A significant portion of Salt Lake County is currently zoned for low-density residential development. Some higher densities are allowed in eastern Salt Lake City, while the southeast and southwest areas of Salt Lake County are zoned for lower housing densities. Industrial land uses are planned for west Salt Lake City, along the I-15 corridor, northern West Valley City, the western portion of North Salt Lake, and the west side of Salt Lake County. Areas for commercial land uses include concentrations in Salt Lake City's central business district and along primary transportation corridors including I-15, I-215, State Street, 400 South, Highland Drive, 3500 South, 4500 South and 7200 South. Additional commercial land use nodes are dispersed throughout Salt Lake County to serve adjoining residential communities. An extension of the existing transportation network will provide needed highway and transit service to newly developed land. As land use changes, so will the type and size of facilities needed to meet increased travel demand. Certain areas of the region will remain undeveloped into the future even with projected high growth. Many of these public and private lands will remain undeveloped because of specific environmental constraints, such as steep slopes or prime wetlands. Some areas currently being used for industrial or mining activity are planned to be reclaimed for other uses. For example, Kennecott Utah Copper Corporation is planning a 12,000-unit, mixed use development on 4,500 acres that it owns in South Jordan. Higher population densities are projected to be concentrated in the currently developed areas with the recent development occurring at lower densities in the outlying areas.

Many of the cities and the county understand the importance of reducing the risk of natural hazards and have therefore already adopted codes, ordinances, and regulations. Such enforcements include earthquake-building codes and slope failure setback requirements. State and local agencies are joining forces with local communities to understand the risk of living in URWIN zones and the measures that can be taken to lessen the loss of life and property in the event of a wildland fire. Drought has been identified as a problem and most cities have taken the initiative to incorporate discounts or credits for using less water. Severe weather has always bee a problem in this region and the response measures taken are kept up to date and include many mitigation measures. For examples of the identified measures refer to Part IV. Regional Data, Development Trends.

E. Risk Assessment

A risk assessment hazard profile was completed for the following identified hazards; earthquake, severe weather, wildland fire, flood, dam failure, landslide, and drought. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 410 critical facilities in Salt Lake County. The recognized critical facilities include 5 Water Treatment Facilities, 2 Oil Facilities, 1 Natural Gas Facility, 6 Electric, 42 Communication, 291 Schools, 31 Police Stations, 16 Fire Stations, 1 Emergency Facility, and 15 Care Facilities. Refer to Appendix D for the complete list for the county.

1. Earthquake

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault movements. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

The Wasatch Fault Zone is an active fault zone located in Salt Lake County. The Wasatch Fault is roughly 200 miles long and is broken down into ten segments that can rupture separately during earthquakes. There are six major segments of the Wasatch Fault, from north to south known as the Brigham City segment, Weber segment, Salt Lake City segment, Provo segment, Nephi segment, and the Levan segment. Within the Salt Lake City segment are three smaller segments from north to south known as Warm Springs Fault, Virginia Street Fault, and the East Bench Fault (Figure 9-4).

The Wasatch Fault Zone appears to be one of the most frequent sources of large earthquakes and because of the geologic conditions the secondary threats of earthquakes are high. Recent evaluation of the earthquake potential along the Wasatch Front indicated that a normal fault zone earthquake could measure in excess of 7 on the Richter scale and could happen about once every 300-400 years.

The secondary threats associated with an earthquake include ground shaking, liquefaction, lateral spread, and surface fault rupture. Of these threats the county is most subject to ground shaking and liquefaction.

Ground shaking is most severe in areas of deep thick sediment, which in the case of the Wasatch Front is the entire Salt Lake Valley. Generally, the thicker the sediments the greater the shaking will be.
Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration do to gravity. The following Figures 9-5, 9-6, and 9-7 developed by Ivan Wong illustrate the amount of ground acceleration expected in different areas of Salt Lake Valley based on a 7.0 magnitude earthquake. According to Sandra Eldredge, a magnitude 7.0 and 7.5 earthquake would create surface fault rupture with a displacement between 16 to 30 feet high and break segments 12 to 44 miles long.

Liquefaction is also severe due to the high water table and sandy ancient lakebed sediments that makeup the valley floor. There is a greater than 50% probability of having an earthquake within a 100 year period strong enough (over 5.0 Richter magnitude) to cause liquefaction (Figure 9-8).

Historically, the last major earthquake to hit Salt Lake City occurred approximately 1350 years ago. According to Eldredge, the Wasatch Fault segments between Brigham City and Nephi have a composite recurrence interval for a large earthquake (magnitude 7.0 to 7.5).

Figure 9-4 Fault Lines

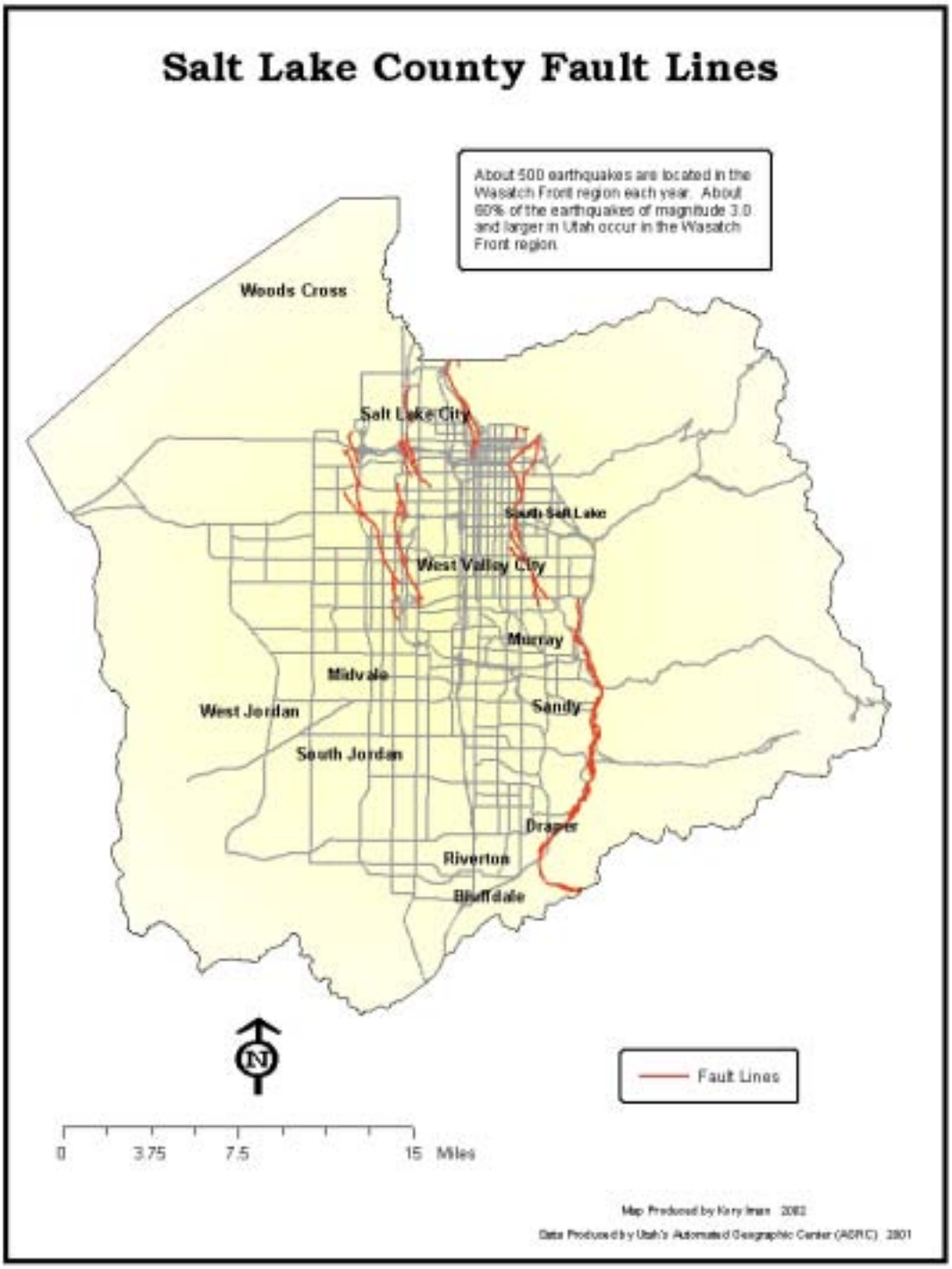


Figure 9-5 PGA Values

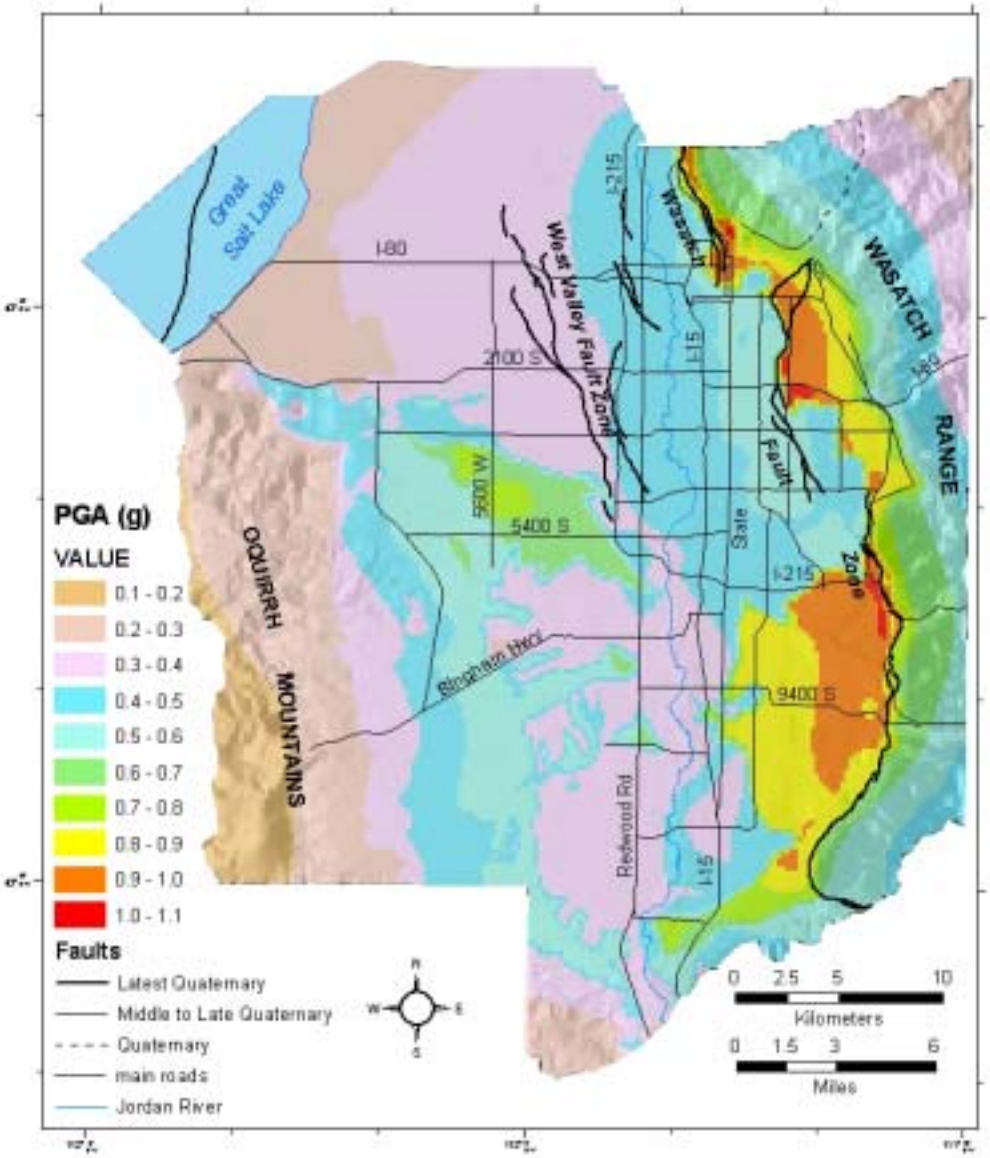


Figure 1. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario: Peak horizontal acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-6 Salt Lake City 0.2 PGA Values

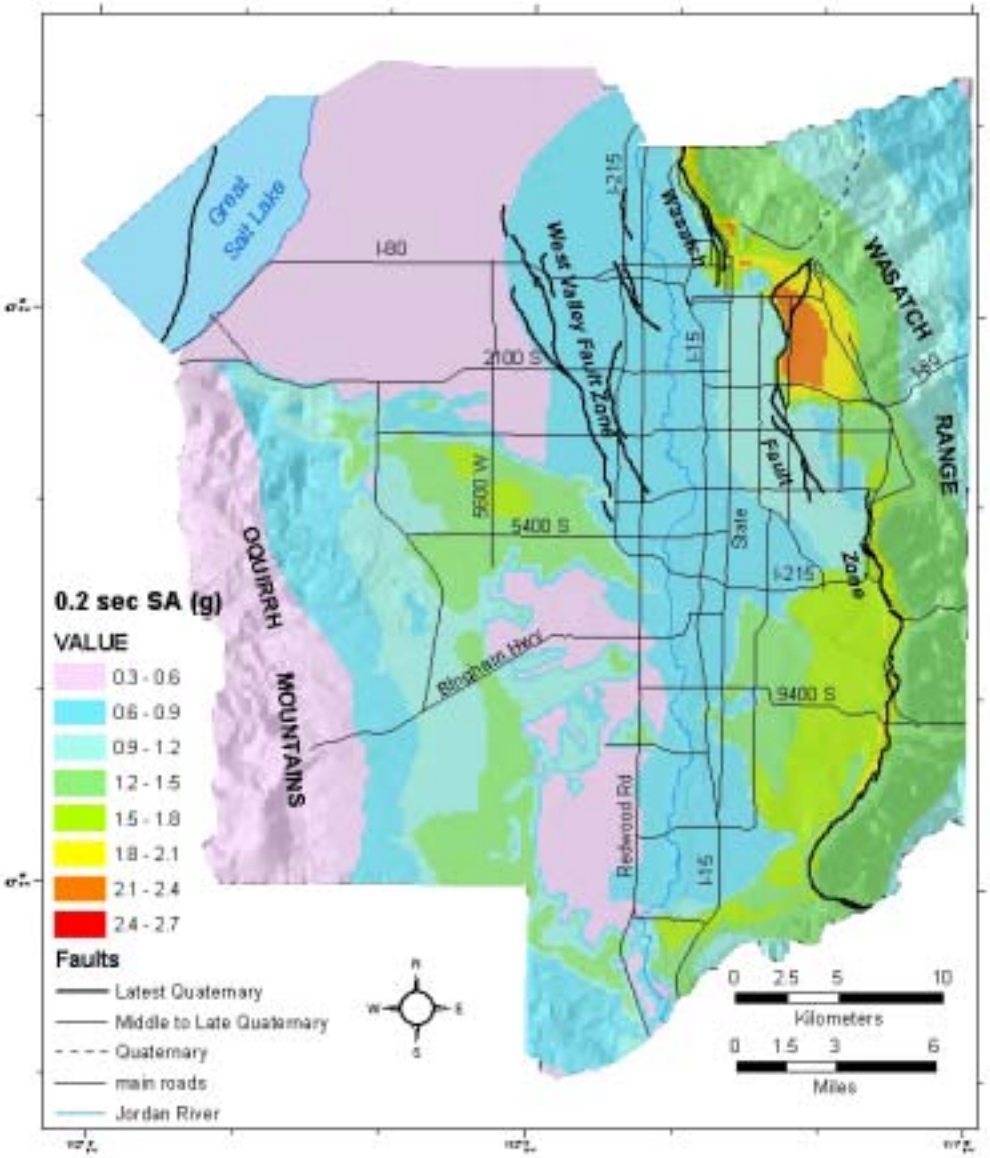


Figure 2. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario: 0.2 second spectral acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-7 Salt Lake City 1.0 PGA Values

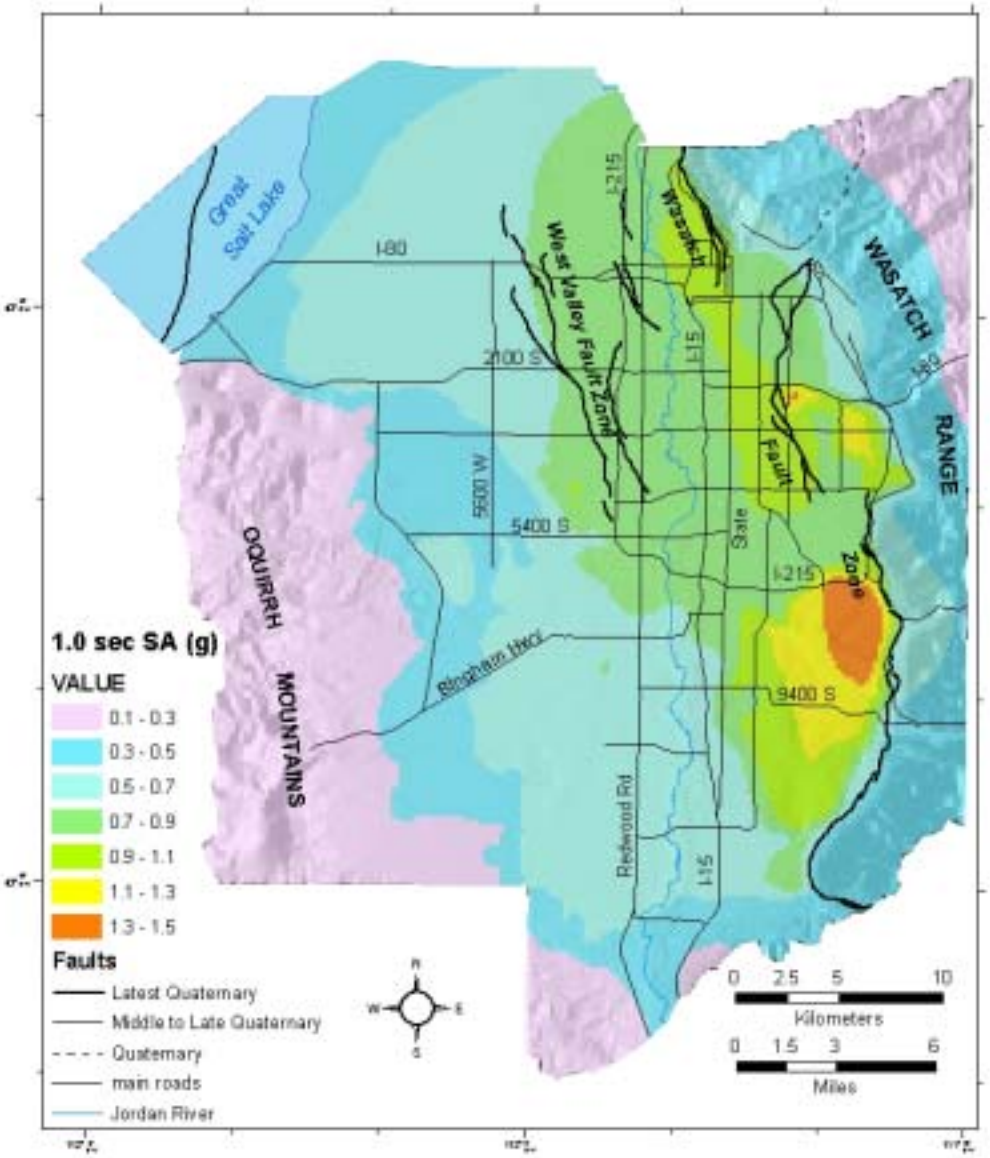
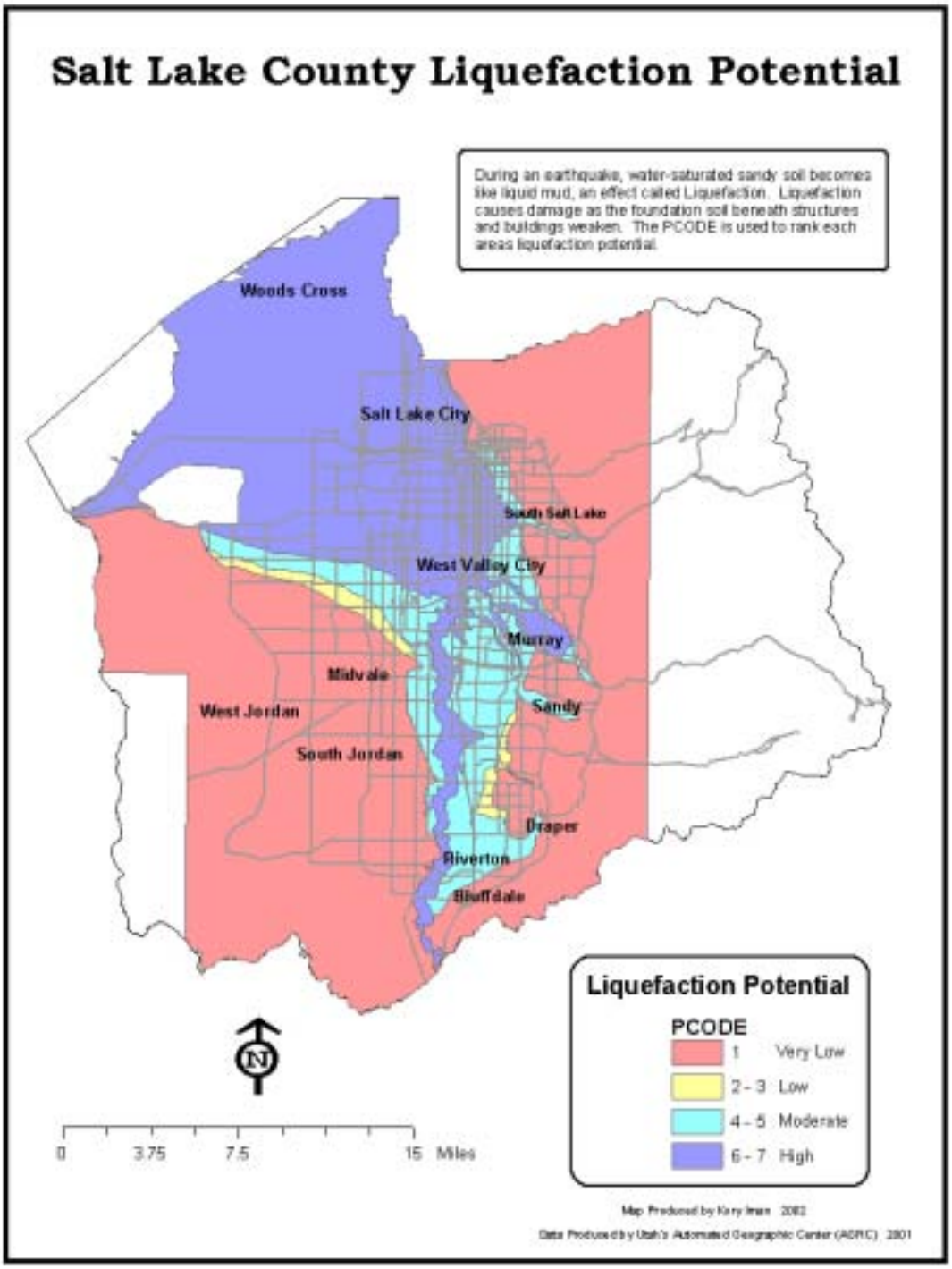


Figure 3. Salt Lake City segment, Wasatch Fault, M7.0 earthquake scenario: 1.0 second spectral acceleration (g) at the ground surface. From Wong, et al., 2001.

Figure 9-8 Liquefaction Potential



Vulnerability Assessment

Refer to Tables 9-9, 9-10, and 9-11 for the inventory of people, property, and other infrastructure located within the identified earthquake fault zones. Refer to Appendix I for the list of critical facilities within the earthquake fault zones as well as the liquefaction zones.

Table 9-9 Property Inventory within Fault Zones

City Name	City Area (Acres)	Acres in Fault Zone	Acres in Liquefaction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Commercial/ Annual Sales	Residential/ Value	Commercial/ Annual Sales	Residential/ Value	Earthquake	Liquefaction
Alta	2,623	0	0	0	0	0	0	0	0
Bluffdale	10,543	0	1,818	0 / $0	0 / $0	25 / $30,600,000	116 / $16,699,590	0	492
Draper	14,187	4,125	6,060	67 / $43,300,000	1,379 / $364,034,940	755 / $14,115	2,903 / $478,415,790	3,223	4,108
Herriman	7,744	0	0	0	0	0	0	0	0
Holladay	3,235	2,882	1,295	564 / $380,700,000	4,018 / $866,261,690	143 / $93,200,000	1,025 / $303,784,480	13,870	3,460
Midvale	3,840	0	3,822	0	0	1,949 / $2,514,500,000	6,151 / $673,324,410	0	31,569
Murray	6,690	0	6,686	0	0	3,190 / $7,252,700,000	10,714 / $1,280,966,290	0	54,968
Riverton	8,044	0	400	0	0	14 / $3,500,000	477 / $83,332,570	0	1,869
Salt Lake City	70,938	38,857	45,306	7,871 / $15,918,200,000	39723 / $5,696,835,420	8,827 / $177,176	24,414/ $2,164,509,820	157,7212	106,264
Sandy	14,367	2,983	4,287	158 / $145,300,000	2,655 / $664,122,660	1,774 / $2,802,300,000	5,550/ $624,844,790	18,145	25,336
South Jordan	14,150	0	2,602	0	0	203 / $781,900,000	1,395/ $270,539,660	0	8,205
South Salt Lake	4,409	496	4,409	144 / $168,700,000	1,298 / $119,392,100	2,614 / $47,997	4,318 / $372,589,610	7,332	27,524
Taylorsville	6,963	1,755	4,260	303 / $390,500,000	3,923 / $414,570,64	755 / $1,199,400,000	7,510 / $811,362,050	17,696	43,056
West Jordan	20,448	0	2,972	0	0	591 / $749,100,000	4,381 / $467,682,890	0	18,902
West Valley	22,808	6,489	14,085	1,883 / $6,777,100,000	9,209 / $850,608,020	2,618 / $8,581,900,000	19,140 / $1,813,906,940	45,972	89,463
Un-Incorporated	304,953	22,008	56,423	3,603 / $4,711,000,000	28,433 / $4,546,764,370	3,013 / $3,950,500,000	18,338 / $2,205,379,610	102,835	96,902

Table 9-10 Infrastructure affected by Liquefaction

Item	Length (Miles)	Replacement Cost
Local Roads	44.7600	$89,520,000
State Highways	122.4990	$295,651,337
US Highways	14.2038	$34,280,871
US Interstates	64.5455	$232,363,800
Power Lines	771.17	$37,232,088

Table 9-11 Infrastructure affected by Earthquake Fault Zones

Item	Length (Miles)	Replacement Cost
Local Roads	4.22	$8,430,400
State Highways	76.60	$184,882,065
US Highways	5.07	$12,224,619
US Interstates	34.48	$124,130,160
Power Lines	222.25	$10,730,230
Gas Lines	60.18	$14,526,850

HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 9-12 identifies the probable casualties during an earthquake.

Table 9-12 Casualties

Casualties	Nighttime –Minor	14,162
	Nighttime –Major	392
	Nighttime -Fatalities	756
	Daytime –Minor	21,828
	Daytime –Major	872
	Daytime- Fatalities	1,689
	Commute –Minor	17,772
	Commute –Major	660
	Commute-Fatalities	1,259

Building Damage by Count
Building damage is classified by HAZUS MH in five damage states: none, slight, moderate, extensive and complete. Table9-13 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 9-14 identifies the critical facilities that would be affected by an earthquake.

Table 9-13 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	16,528
Commercial	3,220
Industrial	485
Totals	169,144*

*****Includes all building categories with moderate to complete damage

Table 9-14 Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	15	15	0	0
Schools	291	276	0	0
Emergency Operation Centers	1	0	0	1
Police Stations	31	30	0	0
Fire Stations	16	14	0	0

Debris Removal
Table 9-15 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 9-15 Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	9
Loads (25 tons per load)	360,000

Fire Following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9-16 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 9-16 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	95
People Displaced	2,631
Value Exposed (mill. $)	138

2. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

The portions of Salt Lake County that could experience the most significant amount of destruction due to a wildland fire include the foothills and the bench areas on or near the Wasatch Front Mountain Range. These URWIN areas are threatened most because of the amount of forested lands and the increasing population growth spreading into the foothills. Another concern is the type of vegetation in these areas that burns easily, such as sagebrush, mountain shrub, pinion and juniper trees, and rural and riparian vegetation. Sagebrush burns hot and fast and spreads easily, and is found throughout the county. Mountain shrub also burns hot and fast and is one of the more dense types of vegetation throughout the county. During prime burning conditions (hot, dry, and windy) the pinion juniper class will burn.

As the population growth continues development in URWIN areas will also continue. This will dramatically increase the threats associated with fire and mitigation measures will need to be recognized and enforced.

The wildfire threat in Salt Lake County in the past has had a significant affect on the watersheds, including slope failure, debris flows, and other forms of erosion. State and local Agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect county watersheds in the past.

Wildfire maps were created using GIS and can be viewed in Section H, Map 9.2.1 Salt Lake County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Salt Lake County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population and history can also be viewed in the following tables (Table 9-17, 9-18, 9-19). Due to the large extent of data please refer to Appendix I Salt Lake County critical facilities affected by hazards.

Table 9-17 Wildfire Risk Assessment

City Name	City Area (Acres)	Acres in Wildfire Area			Number of Structures within Wildfire Area		Population in Hazard Area
		Extreme	High	Moderate	Residential/ Replacement Value	Commercial/ Annual Sales	
Alta	2,623	186	1098	746	194 / $91,726,710	0	677
Bluffdale	10,543	291	4440	496	87 / $17,594,660	17 / $24,900,000	532
Draper	14,187	.5	2,444	3911	2,667 / $612,538,980	103 / $78,500,000	5,571
Herriman	7,744	229	1,569	2,382	825 / $110,359,550	116 / $77,200,000	1,265
Holladay	3,235	0	0	0	0	0	0
Midvale	3,840	0	0	0	0	0	0
Murray	6,690	0	0	0	0	0	0
Riverton	8,044	0	0	193	447 / $52,301,400	11/ $7,800,000	1,366
Salt Lake City	7,0938	70	1,234	9,479	373 / $169,550,700	54 / $108,200,000	1,305
Sandy	14,367	0	345	880	169 / $79,436,700	11 / $364,000,000	569
South Jordan	14,150	0	0	2,730	0	0	0
South Salt Lake	4,409	0	0	0	0	0	0
Taylorsville	6,963	0	0	0	0	0	0
West Jordan	20,448	0	0	222	0	0	0
West Valley	22,808	0	0	2,508	0	40 / $480,300,000	0
Un-Incorporated	304,953	2,434	35,452	36,470	679 / $165,498,160	94 / $192,900,000	1,020

Table 9-18 Infrastructure Affected by Wildfire

Item	Length (Miles)	Replacement Cost
Local Roads	2.55	$5,108,000
State Highways	13.66	$32,967,927
US Highways	1.35	$3,264,259
US Interstates	9.29	$33,432,840
Power Lines	56.80	$2,742,304
Gas Lines	11.20	$2,703,568

Table 9-19 Wildfire History

Date	Fire Name	Cause	Size
7/18/87	Camp Williams 5	Incendiary	300-999 Acres
9/2/88	Affleck Park	Miscellaneous	>5000 Acres
7/16/01	Beef Hollow	Equipment	>5000 Acres

3. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Flooding would mainly occur in and along floodplains. See map in Section H.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

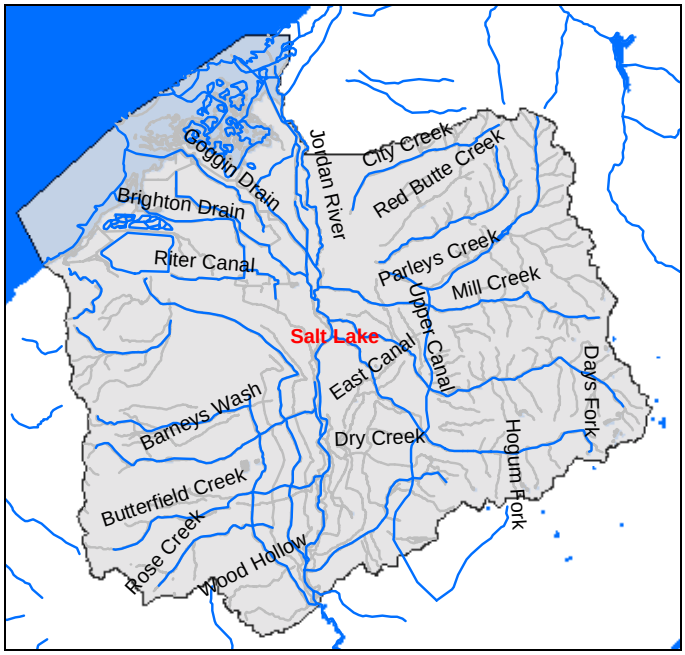
Description of Location and Extent

Flooding in Salt Lake County is similar to the rest of the region in that it is the result generally of snowmelt runoff, or cloudburst storms. Snowmelt flooding is the result of rapid melting of snowpack and occurs between Aril through June. Cloudburst rainstorms are high intensity short duration storms that occur over a relatively small area in the summer months. However, flooding can occur from any precipitation event.

The major waterways in the county include the Jordan River, Big and Little Cottonwood Creeks, Parleys Creek, Emigration Creek, Red Butte Creek, City Creek, Lambs Creeks, Dell Creek, and Millcreek. All have the potential to flood. However, due to the flooding of the early 1980's and other flood events, flood mitigation measures were incorporated that significantly reduces the flood threat. The flows of the Jordan River are controlled and so the flood threat is very low. Parleys Creek has flood storage capacity at Mountain Dell and Little Dell Reservoirs and is routed through a retention basin in Sugarhouse Park. Big and Little Cottonwood Canyons, and Bells Canyon have a number of smaller flood storage lakes and ponds. But not all are regulated and they offer minimal flood protection. In Salt Lake City, Parleys Creek, Emigration Creek, and Red Butte Creek have all been routed to come together at Liberty Park. Retention ponds are also used to store runoff from commercial and residential development areas (Figure 9-12).

*On September 29, 1982, floodwaters destroyed portions of the road near the Storm Mountain area of Big Cottonwood Canyon east of Salt Lake City. The flooding occurred after several days of heavy rains brought on by tropical moisture that moved into the state from dying hurricane Olivia and the energy supplied from an active cold front. (Photo by David Carpenter.) Source: http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html.

Figure 9-12 Salt Lake County Rivers



The following table identified the daily average cubic feet per second flow of the streams within Salt Lake County from 1900 to 1999, according to the Salt Lake City Multi-Hazard Mitigation Plan of 2002 (Table 9-20). Flooding within the county in the past has been recorded, Table 9-21 details the flood event.

Table 9-20 Daily Average CFS

Watershed Area in Square Miles	Stream in Order of Peak Date	Yearly Average in Cubic Feet Per Second (cfs *)	Usual Runoff Peak in cfs	Average Peak Date
18.0	Emigration	6.53 cfs	24.27 cfs	May 7th
23.1	Dell	11.45 cfs	63.16 cfs	May 16th
19.7	Lamb's	12.32 cfs	40.29 cfs	May 27th
21.7	Millcreek	15.52 cfs	44.78 cfs	May 28th
19.2	City Creek	16.81 cfs	56.24 cfs	May 29th
48.5	Big Cottonwood	74.45 cfs	292.8 cfs	June 6th
27.4	Little Cottonwood	64.46 cfs	289.0 cfs	June 14th

Tributaries of Parleys Creek, data compiled 1970 through 1999. Study done by Dan Schenck Salt Lake City Hydrologist.
*cfs- cubic feet per second

Table 9-21 Flood Events

Flood Year	Stream	Discharge* (cfs)	Estimated Return Interval (Years)
1909	Parleys Creek	247	18
1917	City Creek	105	7
	Emigration Creek	64	8
	Parleys Creek	242	11
1922	City Creek	118	13
	Emigration Creek	110	33
	Parleys Creek	317	40

1952	City Creek	127	20
	Emigration Creek	156	100
	Parleys Creek	365	100

*Discharges given in mean daily values actual peak flows would have been somewhat higher. From Salt Lake City Flood Insurance Study.

*During the past 149 years, the Great Salt Lake has peaked three times at 4,211 feet above sea level: 4,211.60 feet in June 1873, 4,211.50 feet in June 1986, and 4,211.60 feet in June 1987. This picture of the Saltair Resort on the southeast shore of the Great Salt Lake was taken during the flood years of the 1980's. Large pumps were installed on the west side of the Great Salt Lake (at a cost of $60 million) and began pumping water into the west desert in 1987. These pumps now make it possible for man to control the level of the lake. (Photo courtesy of the National Weather Service.) Source: http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html.

Vulnerability Assessment

Although, this plan discusses flood potential and shows history of flooding and contains corresponding mitigation strategies to deal with flood prone areas the reader needs to understand that a detailed survey of risk and capability shows that Utah has relatively little flood risk. This is due in part to the dry climate, but due in large to flood mitigation that occurred in the early 1980's. Some of these recent measures include the Salt Lake County Flood Control Project, City Storm Drainage Master Plans, SNOTEL Sites, NFIP Community Rating System, City Watershed Plans, Retention ponds, Detention basins, and regular Dam Inspections.

The following tables identify the number of residential and commercial property within the 100-year floodplain along with the population (Table 9-22). Critical facilities that lie within the 100-year floodplain have also been assessed. Due to the large extent of data please refer to Appendix I Salt Lake County critical facilities affected by hazards. Refer to Map 9.3.1 for the location of the 100- year floodplains within the county. Salt Lake City was a Utah Project Impact Community in 1999 and analyses from this study were added into the State Hazard Mitigation Plan and reviewed for the making of this plan.

Table 9-22 Floodplain Risk Assessment

City Name	City Area (Acres)	Acres in 100 Year Flood Plain	Number of Structures within 100 Year Floodplain		Population in Hazard Area
			Residential / Replacement Value	Commercial/ Annual Sales	
Alta	2,623	3	0	0	0
Bluffdale	10,543	179	11 / $5,628,290	1 / $100,000	35
Draper	14,187	293	172 / $48,378,260	38 / $22,400,000	550
Herriman	7,744	204	71 / $14,128,210	1 / $300,000	227
Holladay	3,235	43	19 / $14,681,820	25 / $9,600,000	61
Midvale	3,840	32	8 / $654,400	18 / $32,400,000	26
Murray	6,690	170	196 / $30,533,950	61 / $56,100,000	568
Riverton	8,044	361	210 / $43,393,200	11 / $7,400,000	609
Salt Lake City	70,938	2,975	459 / $66,013,850	353 / $941,800,000	1,331
Sandy	14,367	201	141 / $37,322,340	15 / $11,600,000	409
South Jordan	14,150	786	378 / $99,249,270	25 / $11,800,000	1,096
South Salt Lake	4,409	281	165 / $18,299,500	84 / $187,400,000	528
Taylorsville	6,963	141	93 / $22,173,160	2 / $900,000	307
West Jordan	20,448	717	287 / $77,460,590	96 / $153,200,000	947
West Valley	22,808	715	335 / $49,542,360	85 / $588,100,000	1,106
Un-Incorporated	304,953	56,806	861 / $234,634,650	92 / $159,100,000	2,238

3. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the eastern portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

Description of Location and Extent

Twenty-eight High Hazard dams are located in Salt Lake County, according to the Utah Division of Water Rights, Dam Safety Inspection agency. A high hazard threat means if the dam were to fail it would have a high probability of causing loss of life and extensive economic loss. The county also has fifteen moderate hazard dams; meaning if the dam were to fail it would have a low probability of causing loss of life but would cause appreciable property damage. Seventy-two dams have a low hazard threat, if the dam were to fail there would be a minimal threat to life and economic losses would be minor. The damage would be limited to the owner of the dam, however they should still be monitored. Refer to Table 9-23 for a listing of the high hazard dams within the county. Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Table 9-23 High Hazard Dams

Dam Name	
Ensign Downs Db (Victory Road Db)	Salt Lake County Federal Heights (#1a)
Kennecott Mine Bingham Creek	Salt Lake County School Pond (#14)
Lake Mary-Phoebe	Salt Lake County Shriner's (#12)
Little Dell	Salt Lake County-Rotary Glen Park
Mountain Dell	Sandy City - Alta Canyon
Red Butte Dam	Sandy City - Buttercup
Red Pine	Sandy City - East Sandy Elementary
Riverton City - 3200 West Pond	Sandy City -Willow Creek
Riverton City - 4200 West Pond	Sandy City-Falcon Db
Salt Lake C0-Creekside Park (Big Cottonwood)	Sandy City-Flat Iron Mesa
Salt Lake Co.-Big Cottonwood (Spencer's)	Sandy City-Storm Mountain Db
Salt Lake County - Scott Avenue	South Jordan RDA Db
Salt Lake County - Sugarhouse	Twin Lakes (Salt Lake)
Salt Lake County Chandler Drive (#13)	White Pine

Vulnerability Assessment
The following identifies the number of people, property, and other infrastructure that could be affected in the event of a dam failure as well as the replacement values (Table 9-24). A break on most of the dams listed would cause localized flooding and property loss to the facilities and property down stream and/or down slope from the dam.

Table 9-24 Dam Failure Risk Assessment

City Name	City Area (Acres)	Acres in Dam Failure Area	Number of Structures within Dam Failure Area		Population in Hazard Area
			Residential / Replacement Value	Commercial/ Annual Sales	
Alta	2,623	166	84 / $50,534,080	0	69
Bluffdale	10,543	206	104 / $16,910,230	2 / $300,000	302
Draper	14,187	0	0	0	0
Herriman	7,744	0	0	0	0
Holladay	3,235	632	393 / $162,157,070	62 / $35,000,000	677
Midvale	3,840	653	42 / $3,256,700	272 / $545,900,000	158
Murray	6,690	2,513	3,790 / $480,359,620	1,130 / $1,376,500,000	13,184
Riverton	8,044	0	0	0	0
Salt Lake City	70,938	42,183	17,842 / $1,526,780,840	4,918 / $11,310,600,000	76,198
Sandy	14,367	590	404 / $46,652,930	65 / $484,400,000	1,790
South Jordan	14,150	374	102 / $15,321,400	3 / $2,000,000	430
South Salt Lake	4,409	2,266	314 / $23,632,570	1,131 / $2,313,400,000	967
Taylorsville	6,963	810	1,007 / $113,414,700	70 / $168,200,000	4,498
West Jordan	20,448	2,140	1,917 / $231,124,980	284 / $459,400,000	7,114
West Valley	22,808	5,124	2,198 / $199,677,310	1,195 / $5,317,100,000	7,912
Un-Incorporated	304,953	39,684	5,369 / $896,609,230	1,093 / $1,499,800,000	26,366

4. Landslide / Slope Failure

Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer months usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

Landslides and debris flows are most common in the foothills along the base of the Wasatch Mountain Range from wet climatic conditions. Landsliding occurs in areas of pre-existing landslides. Some major landslide areas include the Grand View Peak rockslide in upper City Creek Canyon, the Baskin Spring landslide in North Salt Lake, the Little Valley Red Rock landslide in Draper, and the shallow disrupted landslides in and near Steep Mountain in Draper. As urbanization is spreading into geologically unstable areas of the county the risk to life and property is increased.

The Grand View Peak slide is a candidate for an earthquake-induced landslide. The Baskin Spring slide is a prehistoric slide on the northern flank of the Salt Lake salient. This slide also has a strong susceptibility to seismic failure. The Little Valley Red Rock slide in Draper is the largest in southern Salt Lake County. The Draper Heights landslide is a post Lake Bonneville slide that occurred on the steep north slope of Steep Mountain. This slide is an earthquake triggered soil slide.

Vulnerability Assessment

The following tables identify the people, property and infrastructure affected by a landslide (Tables 9-25 and 9-26).

Table 9-25 Landslide Risk Assessment

City Name	City Area (Acres)	Acres in Landslide Area	Number of Structures within Landslide Area		Population in Hazard Area
			Residential/Replacement Value	Commercial/ Annual Sales	
Alta	2,623	41	7 /$3,730,530	0	0
Bluffdale	10,543	0	0	0	0
Draper	14,187	0	0	0	0
Herriman	7,744	0	0	0	0
Holladay	3,235	556	846 /$253,001,890	42 /$18,900,000	2,565
Midvale	3,840	0	0	0	0
Murray	6,690	0	0	0	0
Riverton	8,044	0	0	0	0
Salt Lake City	70,938	658	924 /$301,456,800	86 /$116,400,000	3,370
Sandy	14,367	0	0	0	0
South Jordan	14,150	0	0	0	0
South Salt Lake	4,409	0	0	0	0
Taylorsville	6,963	0	0	0	0
West Jordan	20,448	0	0	0	0
West Valley	22,808	0	0	0	0
Unincorporated	304,953	2,592	3,208 /$922,336,300	263 /$279,000,000	7,635

Table 9-26 Infrastructure Affected by Landslide

Item	Length (Miles)	Replacement Cost
Local Roads	0.31	$624,800
State Highways	1.69	$4,067,713
US Highways	0.00	$0
US Interstates	3.32	$11,948,400
Power Lines	3.22	$155,462
Gas Lines	3.60	$869,004

F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Table 9-27 identifies historic events with as much relevant information as was available including date, location, area impacted, and damage costs.

Table 9-27 Hazard History

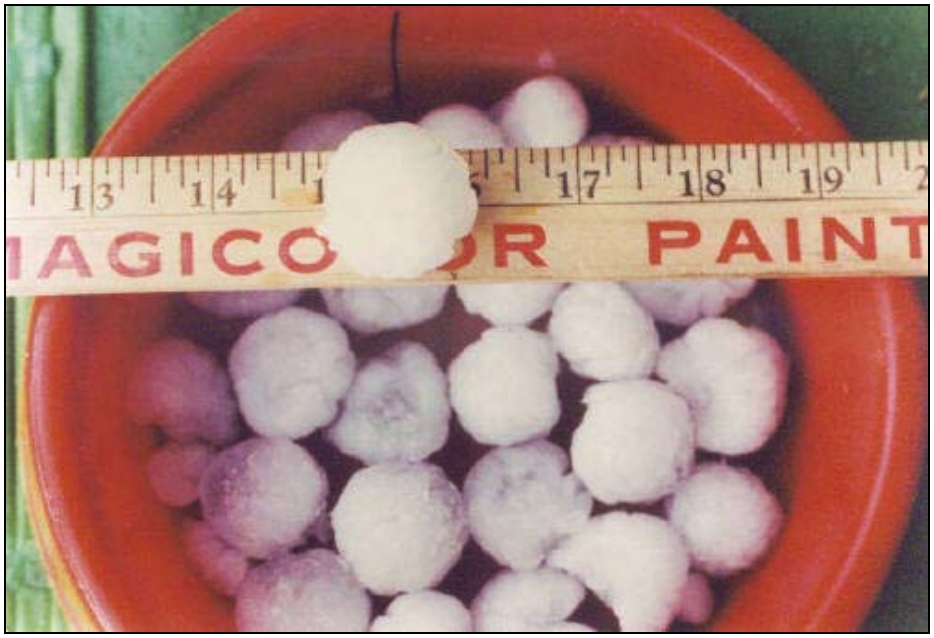
Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Avalanche	04/01/1864	Mill Creek Canyon		2 deaths.
Avalanche	02/15/1865	City Creek Canyon		4 deaths.
Avalanche	04/01/1869	Mill Creek Canyon		3 deaths.
Avalanche	02/05/1872	Big Cottonwood Canyon		2 deaths.
Avalanche	12/26/1872	Little Cottonwood Canyon		10 deaths. Property damage.
Avalanche	01/11/1875	Little Cottonwood Canyon		4 deaths. Property damage.

Avalanche	01/19/1875	Big Cottonwood Canyon		6 deaths. Property damage.
Avalanche	01/20/1875	Big Cottonwood Canyon		6 deaths. Property damage.
Avalanche	03/03/1875	Big Cottonwood Canyon		1 death.
Avalanche	12/25/1875	Little Cottonwood Canyon		1 death. Property damage.
Avalanche	12/29/1876	Little Cottonwood Canyon		2 deaths.
Avalanche	03/11/1877	Little Cottonwood Canyon		2 deaths.
Avalanche	01/12-17/1881	Little Cottonwood Canyon/ American Fork Canyon		15 deaths. Property damage.
Avalanche	02/17/1882	Big Cottonwood Canyon		7 deaths. Property damage.
Flood	09/29/1982	Big Cottonwood Canyon	Storm Mountain	Road damage.
Avalanche	03/07/1884	Little Cottonwood Canyon		12 deaths.
Avalanche	02/12-13-1885	Bingham Canyon/ Little Cottonwood Canyon		17 deaths. Property damage.
Avalanche	03/02/1889	Little Cottonwood Canyon		15 deaths. Property damage.
Avalanche	01/17/1899	City Creek Canyon		Property damage.
Avalanche	02/08/1899	Bingham Canyon, Big Cottonwood Canyon		2 deaths. Property damage.
Avalanche	01/20/1906	Little Cottonwood Canyon		6 deaths. Property damage.
Avalanche	01/31/1911	Big and Little Cottonwood Canyons		4 deaths. Property damage.
Flood	08/02/1922	Magna		1 death, property damages.
Flood	08/13/1923			Intense thunderstorms, 7deaths, and $3,000,000 damage.
Drought	1930-1936	Countywide		
Avalanche	02/09/1939	Bingham Canyon		4 deaths
Avalanche	01/01/1941	Alta Ski Area		1 death
Avalanche	03/21/1943	Big Cottonwood Canyon		1 death
Flood	08/19/1945	Salt Lake City	Perry's Hollow	Severe Storm/ Heavy rainfall. $500,000 damage to homes and cemetery.
Severe Storm	1948-1949	Salt Lake Valley		Heavy snow, severe cold, high winds.

Flood	08/9-10/1949	Bingham		Heavy rainfall. Residential and commercial damages, over $9,000.
Avalanche	03/27/1950	Little Cottonwood Canyon		1 death
Flood	04/23/1951	Salt Lake City	West side of city.	Residential damages.
Flood	07/27/1951	Salt Lake City/ Bingham	Flash flood between Bingham and Copperton.	Severe Storm. Extensive property damage and highway washed out.
Flood	08/03-04-1951	Magna		Homes destroyed.
Flood	08/04/1951	Salt Lake City		Heavy cloudburst storm. Residential and business damages.
Landslide	08/04/1951	Salt Lake City	City Creek Canyon	From cloudburst storm.
Flood	April 27-June 30 1952	Ogden, Weber, and Jordan Rivers	Disaster Declared. Parleys, Emigration, and Red Butte Canyons.	Snowpack melt.2 deaths. $8.4 million damage to streets, homes, and power.
Earthquake	07/23/1952	Salt Lake City		Richter magnitude 3.7
Earthquake	05/24/1953	Salt Lake City		Richter magnitude 4.3
Earthquake	08/16/1953	Salt Lake City	Rose Park	Richter magnitude 3.7
Earthquake	02/02/1955	Salt Lake City		Richter magnitude 4.3
Drought	1953-1965	Countywide		
Flood	07/26/1955	Bingham	Bingham Canyon	Damage to homes and streets.
Flood	08/06/1955	Salt Lake City/ Herriman/ Riverton		Thunderstorms damaged homes, farms, and streets.
Flood	08/01/1961	Salt Lake City	Big Cottonwood Creek	Washed out Big Cottonwood Canyon Road.
Earthquake	09/05/1962	Magna		Richter magnitude 5.2
Flood	08/31/1963	Magna	Reported worst storm in 20 years.	Residential, commercial, and roads damaged.
Flood	09/21/1963	Salt Lake City		Heavy rain. Streets, property, Highland High School, Hall of Justice construction all damaged.
Tornado	02/09/1965			F2

Flash Flood	07/30/1965	Neff's Canyon		Flash Flood. Damage to homes, roads, sewer, and water lines.
Flood	08/19/1965	Midvale		Severe Storm. Damage to homes.
Flood	09/05-07/1965	Midvale		Heavy rain. Damage to homes and streets.
Flood	06/07/1966	Holladay		Cloudburst storm. $10,000 damage to homes.
Avalanche	02/12/1967	Grandeur Peak		2 deaths.
Lightning	06/16/1967	Copperton		1 death.
Flood	07/21/1968	Midvale/ Riverton/ Murray		Heavy rain. Damage to homes and crops.
Tornado	08/14/1968			F1
Earthquake	01/23/1969	Emigration Canyon		Richter magnitude 3.0
Flood	07/29/1969	Salt Lake City	Little and Big Cottonwood Canyons.	Severe Storm. Damaged roads and block Big Cottonwood.
Flood	08/17/1969	Salt Lake City	East Bench	Thunderstorm. Damage to homes. Dam failure flooded more homes.
Avalanche	01/29/1970	Alta Ski Area		1 death.
Earthquake	09/17/1971	Near Alta		Richter magnitude 3.2
Earthquake	09/19/1971	Near Alta		Richter magnitude 3.3
Lightning	08/02/1972	Riverton		1 death.
Avalanche	12/30/1973	Alta Ski Area		Property damage.
Avalanche	01/05/1976	Alta Ski Area		1 death
Drought	1974-1978	Countywide		
High Winds	04/04-06/1983	Wasatch Front Region		Over $8 million in damage.
Flood	April-June 1983	Great Salt Lake and tributaries between Ogden and Salt Lake City.	Disaster Declared by president	Snowpack melt. $621 million.
Flood	April-June 1984	Jordan River, Red Butte Creek.		Snowpack melt.
Lightning	07/08/1984	Little Cottonwood Canyon		1 death.
Waterspout	06/25/1985	Great Salt Lake		
Flood	06/03/1986	Great Salt Lake		Large runoff. 140 year record altitude of 4211.85 feet on June 3, 1986. $268 million in damage.
Tornado	09/09/1986			F0

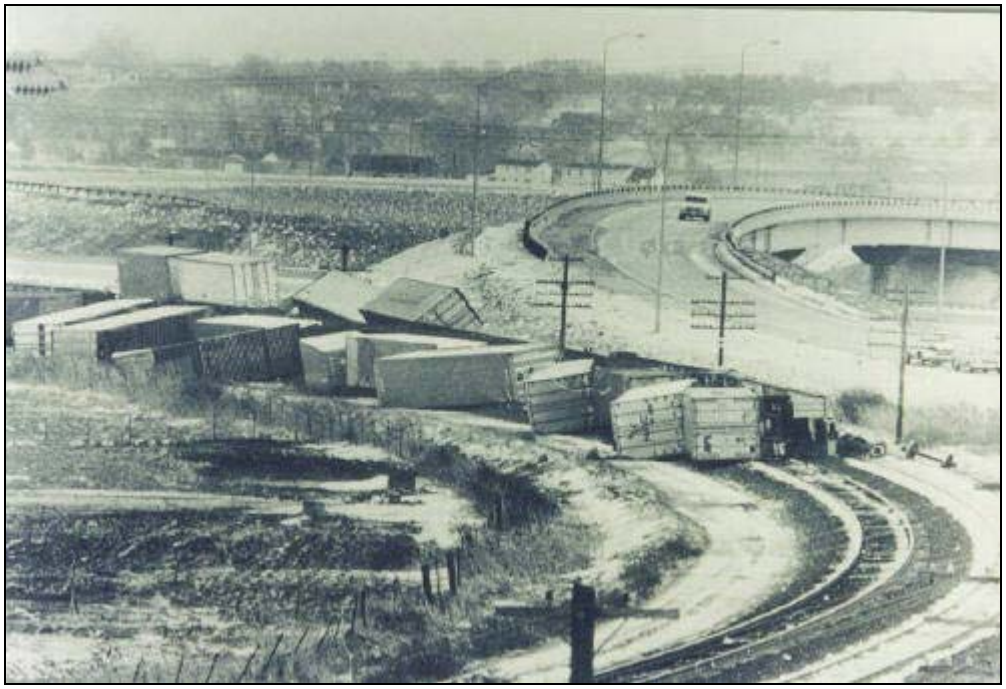
Tornado	01/10/1989			F1
Tornado	03/02/1989			F1
Tornado	07/08/1989			F1
Tornado	08/16/1990			F0
Tornado	08/30/1992			F0
Tornado	11/05/1993			F0
Severe Storm	10/05/1994	Salt Lake Valley	Airport, Holladay, Cottonwood Heights, Millcreek.	Over $330,000 damage
Tornado	05/08/1998			F0
Lightning	07/10/1998	Draper		1 death.
Tornado	09/12/1998			F0
Tornado	08/11/1999	Salt Lake City		F2. 1 death, 80 injured.
Lightning	05/24/2000	Midvale		1 death.
Lightning	07/25/2002	Lone Peak		2 deaths.
Severe Storm	12/25-29/03			Power outages, road closures, Provo Canyon Avalanche
Severe Storm	12/26-27/03	Salt Lake City		Heavy snowfall. Record precipitation of 14.8 inches.



*On September 3, 1983, thunderstorms produced hail ½" to 1½" in diameter throughout the Salt Lake Valley, destroying gardens, denting cars, and damaging roofs. (Photo courtesy of National Weather Service.)

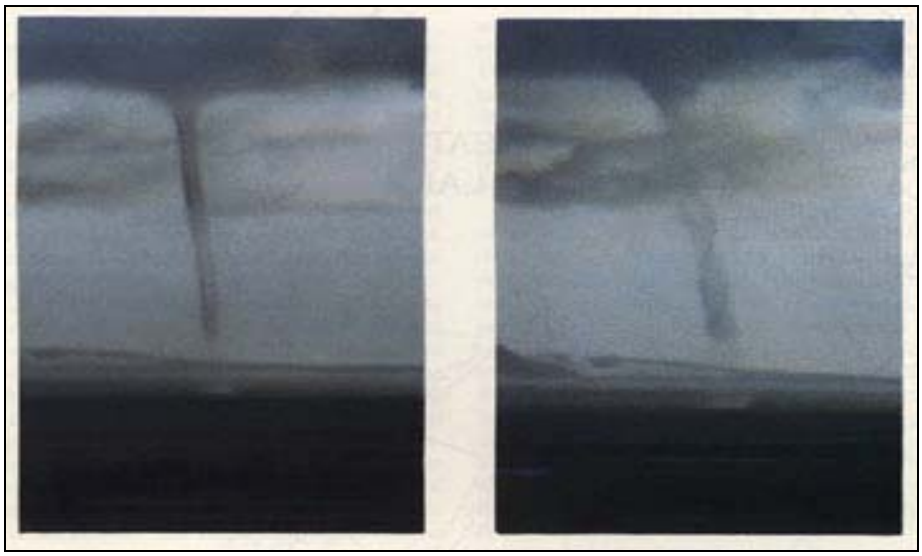
On February 13, 1885, a snow slide at Alta (that was then a mining town) killed 16 people. This photograph was taken on July 3, 1885. (Photo by C.R. Savage.)

On December 23, 1988, a cold front produced heavy snow over the Wasatch Front, with up to five inches reported in some valleys, eight inches along the benches, and two to three feet in the mountains. Several avalanches occurred up Little Cottonwood Canyon. This bus was caught in a snow slide at White Pine in Little Cottonwood Canyon. (Photos courtesy of the National Weather Service.)



On April 4-6, 1983, strong canyon winds created havoc along the Wasatch Front. Wind speeds gusted over 70 mph in many locations, and Hill Air Force Base recorded a gust to 104 mph. Hundreds of trees were uprooted, numerous windows were blown out, and several semi trucks were blown over. The train in this

picture was derailed near Lagoon. Total damage from the winds was estimated at eight million dollars. (Photo by Ogden Standard Examiner.)



Great Salt Lake Waterspout, June 26, 1985.Photo courtesy of National Weather Service.

Great Salt Lake Waterspout, September 12, 1998. Photo courtesy of KTVX News 4 Utah.

Salt Lake City Tornado, August 11, 1999. Photo courtesy of KTVX News 4 Utah.

Salt Lake City Tornado, August 11, 1999. (Orange fireball is a power sub-station exploding.) Photo courtesy of KTVX News 4 Utah.

*Lightning over Lewis Peak, North Ogden, Utah, August 8th 2003, photo by Gene Poncelet.

G. Mitigation Goals, Objectives, and Actions

Salt Lake County
Pre Disaster Mitigation FY2003
(PDM03) Workbook

County: Salt Lake County
Address: 3380 S. 900 W.
City: Salt Lake City, UT
Zip Code: 84119

Point of Contact: Dennis Stanley
Email: dstanley@co.slc.ut.us

Signature: _____
Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group

Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name:	Russ Scholz	Title:	Emergency Coordinator SLC A.R.E.S., Inc.
Name:	David Chisholm	Title:	Citizen Committee, Holladay
Name:	Stephen Higgs	Title:	Fire Chief, Midvale
Name:	Randy Willden	Title:	Battalion Chief, Murray
Name:	Dennis Stanley	Title:	Bureau Chief, SLCO Fire Emergency Services
Name:	Kathy Cuff-Case	Title:	Planner, SLCO Fire Emergency Services
Name:	Bob Halloran	Title:	Deputy Bureau Chief, Emergency Services
Name:	Kent R. Miner	Title:	SL Valley Health Department
Name:	Chris Evans	Title:	Battalion Chief, South Jordan
Name:	Dawn Black	Title:	Asst. Emergency Mgr., Salt Lake City
Name:	Nancy Sanchez	Title:	Salt Lake Community College
Name:	Nancy Barr	Title:	Utah DES

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s)

Date: December 3, 2003
Time: 1:30 p.m.
Place: Salt Lake County Emergency Operations Center

Purpose of Meeting:
To identify mitigation strategies already in place and to identify needed mitigation strategies.

List of Attendees:

LaNiece Dustman	Jim Boes
Russ Scholz	David Chisholm
Stephen Higgs	Randy Willden
Dennis Stanley	Kathy Cuff-Case
Bob Halloran	Kent R. Miner
Chris Evans	Dawn Black
Nancy Barr	Nancy Sanchez

Summary of Meeting:
LaNiece Dustman from Wasatch Front Regional Council led the group in the discussion. Jim Boes provided current maps. Possible natural disasters were listed and mitigation projects were identified.

Outcome(s) of Meeting:
To provide mitigation actions for the pre-disaster mitigation plan and ready each community for a hazard event. Note: countywide refers to mitigation measures which address a hazards in each of the following cities within the county; Alta, Bluffdale, Draper, Herriman, Holladay, Cottonwood, Midvale, Murray, Riverton, Salt Lake City, Sandy, South Jordan, South Salt Lake, Taylorsville, West Jordan, and West Valley.

*The term "countywide" in this document refers to mitigation strategies benefiting the following communities; Town of Alta, Bluffdale City, city of Draper, Herriman, Holladay-Cottonwood City, Midvale City, Murray City, Riverton City, Salt Lake City, Sandy City, city of South Jordan, city of South Salt Lake, city of Taylorsville, West Jordan City, and West Valley City.

Hazard: Dam Failure

Problem Identification:
National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34% of all dam failures. Foundation defects, including settlement and slope instability, account for 30% of all failures. Piping and seepage cause 20% of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam. The remaining 16% of failures are caused by other means.

Goal #1
Include dam failure inundation in future County planning efforts.

Objective 1.1: Priority MEDIUM
Review current State Dam Safety information on all identified high hazard dams in the County

Action:
Include dam inundation maps in current County and City EOPs.
Time Frame: 3-5 Years
Funding: Undetermined
Estimated Cost: $ 10,000.00
Staff: Emergency Services Bureau
Jurisdictions: Countywide
Background: Maps are not current and need to reflect impact on new residential and commercial properties. Utah Division of Water Rights Dam Safety Section in currently reviewing the maps as well as digitizing them. Digitized dam failure inundation maps will aid Salt Lake County in future emergency management planning.

Hazard: Drought

Problem Identification:
Salt Lake County is currently in the fifth year of drought conditions. Measures must be taken to conserve and address water shortages for both culinary and agricultural use.

Goal 1
Reduce hardships associated with water shortages.

Objective 1.1: Priority HIGH
Limit unnecessary consumption of water throughout the County

Action:
Continue to encourage water conservation utilizing and promoting Jordan Valley Water Conservation outreach material with each City in the County.

Time Frame: Ongoing
Funding: Minimal
Estimated Cost: Undetermined
Staff: Should coordinate with local water districts.
Jurisdictions: Countywide
Background: County as well as the State are experiencing severe drought conditions. Increasing water demand will result in water shortages at some point in non-drought years.

Objective 1.2: Priority MEDIUM
Address agricultural water shortages in the County

Action:
In areas of agricultural use livestock water rotation has been setup (Herriman, Riverton, Draper and South Jordan, West Valley City and other areas in the Unincorporated County).

Time frame: Ongoing
Funding: Minimal
Estimated Cost: Undetermined
Staff: Emergency Services, USDA Farm Services Agency, And State Agriculture
Jurisdictions: County agricultural communities Herriman, Riverton, Draper, West Valley, and South Jordan
Background: While agricultural areas are limited in County, there still remain concerns for economic hardship for livestock and crop farmers.

Objective 1.3: Priority Medium
Encourage the development of secondary water systems

Action:
Coordinate with current water systems and develop and secondary waters systems plan for drought

Time frame: Immediate
Funding: Undetermined local sources
Estimated Cost: Minimal
Staff: Water Districts
Jurisdictions: Countywide
Background: To reduce the demand on culinary systems it is proposed that more communities study the possibility of using secondary water for agricultural uses such as irrigation and lawn watering.

Problem Identification:
Severe drought continues to maximize the potential for urban wildland interface fires in areas of the Cottonwood Canyons, Emigration Canyon, Rose Canyon, and Neff's Canyon (Unincorporated County) and Traverse/South Mountain and Bear Mountain (Draper City)

Goal 2 Priority High
Reduce the amount of fuels that can impact residential homes in urban wild land interface areas.

Objective 2.1: Priority HIGH
Study the areas and determine which fire resistant natural vegetation can be used in these areas of concern.

Action:
Develop outreach document specific to fire resistant natural vegetation.
Time Frame: Ongoing
Funding: State/County
Estimated Cost: $5000.00
Staff: County, US Forest Service, Dept. of Agriculture, Utah Living With Fire Committee
Jurisdictions: Targeting URWIN communities adjacent to Forest Service boundary.
Background: Residential property owners need to be educated on the most fire resistant forms of vegetation that can be placed around homes to reduce the threat from wildfire.

Hazard: Earthquake

Problem Identification:
Numerous geologic hazards exist in the Salt Lake City metropolitan area, which can constrain land use. Active fault zones pose the threat of earthquakes, while steep mountains adjacent to the city create a potential for landslides, debris flows, rock falls, and snow avalanches. Streams and the fluctuating level of the Great Salt Lake create serious flood and ground-water problems. Considered as a whole, geologic hazards in the Salt Lake City metropolitan area confront planners with a variety of safety and economic issues that must be addressed before wise development can take place. Limited communication or lack of communication capabilities is always a shortfall during an emergency.

Goal 1
Increase and harden emergency and non-emergency communication systems

Objective 1.1: Priority HIGH
Provide redundancies in countywide communication systems.

Action:
Assess current countywide communications and interoperable emergency/warning systems
Time Frame: 1-2 years
Funding: Federal Grants
Estimated Cost: $ 3,000,000.00
Staff: Emergency Services
Jurisdictions: Countywide
Background: Current countywide communications systems need to be reevaluated.

Objective 1.2: Priority HIGH
Ensure adequate coordination of disaster response and recovery activities.

Action:
Assess EOC's (countywide)
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: $ 3,000,000.00
Staff: Emergency Services
Jurisdictions: Countywide
Background: It is essential to have functional EOC to better coordinate disaster response and recovery activities

Goal 2
Countywide earthquake loss reduction and safety education.

Objective 2.1: Priority MEDIUM

Provide information on earthquake potential effects to homeowners and developers.

Action:
Update current earthquake maps (liquefaction and fault) and incorporated into the County GIS system.

Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Emergency Services, County GIS, County Geologist, and UGS
Jurisdictions: Countywide
Background: Current earthquake data specific to the County needs to be centralized and easily accessible.

Objective 2.2: Priority HIGH
Improve public education regarding earthquake risks to improve quality of construction.

Action:
Ensure current natural hazard ordinance(s) are online, linked to Emergency Services website, and easily accessible and can be download.

Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Unknown
Staff: Emergency Services, County Planning and Zoning, Permitting
Jurisdictions: Countywide
Background: Knowledge of construction requirements in high hazard areas prior to the permit process.

Hazard: Flooding

Problem Identification:
Although located in a semi-arid region, Salt Lake City is subject to cloudburst and snowmelt floods. The Jordan River's three main northern tributaries are diverted into storm sewers beneath the city. During May and June 1983, a sudden warming trend rapidly melted a record mountain snow pack. The resulting runoff quickly exceeded the capacities of the storm sewers, and floodwaters were then diverted onto city streets. The flooding in 1983, and to a lesser extent in 1984, caused flood-control agencies to build sediment basins, install stream-bank protection, and dredge stream channels to reduce flood hazards. The Federal Emergency Management Agency (FEMA) has rated flood plains along the Jordan River and its tributaries for expected flood heights and areas susceptible to 100-year flood-frequency inundation have been delineated on County-wide FEMA Flood Insurance Rate Maps (FIRMs). These maps are updated as development occurs and channel obstructions, culvert modifications, and other changes alter potential flood heights and velocities. Salt lake County ordinances require the lowest flood grades (including basements) in new construction to be a minimum of 1 foot (0.3 m) above the appropriate FEMA flood elevation.

Goal 1
Protection of life and property before, during, and after a flooding event.

Objective 1.1: Priority MEDIUM
Encourage 100% participation in the National Flood Insurance Program

Action:
Assist Holladay City and the Town of Alta to apply for participation in NFIP (National Flood Insurance Program).

Time Frame: 1 year
Funding: None required
Estimated Cost: None

Staff: City Manager, County Emergency Services, And State Floodplain Manager
Jurisdictions: Alta and Holladay
Background: Flood insurance is not available in these communities limiting disaster assistance and participation in future mitigation grants.

Objective 1.2: Priority MEDIUM
Provide current FIRMs for emergency planners.

Action:
Update & digitize floodplain maps
Time Frame: 2-3 year
Funding: County Public Works/Flood Control, State Floodplain Office, and FEMA
Estimated Cost: Unknown
Staff: County Flood Control, County GIS, and FEMA
Jurisdictions: Countywide
Background: Countywide digitized flood maps need to updated in a timely and efficient manner and local emergency planners made aware of how to access and interpret the data.

Goal 2
Reduce threat of unstable canals throughout the county.

Objective 2.1: Priority MEDIUM
Identify countywide canal systems

Action:
Map and assess for structural integrity canal systems in the County
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: Public Works Engineering
Jurisdictions: Countywide
Background: Private and Public canals as well as the Salt Lake Aqueduct are used for transportation and dispersion of water as well as flood control.

Objective 2.2: Priority LOW
Identify dry dams/reservoirs that may have the potential for failure.

Action:
Map and assess all dry dams/reservoirs in the county
Time Frame: 3-5 years
Funding: Federal grants
Estimated Cost: Unknown
Staff: Public Works Engineering, Utah Dam Safety Section.
Jurisdictions: Countywide
Background: A dry dam is used for flood control or temporary irrigation storage

Hazard: Landslide

Problem Identification:
Slope instability has not been a major problem in the Salt Lake area, but as development moves higher into the foothills and nearby canyons slope stability is becoming a major issue affecting future development. Types of slope instability in the Salt Lake area include rock fall, debris flow and debris flood, rotational and transitional slumps, and earth flows. During unusually wet springs in 1983 and 1984 numerous slope failures in the Wasatch Range resulted in debris flows and floods that caused extensive damage to urban

areas north of Salt Lake City (Anderson and others, 1984). Similar failures occurred in canyons adjacent to Salt Lake City, but none reached developed areas.

In Salt Lake County, 56 percent of all slope failures have occurred on hillsides where slopes range between 31 and 60 percent. That statistic prompted Salt Lake County in 1986 to lower the maximum allowable build able slope from 40 percent to 30 percent. Even so, 23 percent of observed slope failures have occurred on slopes of 30 percent or less.

Goal 1
Reduce or eliminate the threat of landslide damage.

Objective 1.1: Priority MEDIUM
Reduce the threat of landslides/debris flow following wild fires.

Action:
Develop protocol for working with State and Federal agencies in developing impact of post fire debris flow hazard.

Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services, National Weather Service, NRCS, USFS, and UGS
Jurisdictions: County communities on Alluvial Fans.
Background: Post fire debris flows have caused significant damage to communities impacted by wild fire.

Objective 1.2: Priority MEDIUM
Monitor historical landslide areas.

Action:
Evaluate current landslide maps to verify accuracy.

Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Jurisdictions: Salt Lake City and Draper
Staff: Emergency Services, County Geologist, UGS, and USGS
Background: Currently available mapping on active landslides within Salt Lake County may not reflect accurately the risk on the ground.

Objective 2.2: Priority MEDIUM
Improve public awareness regarding high-risk landslide areas.

Action:
Have landslide maps readily available on line through County EM website

Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services/County Geologist, UGS, and USGS
Jurisdictions: Target identified high-risk communities.
Background: Allows communities, residents, developers, planners and emergency managers access to information

Hazard: Severe Weather

Problem Identification:
Snowstorms over northern Utah have a dramatic effect on regional commerce, transportation, and daily activity and are a major forecast challenge for local meteorologists. The region is characterized by intense

vertical relief with the Great Salt Lake and surrounding lowlands located near 4300 ft MSL while the adjoining Wasatch Mountains to the east reach as high as 11,000 ft MSL. This relief has major impact on winter storms and results in large contrasts in average annual snowfall. For example, Salt Lake City International Airport (4280 ft MSL) receives an average annual snowfall of 65" while Alta ski area (8750 ft MSL) observes 520". Populated terrain benches surrounding the Salt Lake, which are located 150-200 m higher than the airport, have annual accumulations near 100".

Goal 1
Reduce the threat of life loss due to severe weather.

Objective 1.1: Priority LOW
Become NWS Storm Ready Community

Action:
Contact NWS/SLC Office and begin process of becoming a Storm Ready Community.
Time Frame: Unknown
Funding: None
Estimated Cost: Unknown
Staff: Emergency Services/National Weather Service
Jurisdictions: Countywide
Background: Becoming a Storm Ready Community is a positive public outreach and preparedness effort that involves the entire County.

Objective 1.2: Priority LOW
Improve response times to severe weather alerts.

Action:
Incorporate NWS on light boards on freeway system.
Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services/National Weather Service/UDOT
Jurisdictions: Countywide
Background:

Objective 2.1: Priority LOW
Address Countywide needs of special populations that may be impacted by severe weather conditions.

Action:
Create outreach materials (what to do when severe weather strikes) specific to this group and insert the information into County-wide phone books, and phone books specific to 55+ age group developed in County Aging services.
Time Frame: Unknown
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services/National Weather Service
Jurisdictions: Countywide
Background: Secondary events due to severe weather such as power outages and the shoveling of snow can have a great impact on the elderly population.

Action:
Encourage avalanche preparedness for county backcountry users.
Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal

Staff: City and county Emergency Managers, State Hazard Mitigation Team members, Utah Avalanche Forecast Center.
Jurisdictions: Countywide
Background: Avalanches and avalanche preparedness is not often considered when discussing mitigation on the county or city level, yet several people die each year in Utah's backcountry. While the avalanche terrain is mainly on US Forest Service land the search and rescue for the lost individual in more often than not coordinated by emergency managers with search parties comprised of county and city staff. Introductory avalanche awareness training could lessen the costs to Salt Lake County and the cities within the county. Most avalanche victims die in avalanches started by themselves or someone in there party. Thus, education can limit the number of avalanche related searches each year.

Objective 2.2: Priority MEDIUM
Prevent damage to critical facilities

Action:
Assess EOCs to ensure they are grounded lightning, to include buildings with towers, etc.
Time frame: 2-3 years
Funding: Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services/County Facilities
Jurisdictions: Countywide
Background:

Hazard: Wildfire

Problem Identification:
Utah's typical fire season is the dry period from May through October. Lightning causes the largest numbers of wildfires. The recent wildfires in the western States, the 1994 Tyee fire in Washington, the 1993 Southern California fire siege, and the 1991 Oakland Hills fires are examples of the growing fire threat which results from the Wildland/Urban Interface. The Wildland/Urban interface is defined as the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Since 1985, approximately 9,000 homes have been lost to urban/wildland interface fires across the United States. In 1990 Salt Lake County created a wildland program shortly after a wildland fire threatened Emigration Canyon, a major urban interface area at the county's eastern boundaries. The fire began in a day use picnic area known as Afleck Park, possibly the result of an unattended campfire. The fire quickly spread to the west and up the side of the mountain, with only one ridge between it and Emigration Canyon. The incident lasted for five days, in which time 5500 acres were burned, but fortunately, no one was injured and no structures were lost.

Goal 1
Wildfire community education.

Objective 1.1: Priority HIGH
Reduce overall risk from wild fire through education programs.

Action:
Public awareness through "Fire Wise" programs.
Time Frame: 2-3 years
Funding: Unknown
Estimated Cost: Unknown
Staff: Fire Departments, Utah Living With Fire, US Forest Service, and UFFSL
Jurisdictions: Countywide
Background: Wildfire education will be part of a holistic natural hazard education program pushed countywide. The program will include training on wildfires,

earthquakes, flooding, landslides, and severe weather. Fire Wise training will include Utah specific wildfire safety material developed by the Utah Living With Fire Committee. Urban Wildland Interface areas will be identified and targeted. County and City fire departments in the past have pushed wildland fire prevention and protection techniques with success. Fire departments have used door hangers discussing defensible space, participated in Emigration Canyon public wildfire awareness exercises, and offered free home fire proofing evaluations.

Objective 1.2: Priority HIGH
Educate homeowners on the need to create open space free of burnable fuels near structures in urban wild land areas.

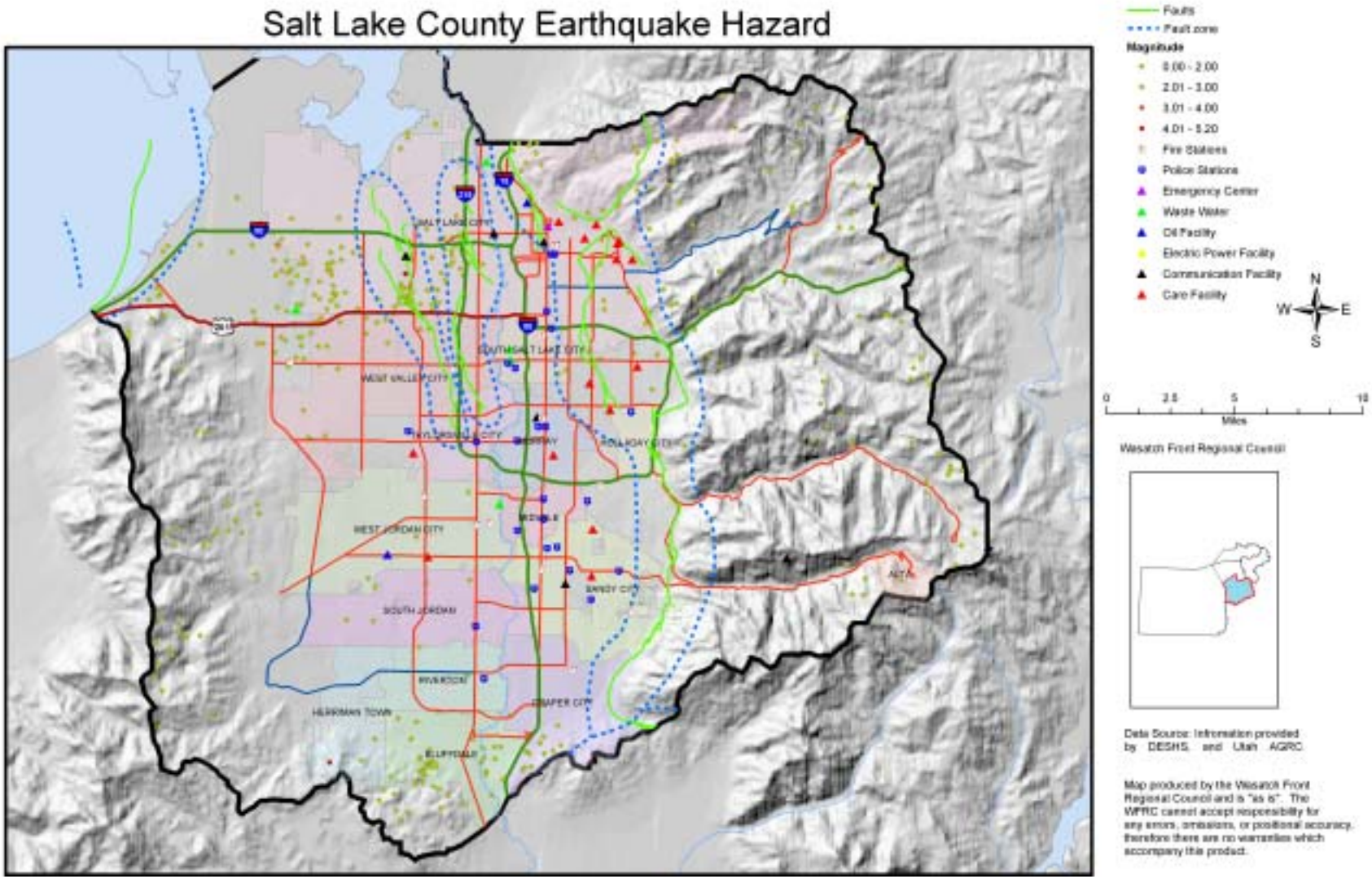
Action:
Defensible space

Time frame: Ongoing
Funding: Local
Estimated Cost: $ 5000.00
Staff: Emergency Services, County and City Fire Departments.
Jurisdictions: Identified URWIN communities
Background: Defensible space is the process of preparing ones home to be easily defended by the fire department in the event a wildfire occurs.

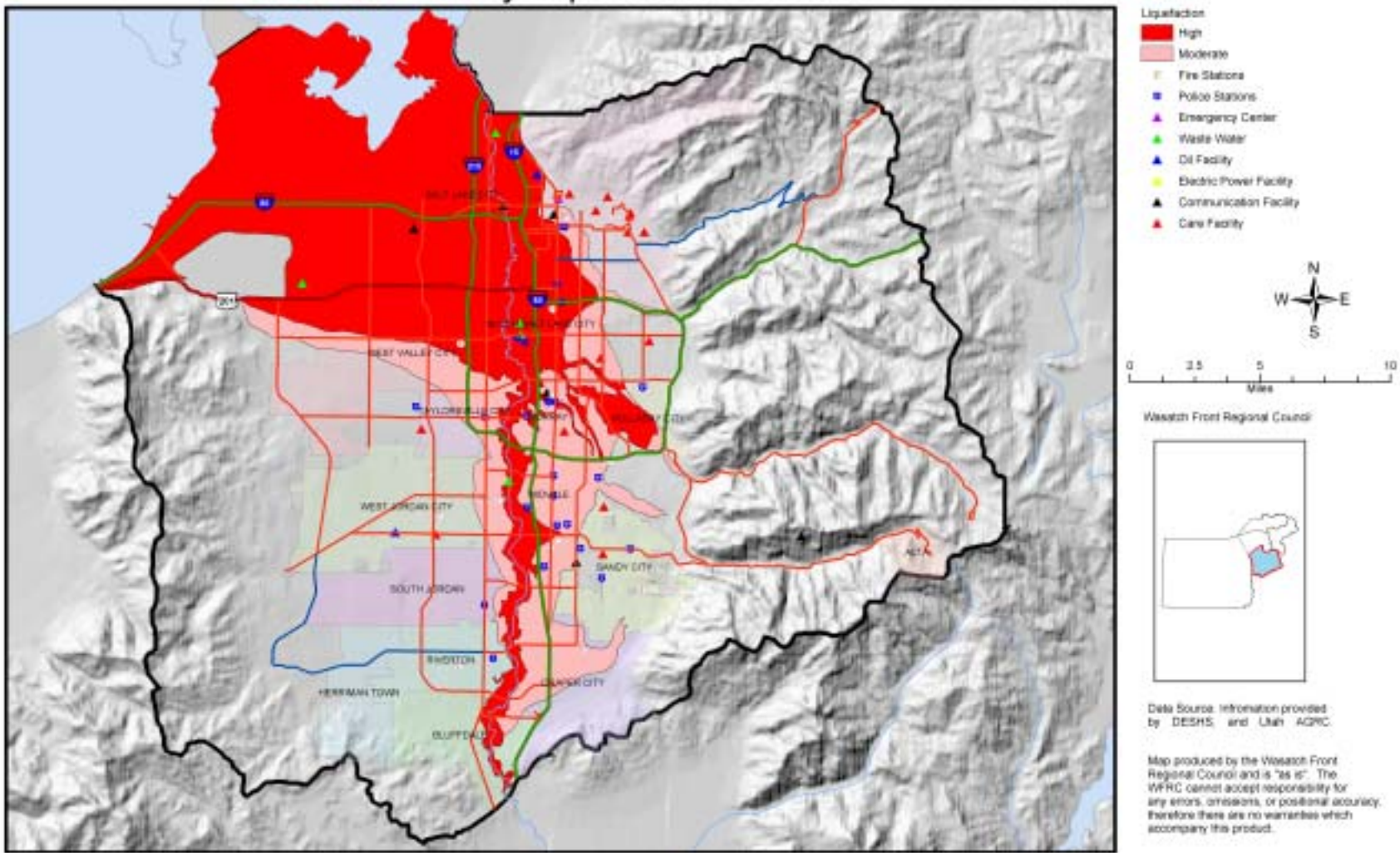
H. Maps

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan.

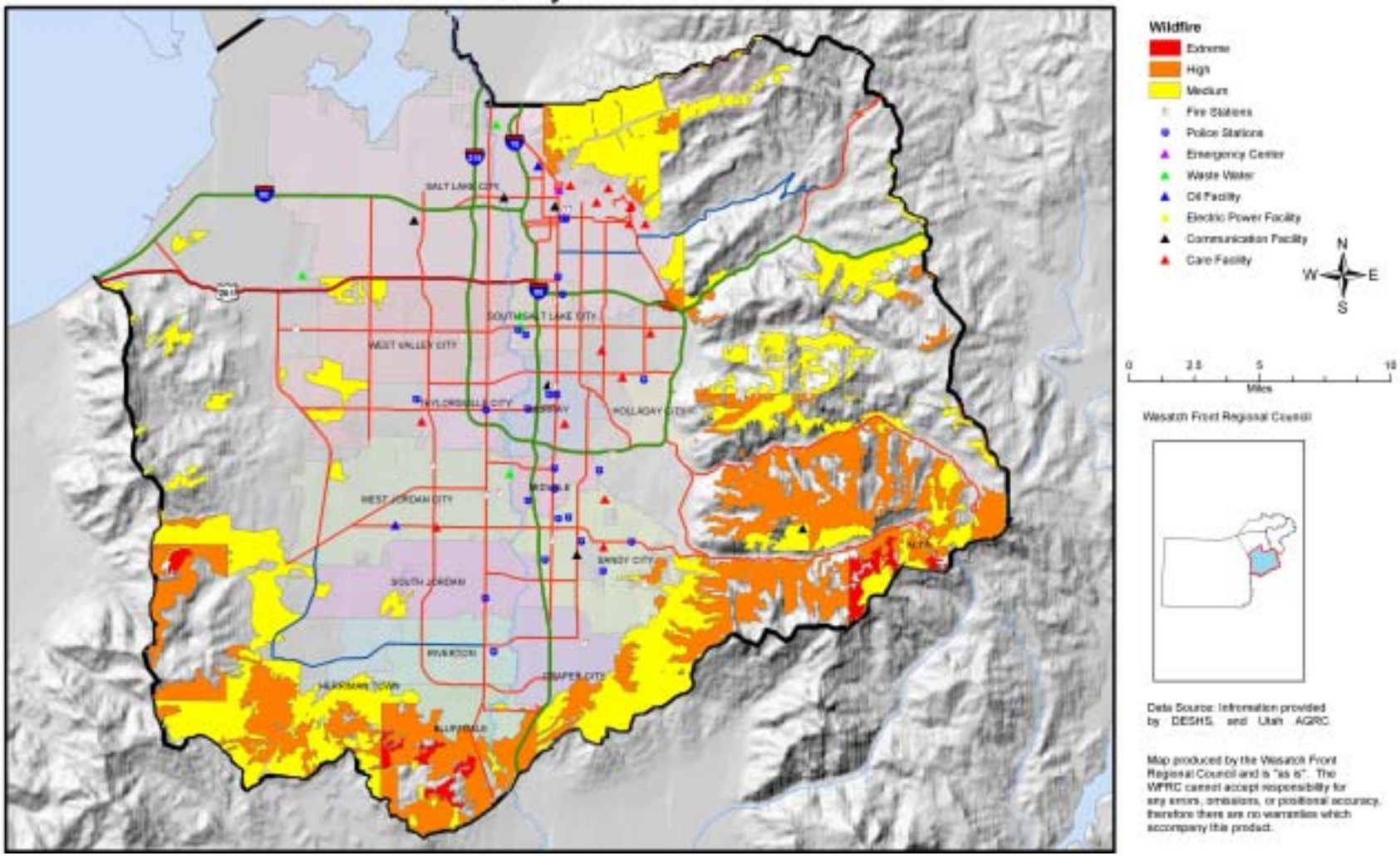
Map 9.1.1 Salt Lake County Earthquake Hazard
Map 9.1.2 Salt Lake County Liquefaction Potential
Map 9.2.1 Salt Lake County Wildfire Risk
Map 9.3.1 Salt Lake County Flood Hazard
Map 9.4.1 Salt Lake County Dam Hazard
Map 9.4.2 Salt Lake County Dam Failure Hazard
Map 9.5.1 Salt Lake County Landslide Hazard


Salt Lake County Earthquake Hazard
Faults
Fault zone
Magnitude
0.00 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.20
Fire Stations
Police Stations
Emergency Center
Waste Water
Oil Facility
Electric Power Facility
Communication Facility
Care Facility
N
W
E
S
0
2.5
5
10
Miles
Wasatch Front Regional Council
Data Source: Information provided by DESHS and Utah AGRC.
Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

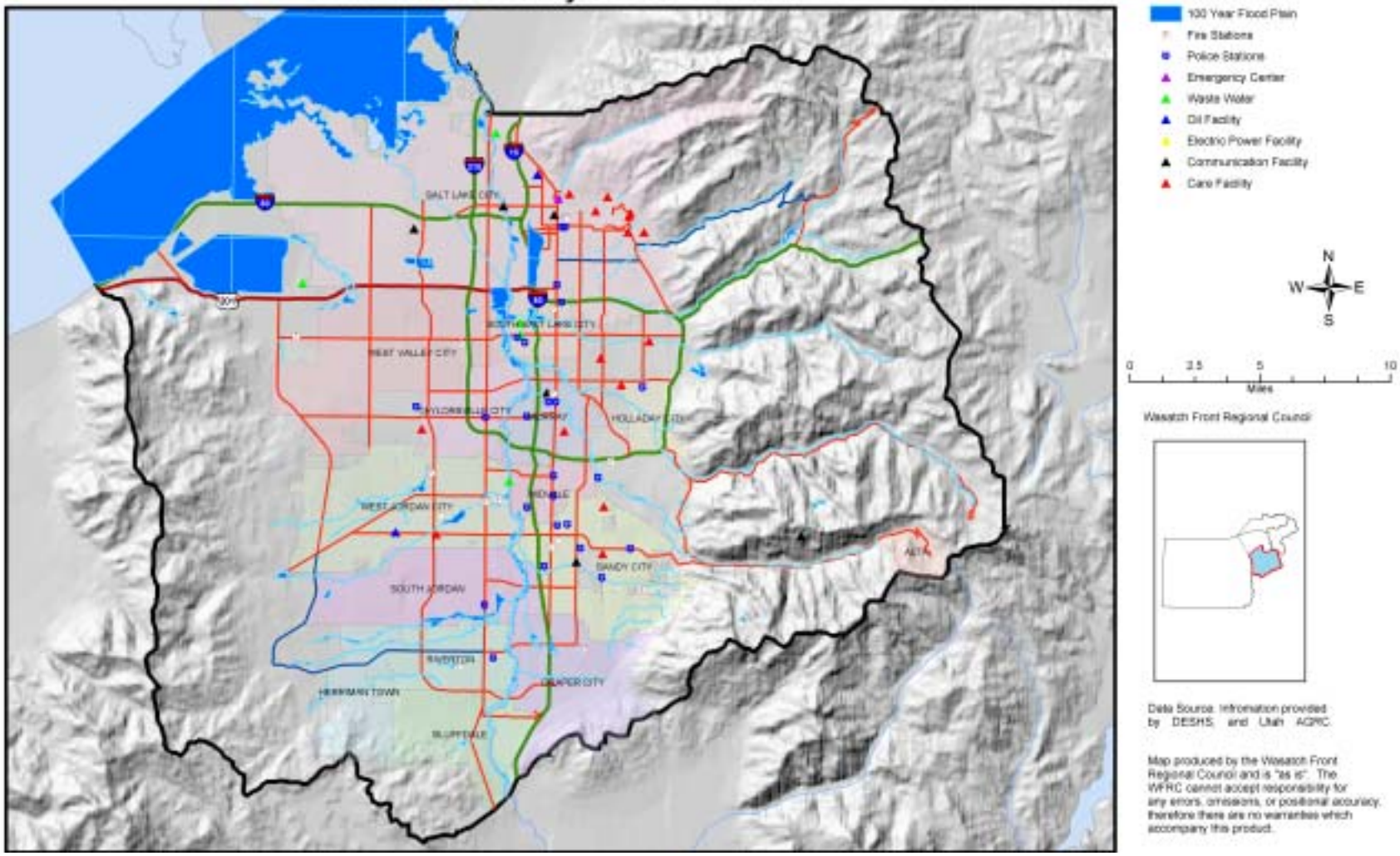
Salt Lake County Liquefaction Potential



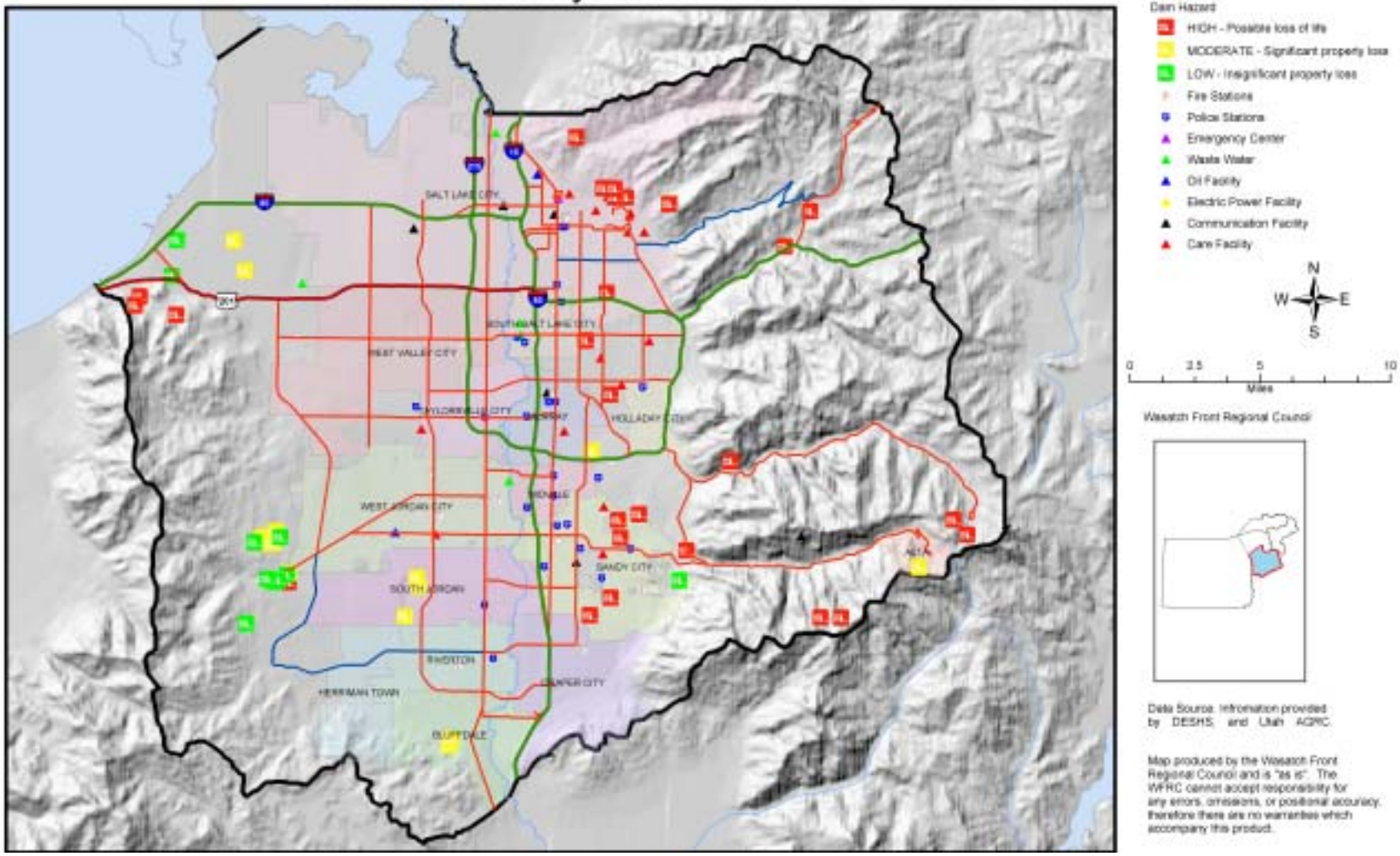
Salt Lake County Wildfire Hazard



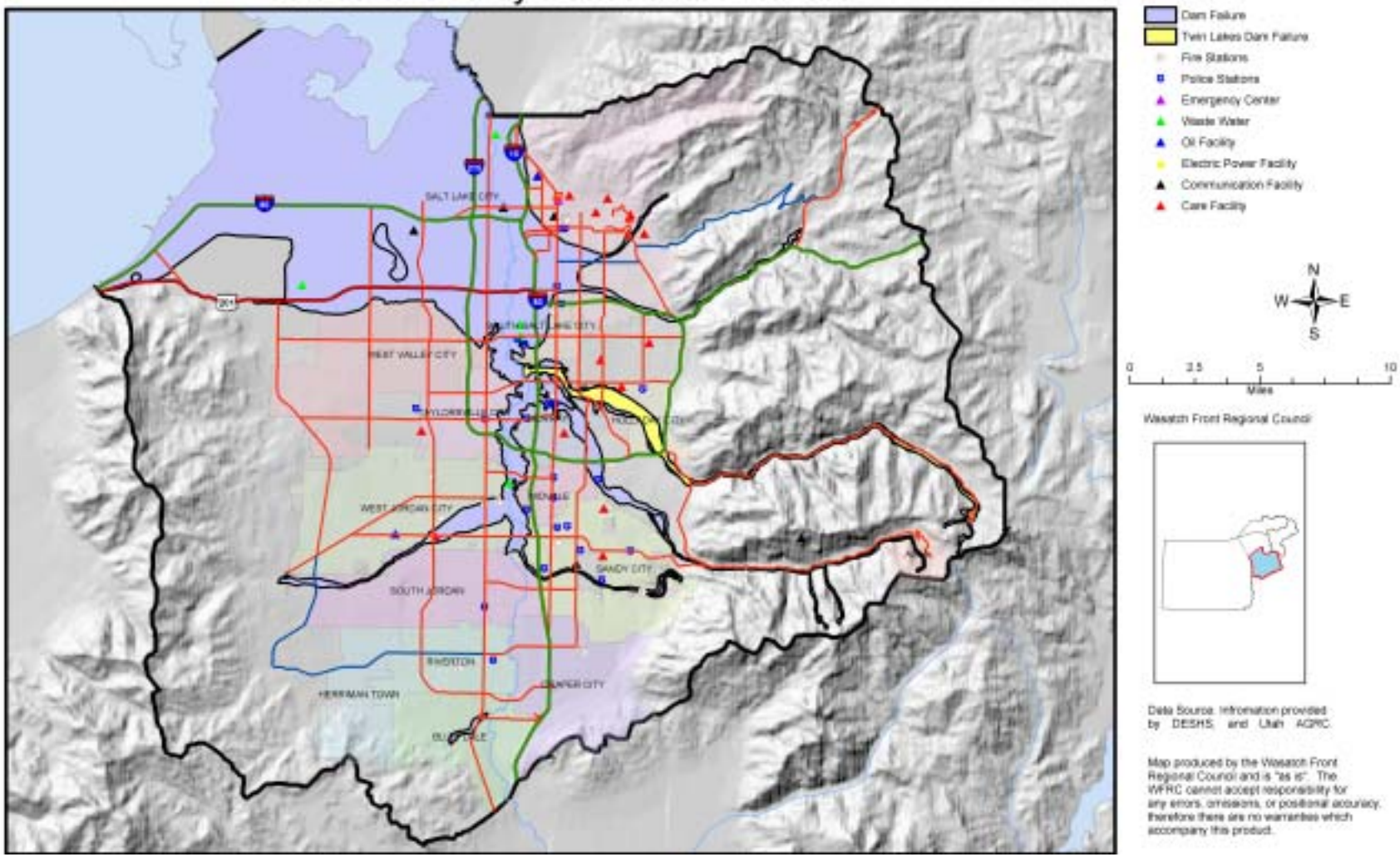
Salt Lake County Flood Hazard



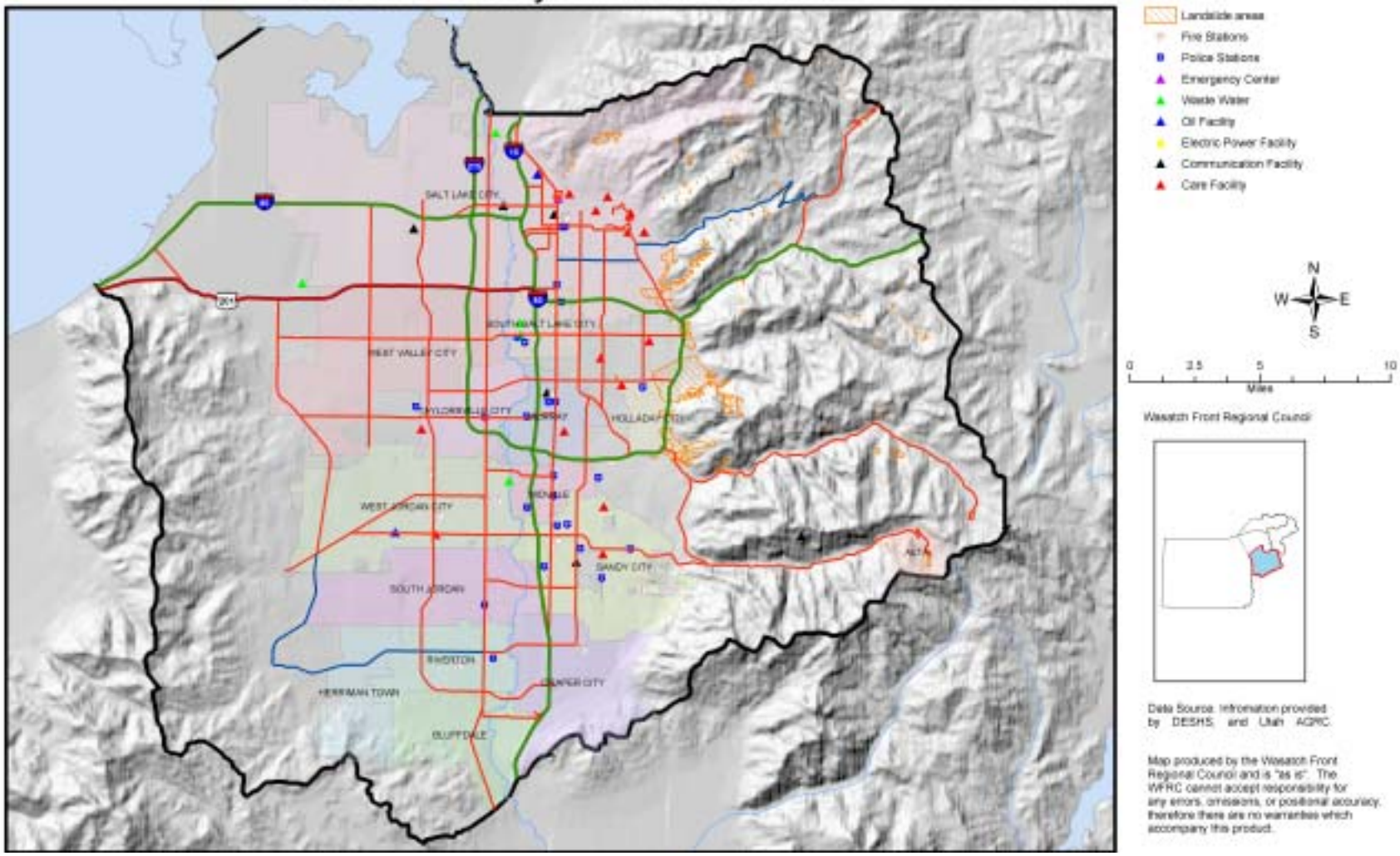
Salt Lake County Dam Hazard



Salt Lake County Dam Failure Hazard

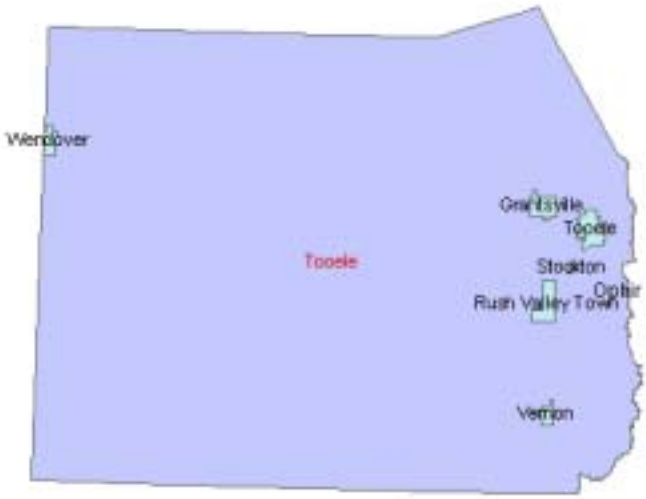


Salt Lake County Landslide Hazard



Part X. Tooele County

Tooele County is the second largest county in Utah in terms of land area, with 6,923 square miles. Salt Lake and Utah Counties bound the county to the east, Juab County to the south by, Davis and Box Elder Counties to the north, and to the west the State of Nevada. Three fourths of the population lives in the eastern valleys where most of the irrigated and dry farm land is located. The western sectors make up the Great Salt Lake Desert and are more arid and generally uncultivated. Tooele County includes seven municipalities: Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the city of Wendover.



A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends are summarized in Table 10-1 below. Understanding population and development trends is important in defining the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community.

Table 10-1 Population

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Tooele County	26,601	40,735	14,134	53.1%	4.4	8	8	4	4
Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Tooele County	26,033	26,601	40,735	50,119	59,780	70,338	79,539	97,055	2.94%

Households by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Tooele County	7,966	8,581	12,677	16,057	19,669	23,679	27,505	35,123	3.46%

Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Tooele County	1.78%	1.54%	1.82%	2.03%	2.14%	2.25%	2.36%	2.57%	1.15%

Household Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Tooele County	1.78%	1.60%	1.81%	2.03%	2.15%	2.28%	2.41%	2.66%	1.29%

Average Household Size by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Tooele County	3.23	3.07	3.11	3.04	2.97	2.90	2.82	2.70	-0.47%

Source Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change

B. Economy

Employment in Tooele County is based on four main types of industry according to the Employment Distribution of 2000; Government and Local Government 30.9% (Federal Defense- Tooele Army Depot and Dugway), Trade 19.4% (restaurants, grocery stores, department stores), Services 17.5% (health care, engineering services, and business services), and Manufacturing 13.3%. Other industries include Construction 5.4%, Fire 2.6%, and Transportation/ Communication/ Utilities 10.9%. Some of the largest employers include Tooele County School District, Dugway Proving Grounds, EG&G Defense Materials, Detroit Diesel, Magnesium Corp of America, Wal-Mart, Tooele County, Tooele Valley Regional Medical Center, Battelle Memorial Institute, and Envirocare of Utah. Top private sector employers include EG&G, Magnesium Corporation of America, Detroit Diesel, Laidlaw Environmental, Wal-Mart, Mortan Salt, Smiths, and Albertson's.

In 2000 the average monthly wage in the county was $2,508, 4% higher than the state average of $2,401. This was mainly due to the amount of federal employees. However, recent federal job losses have reduced Tooele County wages closer to the state average. Total personal income in millions in 2000 and 2001 was $772 and $840 respectively. The 2001 per capita income was $18,906 and the average monthly nonfarm wage for 2001 was $2,585. The unemployment rate in 2000 was 5.3% with the unemployed labor force equaling 642.

Tooele County migration patterns show that most of the 1980's is characterized by out-migration. However, in the 1990's the pattern reversed and beginning in 1996 in-migration from Salt Lake County residents began, mainly for the cheaper housing in the county.

C. Transportation and Commuting Patterns

The major transportation routes within the county include Interstate 80 (I-80), which runs east west and carries the most traffic. The 2000 annual average daily traffic volume for Interstate 80 was 36,170. Another major route is State Route 196 (SR 196) that extends north south close to the central portion of the county. The 2000 annual average daily traffic volume for SR 196 was 305. State Route 36 (SR 36) from Mills Junction also extends north south on the eastern edge of the county and has an average daily traffic volume of 25,820. State Route 138 (SR 138) is the connection route from I-80 to Grantsville and Mills Junction. This route has an average daily volume of 7,305 in 2000. Local County Road 2694 runs north south and connects I-80 to Grantsville and has an average daily traffic volume of 1450 users. State Route 112 (SR 112) beginning from SR 138 into Tooele City had 2000 annual average daily traffic volume of 5,145. State Route 199 (SR 199) had 955 average daily users from SR 36 west of Rush Valley.

D. Land Use

Construction activity in the county has been climbing since the last 1990's and in 1996 exploded. In 2000 and 2001 the housing growth slowed slightly, but still remains highly active. The 2000 numbers for persons per square mile within the county was 5.9, ranked 15th in the state. Percent of land ownership is 78.5% Federal, 5.9% State, 0.3% Native American, 11.2% Private and Local Government, 4.1% water.

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. A majority of the county is expected to be developed for residential uses. These local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Population growth and new commercial development are expected to occur in relatively undeveloped areas of the region. New commercial development is projected in Tooele County is serve the increasing numbers of residences in the county. Tooele County, is projected to more than double its population to 97,055. A significant portion of this increase is expected to commute to Salt Lake County to work. Recent census data shows that approximately 40 percent of Tooele County workers commute to Salt Lake County.

Tooele County has taken measures to help eliminate the risk related to natural hazards including drought, infestation, and severe weather. These measures include giving discounts or credits to those residents who use less water. Infestation has been mitigated through research activities identifying breeding patterns, control methods, and feeding and reproducing patterns. Tooele County is the first and only "Storm Ready Community" in Utah; this allows those participating agencies to always stay on top of severe weather hazards. For more information review Section G for specific mitigation actions.

E. Risk Assessment

The risk assessment process revealed the following for identified hazards of drought, wildland fire, severe weather/ flash flood, earthquake, and infestation. Severe weather and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are 39 critical facilities in Tooele County, refer to Appendix D for a complete list for the entire county.

1. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

Potential wildfire hazard within Tooele County is growing as population growth is spreading into wildland areas known as Urban-Wildland Interface Zones. Over the past 20 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property.

According to the County Emergency Operations Plan the following communities and surrounding areas are within the interface zone; Lofgreen, Vernon, Faust, Ophir, Mercur, Deseret Chemical Depot, Rush Valley, Big Hollow Canyon, Terra, Dugway, Skull Valley, Grissamar's Farm, Hogan's Ranch, Stockton, Soldier Canyon, Settlement Canyon, Tooele Army Depot, Pine Canyon, South Willow Canyon, Outer Grantsville City, Erda.

Wildfire maps were created using GIS and can be viewed in Section H Map 10.1.1 Tooele County Wildfire Risk. The map layers were provided by DESHS and show five categories of wildfire risk:

- Extreme
- High
- Medium
- Low
- Very Low

These ratings cover all of Tooele County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment. For an idea of the wildfire history for Tooele County refer to Table 10-5.

Vulnerability Assessment

The following tables identify the value and number of structures, infrastructure, and critical facilities located in the wildfire areas, population numbers are also included (Tables 10-2, 10-3, 10-4).

Table 10-2 Structures and Population in Wildfire Area

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres of Moderate	Number of Structures within Wildfire Risk Area		Population In Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	

Grantsville	10,873	0	5	1362	0 / $0	24 / $3,006,432	64
Ophir	37	0	0	13	0 / $0	2 / $250,536	0
Rush Valley	11,560	0	91	4,336	0 / $0	22 / $2,755,896	46
Stockton	1,085	0	0	503	1 / $800,000	45 / $5,637,060	100
Tooele City	13,521	21	1,850	4,806	26 / $77,900,000	796 / $99,713,328	2,415
Vernon	5,143	0	0	13966	0 / $0	3 / $375,804	7
Wendover	5748	0	0	0	0 / $0	0 / $0	0

Table 10-3 Infrastructure Affected by Wildfire

Item	Length (Miles)	Replacement Cost
Local Roads	55.21	$110,420,000
State Highways	67.46	$162,823,157
US Highways	0.00	$0
US Interstates	12.66	$45,582,480
Power Lines	151.58	$7,318,282
Gas Lines	0.00	$0

Table 10-4 Critical Facilities Within Wildfire Area

Facility Type	Name	City	Wildfire Risk
Communication	KUUU Channel 221	Unincorporated	High
Communication	KTVX Channel 4	Unincorporated	Moderate
Fire Station	North Tooele Co. Fire	Unincorporated	High

Table 10-5 Wildfire History

Date	Fire Name	Cause	Size
6/18/84	Skull Valley	Lightning	300 - 999 Acres
7/12/84	Magpie	Lightning	300 - 999 Acres
7/7/85	Faust Fire	Lightning	1000 - 4999 Acres
7/8/85	Lofgreen	Lightning	300 - 999 Acres
7/30/85	Antelope Canyon	Lightning	300 - 999 Acres
8/26/85	Teko Test Range	Lightning	1000 - 4999 Acres
6/27/86	Salt Mtn	Equipment	1000 - 4999 Acres
7/10/86	Circus	Cigarette	1000 - 4999 Acres
7/14/86	Pole	Lightning	1000 - 4999 Acres
7/28/86	Tracy	Equipment	300 - 999 Acres
8/8/86	Cristine	Lightning	1000 - 4999 Acres
8/28/86	Sheep Lane	Lightning	300 - 999 Acres
6/15/87	Ripple Valley	Lightning	> 5000 Acres
6/19/87	BLM Fire # R040	Miscellaneous	300 - 999 Acres
6/24/87	Double Decker	Debris Burn	1000 - 4999 Acres

7/5/87	Torch Turnover	Incendiary	300 - 999 Acres
8/14/87	Coyote	Lightning	300 - 999 Acres
9/12/87	Quincy	Lightning	> 5000 Acres
9/20/87	Post Hollow	Equipment	1000 - 4999 Acres
10/11/87	Winter Springs	Incendiary	300 - 999 Acres
6/14/88	Mud Spring	Miscellaneous	1000 - 4999 Acres
6/16/88	South Davis	Equipment	1000 - 4999 Acres
6/22/88	Davis Complex	Incendiary	> 5000 Acres
7/25/88	South Marble	Lightning	1000 - 4999 Acres
8/14/89	Lakeside	Lightning	1000 - 4999 Acres
8/21/89	Box Elder	Lightning	1000 - 4999 Acres
10/11/89	White Rock	Debris Burn	1000 - 4999 Acres
8/9/90	Big Hollow Complex	Lightning	> 5000 Acres
8/10/91	Cold Spring	Miscellaneous	300 - 999 Acres
8/23/91	West Stansbury	Miscellaneous	300 - 999 Acres
8/25/91	Confusion	Lightning	300 - 999 Acres
6/21/92	Rush Lake	Lightning	300 - 999 Acres
6/21/92	Rush Lake	Lightning	300 - 999 Acres
7/10/93	Table Mountain	Incendiary	300 - 999 Acres
6/7/94	Hatch Well	Miscellaneous	300 - 999 Acres
6/26/94	Choke Cherry	Miscellaneous	1000 - 4999 Acres
7/2/94	Terra	Lightning	1000 - 4999 Acres
7/28/94	Castle Rock	Lightning	1000 - 4999 Acres
8/2/94	Skunk Ridge	Lightning	300 - 999 Acres
8/12/95	South Mountain Fire	Miscellaneous	300 - 999 Acres
6/14/96	Round Top	Incendiary	> 5000 Acres
7/3/96	Gold Hill Fire	Lightning	1000 - 4999 Acres
7/8/96	Davis Knolls	Lightning	> 5000 Acres
7/23/96	Simpson	Incendiary	1000 - 4999 Acres
7/27/96	Aqueduct	Miscellaneous	1000 - 4999 Acres
8/1/96	North Stansbury Complex	Miscellaneous	> 5000 Acres
6/29/97	Railroad #1	Railroad	1000 - 4999 Acres
7/15/97	South Area Fire	Miscellaneous	300 - 999 Acres
8/19/97	Lakeside	Miscellaneous	300 - 999 Acres
9/11/97	Penny's Fire	Lightning	300 - 999 Acres
7/4/98	Simpson Springs	Miscellaneous	1000 - 4999 Acres
7/13/98	Tekoi	Miscellaneous	> 5000 Acres
7/20/98	Topliff	Lightning	> 5000 Acres
6/23/99	Pony Road	Miscellaneous	> 5000 Acres
7/2/99	Rush Fire	Lightning	1000 - 4999 Acres
7/7/99	Clover	Lightning	300 - 999 Acres
7/11/99	Hwy 36	Equipment	1000 - 4999 Acres
8/28/99	Marble Head	Lightning	300 - 999 Acres
8/28/99	Flat	Lightning	1000 - 4999 Acres
8/31/99	Parker Fire	Incendiary	300 - 999 Acres
11/5/99	Salt Mountain	Debris Burn	300 - 999 Acres

6/10/00	Brown Springs	Miscellaneous	1000 - 4999 Acres
6/18/00	Bullion	Lightning	1000 - 4999 Acres
7/5/00	Barrow Pit	Railroad	1000 - 4999 Acres
7/10/00	Cedar Mountain	Lightning	300 - 999 Acres
7/26/00	Cattle Rock	Lightning	> 5000 Acres
8/1/00	Box Canyon	Lightning	300 - 999 Acres
8/12/00	Dry Fork Ii	Lightning	1000 - 4999 Acres
6/9/01	Eight Mile	Lightning	1000 - 4999 Acres
7/4/01	Harrison	Lightning	300 - 999 Acres
7/14/01	Monarch	Lightning	300 - 999 Acres
8/3/01	Magcorp	Lightning	1000 - 4999 Acres

2. Earthquake

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	The Intermountain Seismic Belt, Wasatch and Magna Fault Zones, along with the Oquirrh Marginal and Six Mile Creek Fault Zones. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. The Salt Lake Segment of the Wasatch Fault Zone underlies the Salt Lake valley. The combined average repeat time for large earthquakes on any of the five central segments (Brigham City, Weber, Salt Lake City, Provo, and Nephi segments) of the Wasatch Fault zone is 350 years. The average repeat time on any single segment ranges from about 1200-2600 years. The last earthquakes on the five central segment range from 620-2120 years ago. On the Salt Lake City segment the probability may be as high as 57 percent in 100 years. A large earthquake on any of the five segments has the potential to affect Tooele County.

Within Tooele County 13 fault zones have been identified. The Topliff Hill Fault Zone is located along the west side of the East Tintic Mountains near southern Rush Valley. The most recent geologic Paleoevent was Late Quaternary faulting. Another fault in the county is the Cedar Mountains Faults (East Side). These are short north-trending normal faults along the east side of Cedar Mountains, Quaternary age faulting. The Skull Valley Faults (Mid-Valley) are located in northern and southern Skull Valley; most recent paleoevent was during the Latest Quaternary (later than the Provo Shoreline). The Stansbury Fault Zone is along the western side of the Stansbury Mountains. The most recent Paleoevent was Latest Quaternary. Saint John Station Fault Zone is also a poorly understood zone of Late Quaternary faulting near Saint John Station in southern Rush Valley. The Oquirrh Fault Zone is a Holocene range-front normal fault along the western base of the Oquirrh Mountains. Southern Oquirrh Mountains Fault Zone is a Late Quaternary normal fault bounding the west flank of the southern Oquirrh Mountains. The Deep Creek Faults are poorly understood faults near the northern end of the Deep Creek Range at the Utah-Nevada border, believed to be Quaternary. Deep Creek Range Fault Zone (Northwest Side) is late Quaternary faulting on the northwest side of the Deep Creek Mountains. The Lookout Pass Fault is a poorly understood Quaternary fault on the south side of Lookout Pass. Sheeprock Fault Zone in also a poorly understood zone of late Quaternary faulting along the eastern side of the Sheeprock Mountains and Red Pine Mountain. Vernon Hills Fault Zone is of Late Quaternary faulting on the east side of the Vernon Hills. The Puddle Valley Fault Zone includes three short faults in Quaternary basin-fill deposits east of the Grassy Mountains in northwestern Utah.

Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Tooele County. This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years (Table 10-6).

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on some average probability per year, all probabilities are added, a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain time in years. The values listed are for the nearest grid point in decimal degrees 39.70000 Lat and –66.39999 Long.

For a more detailed explanation of values used and metadata refer to the USGS Earthquake Hazards Program website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The cities of Stockton, Ophir, and Rush Valley coordinate systems were unable to be identified for earthquake probabilistic hazard values.

Table 10-6 Earthquake Probabilistic Hazard- Ground Motion Values

	10% PE in 50 Year	**5% PE in 50 Year**	**2% PE in 50 Year**
Wendover 40:44:08 114:02:09			
PGA	0.5000000	0.5000000	0.5000000
0.2 sec SA	0.5000000	0.6722878	1.288123
0.3 sec SA	0.5000000	0.6338887	1.265440
1.0 sec SA	0.2500000	0.2552070	0.6580135
Grantsville 40:35:49 112:28:03			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477
Tooele City 40:32:11 112:18:05			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477
Vernon 40:05:29 112:26:59			
PGA	0.5000000	0.7227937	1.286365
0.2 sec SA	1.150691	1.918589	3.374138
0.3 sec SA	1.079845	1.796840	3.309244
1.0 sec SA	0.4727494	0.8908601	1.830477

Vulnerability Assessment
The potential losses attributed to the earthquake hazard are identified in the tables below, including the type and number of residential, commercial, and critical facilities located in the earthquake hazard area (Tables 10-7, 10-8, 10-9).

Table 10-7 Structures and Population in Earthquake Fault Zone

City Name	City Area (Acres)	Acres in Earthquake Fault Zone	Number of Structures within Earthquake Fault Zone		Population in Hazard Areas
			Commercial/ Annual Sales	Residential/ Replacement Value	
Grantsville	10,873	0	0	0	0
Ophir	37	3	0	0	0
Rush Valley	11,560	783	0	8 / $1,002,144	23
Stockton	1,085	0	0	0	0
Tooele City	13,521	284	0	98 / $12,276,264	314
Vernon	5,143	0	0	0	0
Wendover	5748	0	0	0	0

Table 10-8 Infrastructure in Earthquake Area

Item	Length (Miles)	Replacement Cost
Local Roads	22.80	$45,600,000
State Highways	58.92	$142,205,592
US Highways	0.00	$0
US Interstates	8.12	$29,246,760
Power Lines	109.69	$5,295,833
Gas Lines	0.00	$0

Table 10-9 Critical Facilities in Earthquake Area

Name	City
Waste Water Facility	Unincorporated
Lake Point Improvement District	Lake Point

HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 10-10 identifies the probable casualties during an earthquake.

Table 10-10 Casualties

Casualties	Nighttime –Minor	241
	Nighttime –Major	6
	Nighttime -Fatalities	11
	Daytime –Minor	278
	Daytime –Major	10
	Daytime- Fatalities	19
	Commute –Minor	239
	Commute –Major	8
	Commute-Fatalities	15

Building Damage by Count

Building damage is classified by HAZUS MH in five damage states: none, slight, moderate, extensive and complete. Table10-11 lists the number buildings by occupancy, which is estimated to have moderate to complete levels of damage. Table 10-12 identifies the critical facilities affected by earthquake.

Table 10-11 Building Damage by Count with Moderate to Complete Damage

Category	Number of Structures
Residential	1,151
Commercial	42
Industrial	9
Totals	5,216*

*****Includes all building categories with moderate to complete damage

Table 10-12 Critical facilities

Classification	Total	Least Moderate Damage >50%	Complete Damage > 50%	Functionality > 50% at day 1
Hospitals	1	1	0	0
Schools	22	0	0	7
EOCs	0	0	0	0
Police Stations	6	0	0	0
Fire Stations	5	0	0	1

Debris Removal
Table 10-13 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 10-13 Debris Generated (thousands of tons)/Loads to Remove Debris

Debris Generated	187
Loads (25 tons per load)	7,480

Fire Following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 10-14 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 10-14 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	3
People Displaced	68
Value Exposed (mill. $)	3

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

3. Infestation

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Agricultural lands, Forested areas, areas of extreme drought, countywide		
Seasonal Pattern or Conditions	Summer months, related to drought		
Duration	Months to years		
Analysis Used	Reviewed information provided by UGS, DESHS, AGRC, Idaho's Forest Health Protections agency, Utah Forestry Fire and State Lands, Utah Forest Service, Utah State University Extension Service, and local input.		

Description of Location and Extent

Tooele County has experienced several destructive insect infestations in the past mainly from grasshoppers, crickets and other insects. In 1999 Tooele County along with several other counties, declared an insect emergency due to the grasshopper inundation that was one of the most severe in recent history. In the small community of Ibapah there were as many as 177 grasshoppers per square yard, a count of eight per square yard is considered an infestation. The county requested funding to help fight the grasshoppers that were causing severe damage to farmland, and even suburban lands. In 1999 grasshoppers infested 30,000 acres and Mormon crickets infested 490,000 acres. A total of 7,262 acres were treated to fight the infestation.

The forests of Tooele County have been infested with numerous destructive insect species that are described further in the paragraph below. Surveyors from Boise, Idaho's Forest Health Protection conducted a study based on infestation in Utah's forests. With help from the Forest Health Coordinator from Utah Forestry Fire and State Lands (FFSL) the following information was made available. No other known county data was available.

In 1998 no surveys were conducted. In 1999 3% of the counties' total acres were surveyed, the Douglas Fir Beetle affected 999 trees or 497 acres and the Spruce Beetle affected 30 acres. The Fall Cranker worm affected 207 acres, and the Aspen Defoliation struck 55 acres. In 2000, 2001, and 2002 no surveys were conducted.

Because of the amount of forested lands within the county the risk potential of infestation is countywide. The probability of a future event is closely related to the probability of drought. Therefore if the county continues to remain in a drought cycle, infestation will also be a problem. Infestation affects agricultural lands, and therefore, the local economy suffers from related impacts. Infestation once in place can last from several months to years.

Vulnerability Analysis

Due to the lack of digitized data and geographic extent of infestation potential loss estimates and a complete vulnerability analysis was unable to be completed. However, current monitoring of the infestation species is providing information on mitigation actions to pursue in a future event. Monitoring has also provided a better understanding of what has been affected in the past.

F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Included in Table 10-15 Hazard Histories are hazard events with as much relevant information as was available including date, location, area impacted, and damage costs. Problem soil, and severe weather events including infestation, avalanche, lightning, and high winds are not included in the table. Due to the geographic extent and nature of these hazards past events have not been recorded.

Table 10-15 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Avalanche	1876	Ophir Canyon		1 death, property damages.
Flood	07/23/1878	Skull Valley	Johnson's Settlements	2 deaths and loss of cattle
Avalanche	1926	Ophir Canyon		Property damage
Avalanche	1939	Ophir Canyon		3 deaths
Flood	06/04/1945	Tooele City		Streets flooded
Drought	1953-1965	Regional		
Flash Flood	08/23/1955	Grantsville		Flooding along Durfee Street
Flood	08/25/1961	Gold Hill		Deep Creek and Bar Creek. Dam destroyed worth $10,000.
Flood	06/03/1963	Wendover	US 40-50 flooded	Property damage.
Flood	06/17/1963	Tooele		Roads (Main and Vine) and residents flooded.
Tornado	06/01/1965			F1
Tornado	06/25/1965			
Tornado	08/09/1965			F1
Flood	06/10/1967	Tooele		Roads and homes flooded.
Tornado	05/22/1968	Dugway Proving Grounds		F1
Flood	08/10/1968	Tooele		Residential and commercial property flooded. Worst in 50 years.
Flood	05/17/1973	Ophir	Ophir Creek	Residential and culinary water system damage.
Drought	1974-1978	Regional		
Mudslide/ Slope Failure	05/14/1984	Middle Fork Canyon	Carr Fork Mine	1 death
Waterspout	06/25/1985		Great Salt Lake	
Waterspout	09/10/1986		Great Salt Lake	
Tornado	07/25/1991	Erda		F1. Property damage.
Tornado	05/03/1993	Erda		F1. $50000 in damage.
Lightning	08/23/2000	North End Stansbury Mtns.		2 deaths

G. Mitigation Goals, Objectives, and Actions

Tooele County
Pre Disaster Mitigation FY2003
(PDM03) Workbook

County: Tooele
Address: 47 S Main Street
City: Tooele
Zip Code: 84074

Point of Contact: John Michaelson
Phone: 435-843-3267

Signature: Kari Sagers
County/Tribal Emergency Management Director
Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group. Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name: Kari Sagers	Title: Director T.C.E.M.
Name: John Michaelson	Title: Hazard Analyst
Name: Raymond Johnson	Title: Tooele County Engineer
Name: Dana Truman	Title:
Name: Matt Palmer	Title: Tooele County
Name: Nicole Cline	Title: Tooele County Planner
Name:	Title:
Name:	Title:

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s). Include additional sheets of information as needed.

Date: November 13, 2003
Time: 09:30
Place: Tooele County Emergency Management Office

Purpose of Meeting:
Discuss mitigation strategies for natural hazards in Tooele County

List of Attendees:
Kari Sagers
John Michaelson
Dana Truman
LaNiece Dustman
Jim Boes
Matt Palmer
Nicole Cline

Summary of Meeting:
The group completed the drought hazard identification and it was decided that we would split up the rest of the tasks to the people who knew those hazards best. It was also decided that we could accomplish the entire task by e-mail and phone conversations.

Outcome of Meeting:
Created a working group and mitigation workbook for future hazards.

*The term "countywide" shall include the following jurisdictions: Grantsville City, Ophir Town, Rush Valley Town, Stockton Town, Tooele City, Vernon Town, and the City of Wendover.

Hazard: Drought

Problem Identification:
Large areas that lack sufficient precipitation to maintain ground water levels within the County, affecting culinary, agricultural and commercial/industrial uses.

Objective 1: Priority HIGH
Take actions to maintain adequate culinary water supplies

Action:
Develop a public awareness campaign to encourage water conservation.
Time Frame: Ongoing
Funding: Apply for available local, state, and federal grants
Estimated Cost: TBD
Staff: County USU Extension, Health Department, Emergency Management and auxiliary personnel.
Background: Multi-agency coordination effort

Action:
Establish economic incentives for water conservation.
Time Frame: Ongoing
Funding: Grants available through state government
Estimated Cost: TBD
Staff: City Officials, Local water systems
Background: Awareness to city and local officials

Objective 2: Priority MEDIUM

Protect water aquifers

Action:
Create and enforce zoning (land use) to protect primary recharge areas.

Time Frame: Ongoing enactment of ordinances
Funding: Local government funding
Estimated Cost: TBD
Staff: Existing planners, planning commissions, engineers, and public officials
Background: Educate planners and formal adoption of ordinances

Action:
Watch countywide inventory data from public, private, and monitoring wells.

Time Frame: Ongoing
Funding: Local funds supplemented by grants made available
Estimated Cost: TBD
Staff: Health Department, USGS, and Emergency Management personnel coordinated effort
Background: Data has been available, but intra-agency coordination needs to be improved

Hazard: Wildland Fire

Problem Identification:
Lack of code enforcement within and awareness of the Wildland Urban Interface.

Objective 1: Priority HIGH
Take actions to enforce the codes that are currently in place.

Action:
Find personnel qualified to inspect property with regard to Wildfire Protection Standards

Time Frame: 6 months
Funding: N/A
Estimated Cost: None
Staff: City and county fire departments, Emergency Management and Engineering
Background: Regular Fire Warden duties stand in the way of inspection.

Objective 2: Priority MEDIUM
Educate persons living or working in these areas about the hazard.

Action:
Present Fire Wise workshops for residents of high-risk areas.

Time Frame: Ongoing
Funding: N/A (Fire Wise materials are provided free of charge)
Estimated Cost:
Staff: Fire Warden, fire personnel and county planners
Background: People are not being informed of potential hazards.

Action:
Inform people seeking building permits and realtors showing homes in these areas of the risk.

Time Frame: Ongoing
Funding: Local government funding
Estimated Cost: TBD
Staff: Fire Warden, fire personnel and county planners
Background: Potential homebuilders and buyers are not aware of the risk or the building codes to help mitigate the risk.

Action:
Determine the specific areas where the Wildfire Protection Standards are in effect and make it available to the public in a graphic form.

Time Frame: 6 – 12 months
Funding: N/A
Estimated Cost: None
Staff: County GIS Dept. and Emergency Management Staff
Background: Knowledge of these areas is vague and only passed on verbally.

Hazard: Severe Weather

Problem Identification:
Severe weather related incidents result in a large number of disaster declarations and emergency response needs.

Objective 1: Priority MEDIUM
Educate more citizens about recognizing and knowing the dangers of severe weather hazards.

Action:
Increase Weather Spotter training

Time Frame: Ongoing
Funding:
Estimated Cost: Minimal
Staff: Emergency Management Staff and National Weather Service Staff
Background: Weather Spotters add increased forewarning of severe weather.

Action:
Increase Amateur Radio Operator Involvement in weather observations.

Time Frame: Ongoing
Funding:
Estimated Cost: Minimal
Staff: HAM Radio Club, Emergency Management Staff
Background: HAM operators typically discuss weather in all communications.

Note: Tooele County is a NWS Storm Ready county and therefore we have done just about everything possible to mitigate severe weather incidents. This objective is just one more step beyond what we have already accomplished.

Hazard: Infestation

Problem Identification:
Negative economic impacts from grasshopper, Mormon Cricket, and other types of insects.

Objective 1: Priority MEDIUM
Establish continuous funding sources for countywide insect control

Action:
Provide historical data and other information to raise awareness levels of elected and appointed officials regarding infestation impacts and ripple effects.

Time Frame: On going
Funding: Local funds
Estimated Cost: TBD
Staff: USDA APHIS, UDAF, USU Extension and local governments
Background: Insect infestations are cyclic while insect control funding is not.

Objective 2: Priority MEDIUM
Utilize historical data to forecast infestation cycles and monitor pest populations to implement early prevention strategies.

Action:
Review research data and develop additional insect monitoring sites

Time frame: On going
Funding: USDA APHIS, UDAF, and USU Extension
Estimated Cost: TBD
Staff: USDA APHIS, UDAF, and USU Extension
Background: Understanding insect infestation cycles and early detection through monitoring can greatly reduce insect damage.

Hazard: Earthquake

Problem Identification:
Development on identified fault traces increase the risk to life and property following an earthquake.

Objective 1: Priority HIGH
Reduce the threat to life and property within anticipated fault zones.

Action:
Develop and implement land use ordinances.

Time Frame: Ongoing
Funding: Local governmental funding
Estimated Cost: Minimal
Staff: Existing planners, planning commissions, engineers, and public officials.
Background: Existing faults have already been identified and are monitored.

Objective 2: Priority HIGH
Take advantage of continuing education opportunities for planners and policy officials

Action:
Attend ACT-21 classes

Time frame: Ongoing
Funding: Local government funding
Estimated Cost: Minimal
Staff: Existing planners, planning commissions, engineers, and public officials
Background: ATC-21 Training is a pre-earthquake assessment of buildings course helpful in determining the potential danger of a building.

Action:
Collect building data for input into computer earthquake models.

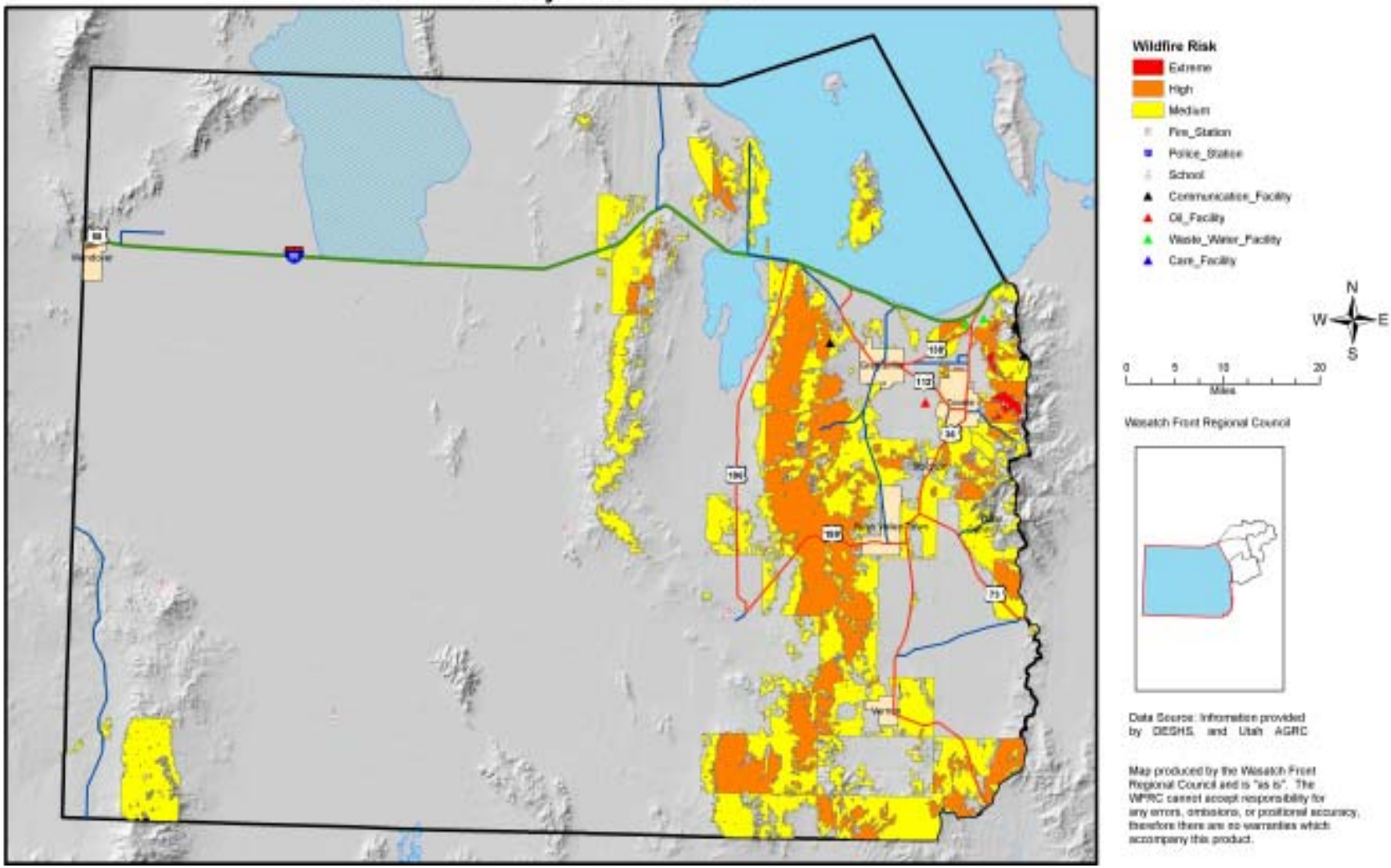
Time Frame: 6-12 months
Funding: N/A
Estimated Cost: None (can be done in house)
Staff: Emergency Management Staff, Planners, and Inspectors
Background: No current data on building inventory for use in damage and cost loss models in the event of an earthquake.

H. Maps

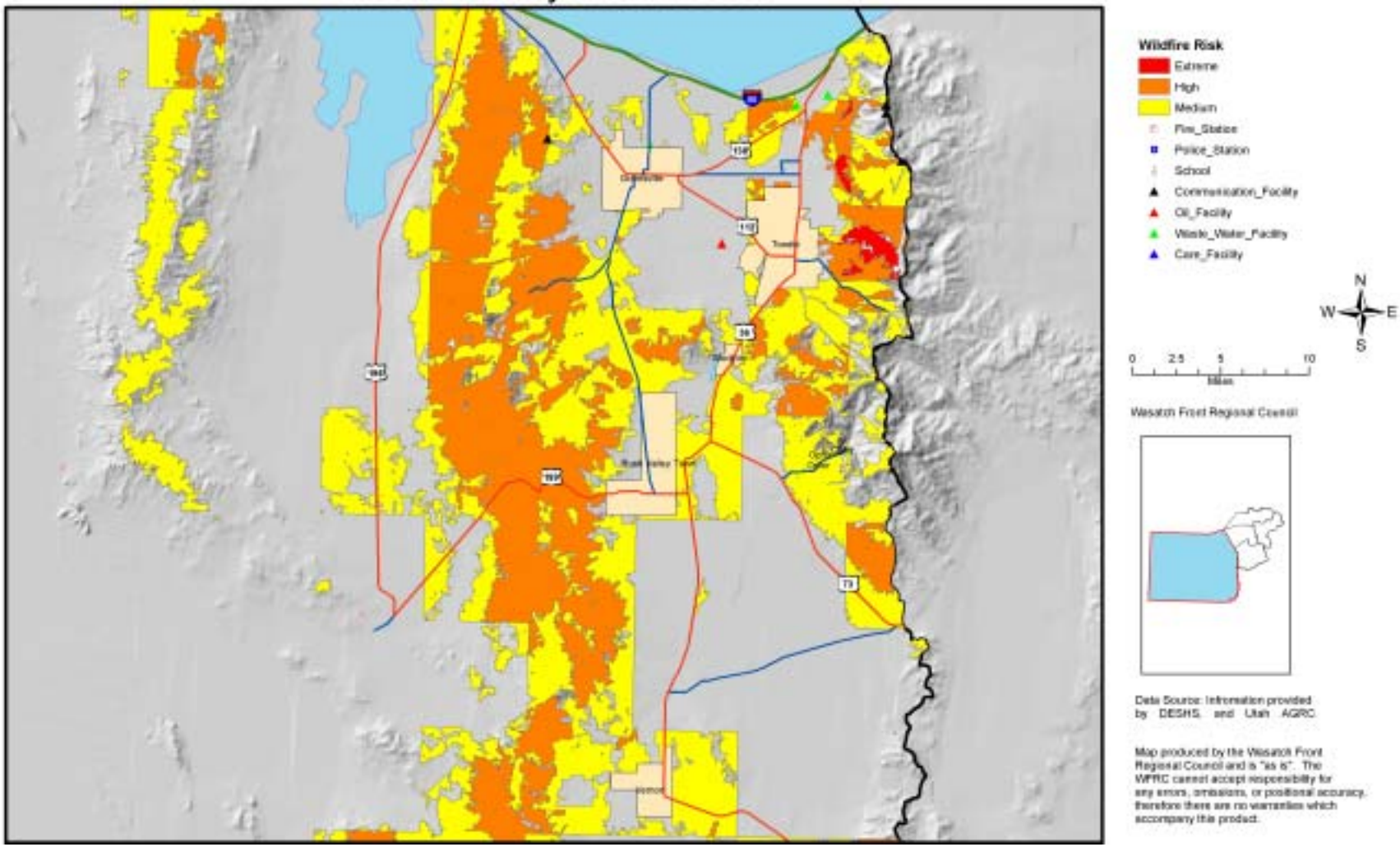
All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 10.1.1 Tooele County Wildfire Risk
Map 10.1.2 Wildfire Risk
Map 10.2.1 Tooele County Earthquake Risk

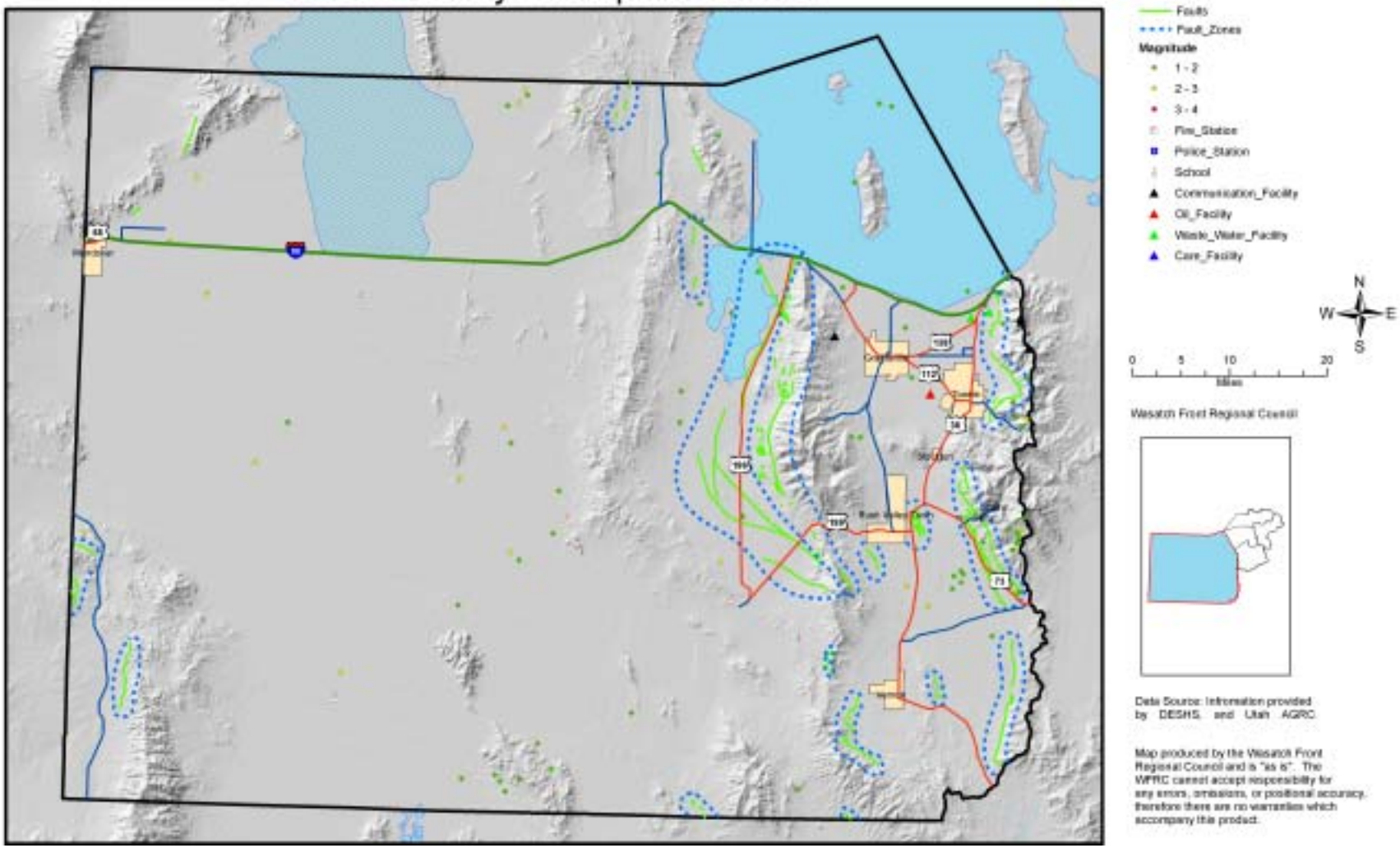
Tooele County Wildfire Risk



Tooele County Wildfire Risk

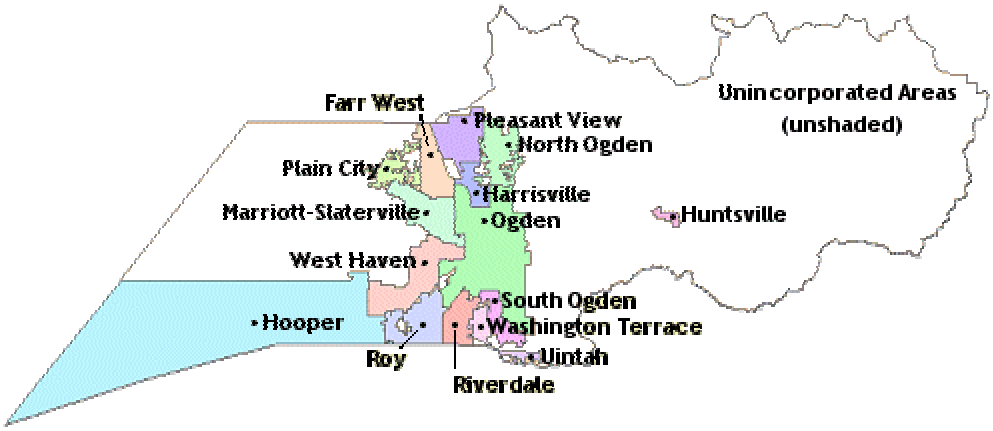


Tooele County Earthquake Hazard



Part XI. Weber County

Weber County includes fifteen municipalities: Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City. Ogden City is the County seat for Weber County and is also a hub for northern Utah. Ogden City is Utah's sixth largest city. Most of Weber County is considered to be a high alpine mountain valley, however, the western portion is a flat fertile plain formed by alluvial deposits from ancient Lake Bonneville.



A. Demographics and Population Growth

The following information involving population estimates, average annual rate of change, and population and development trends is important in understanding the impacts that a natural hazard will have on a local community now and in the future. Population numbers also identify the constancy of a community by determining the degree of change that population inflow and outflow have on a community. The following data include population projections into the year 2030 according to the Census 2000 data (Table 11-1).

Table 11-1 Population

Population Estimates									
	1990 Census Pop	2000 Census Pop	Absolute Change 1990-2000	Percent Change 1990-2000	AARC 1990-2000	Rank by 2000 Pop	Rank by Absolute Change	Rank by Percent Change	Rank by AARC
Weber County	158,330	196,533	38,203	24.1%	2.2	4	5	15	15
Population by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	941,172	1,104,356	1,381,778	1,498,463	1,675,743	1,865,039	2,007,635	2,247,652	1.63%
Weber County	144,616	158,330	196,533	211,207	237,877	265,905	286,919	320,770	1.65%

Households by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	298,700	357,257	446,763	498,470	570,355	645,403	708,641	819,578	2.04%
Weber County	47,643	53,111	65,698	71,436	81,414	91,518	99,699	113,835	1.85%

Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	64.42%	64.10%	61.88%	60.80%	60.11%	59.65%	59.55%	59.59%	-0.13%
Weber County	9.90%	9.19%	8.80%	8.57%	8.53%	8.50%	8.51%	8.50%	-0.11%

Household Percent of State Total by County and Multi-County District									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	66.58%	66.50%	63.71%	62.88%	62.38%	62.08%	62.03%	61.95%	-0.09%
Weber County	10.62%	9.89%	9.37%	9.01%	8.90%	8.80%	8.73%	8.61%	-0.28%

Average Household Size by County and Multi-County									
MCD/ County	1980	1990	2000	2005	2010	2015	2020	2030	AARC 2000-2030
WASATCH FRONT	3.11	3.05	3.04	2.96	2.89	2.85	2.79	2.70	-0.40%
Weber County	2.99	2.94	2.95	2.91	2.88	2.86	2.84	2.77	-0.20%

Source Bureau of the Census; 2002 Baseline Projections, Governor's Office of Planning and Budget. 1980, 1990 and 2000 household sizes are April 1 U.S. Census households; all others are July 1 household sizes. Note AARC is average annual rate of change.

B. Economy

The Weber County 2001 job market has slowed and jobs were even lost due to a nationwide recession. The current jobless rate is between 4-5% for the county. Continued population growth has also contributing to the jobless rate. Twenty three percent of all jobs are in the "goods producing" industry of construction and manufacturing, while seventy seven percent of all other workers are in the "service industries" of transportation, trade, finances, services, and government. Government employment is twenty one percent, higher than the national average of fifteen percent. Total personal income for Weber County in 2000 and 2001 was $4,489 million and $4,610 million respectively. The 2001 per capita income was $22,986 and the average monthly non-farm wage for 2001 was $2,287. Utah Workforce Services identifies Weber County's largest employers (Table 11-2).

Table 11-2 Annual Averages 2002 Company Industry Employment

Company	Industry	Employment
Internal Revenue Service	Federal Gov.	5,000-6,999
Weber School District	Public Education	3,000-3,999

Weber State University	Higher Education	3,000-3,999
Autoliv	Motor Vehicle Equipment	2,000-2,999
McKay-Dee Hospital Center	Health Care	2,000-2,999
Fresenius USA Mfg. Inc.	Medical Instrument Mfg.	1,000-1,999
Convergys	Telephone Call Center	1,000-1,999
Wal-Mart	Discount Department Store	1,000-1,999
State of Utah	State Government	1,000-1,999
Ogden School District	Public Education	1,000-1,999
Source: Utah Department of Workforce Services, Workforce Information, Updated September 2003.		

C. Transportation and Commuting Patterns

The major transportation routes within Weber County include I-15, a major transportation route that runs north south from Roy, in the Davis County area, north into Pleasantview, in the Box Elder County area. I-84 is another major transportation route that runs east west. Other major arteries include Highway 89, State Route 126 (1900 West), State Route 203 (Harrison Blvd.), State Route 204 (Wall Ave.), State Route 26 (Riverdale Rd.), State Route 79 (30-31st St.), State Route 53 (24th St.), State Route 39 (12th St.), and State Route 104 (20th St.). Refer to the Long Range Plan for 2020-projected average weekday traffic by Wasatch Front Regional Council for more information regarding commuting patterns and numbers. Table 11-3 from the Utah Department of Transportation represents 2002 Annual Average Daily Traffic for Weber County. Two major rail lines are also located in the county, as well as spur lines, and a large rail-switching yard. The Union Pacific Railroads has major operations within the county, and Ogden City continues to be a major rail hub.

Table 11-3 2002 Annual Average Daily Traffic

Artery Name	North-South	Entering	East-West	Exiting
State Route 26	36,505	South Ogden		Roy
State Route 39		Plain City, 4700 West	10.805	Into Morgan County
State Route 53		West Ogden	12,040	Harrison Blvd.
State Route 79		SR 126	14,305	SR 203
State Route 104		1900 West	14,970	Harrison Blvd.
State Route 126	25,664	I-89		200 North
State Route 203	34,660	SR 39		I-89
State Route 204	21,538	I-89		SR 26
Highway 89	30,575	North end of County		South end of County
I-15	84,484	North end of County		South end of County
I-84		Weber Canyon	13,191	Davis County

D. Land Use

Weber County is a total of 644 square miles, composed of the following land ownership categories; Private lands 73.6%, Federal Government 18.2%, State Government 8.3%, Military and Bankhead Jones land 1.0%

Under Utah State law, local cities and counties are responsible for setting land use policy in their areas. Projections for the Wasatch Urban Area Long Range Transportation Plan: 2002-2030 are based on individual city and county land use assumptions. A majority of the region is expected to be developed for residential uses. These local master plans call for relatively low-density development patterns, with some pockets of denser activity. This pattern holds true for non-residential development as well as residential development. Large areas of industrial/warehouse development are planned in western Salt Lake City, along the I-15 corridor, and around Hill Air Force Base. High-density office and commercial developments are focused mainly in the Salt Lake and Ogden central business districts, with smaller commercial areas located in southern Salt Lake County, northern Davis County, and southern Weber County. Additional, smaller nodes of commercial and retail development are dispersed throughout urban and rural portions of Salt Lake, Davis, and Weber Counties.

A significant portion of Weber Counties is currently zoned for low-density residential development. Some higher density housing is being built in Ogden City's Canyon Road Community. Industrial land uses are located at the redeveloped Business Depot Ogden (the former Ogden Defense Depot), Hill Air Force Base, the Ogden City Industrial Park and Clearfield's Freeport Center. Areas for commercial land uses include linear concentrations along major arterial roads including Riverdale Road, the southeastern portion of Harrison Blvd., 12th Street between Washington Blvd. and I-15, Hill Field Road near the Layton Hills Mall, State Street (Layton and Clearfield) and Main Street (Kaysville, Clearfield and Sunset). The McKay-Dee Hospital has moved to a new 62-acre location on Glassman Way. Additional commercial nodes are dispersed throughout the Ogden/Layton Urbanized Area to serve adjoining residential communities.

The principal Ogden/Layton Urbanized Area traffic generators are associated with large employment centers as well as with commercial office, retail and industrial land uses. The most significant traffic generator is Hill Air Force Base that employs over 10,000 skilled workers. This employment center is expected to remain the major traffic generator for the greater metropolitan region.

Major traffic generators within the Ogden/Layton Urbanized Area include Ogden City's Central Business District, Hill Air Force Base, Weber State University and the McKay-Dee Hospital Center. Major nodes of commercial development include the Lagoon Amusement Park, Layton Hills Mall, Newgate Mall, and other office/retail developments in Layton, Clearfield and Roy City. Major nodes of industrial development include the Ogden City Industrial Park, the Business Depot Ogden, the Clearfield Freeport Center and Roy City's Iomega complex located on 1900 West

These are just some examples of the mitigation actions that can be put into place when new development occurs. Specific mitigation actions for Weber County can be found in Section G.

E. Risk Assessment

The risk assessment process revealed the following for Earthquake, Flood, Severe Weather, Wildland Fire, Dam Failure, and Landslide/Slope Failure. Severe Weather is considered to be a regional hazard and can be found in Part XII. Risk assessment maps were completed for the mapped hazards and can be viewed at the end of this section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are 31 critical facilities in Weber County, for the complete list refer to Appendix D.

1. Earthquake

Hazard Profile

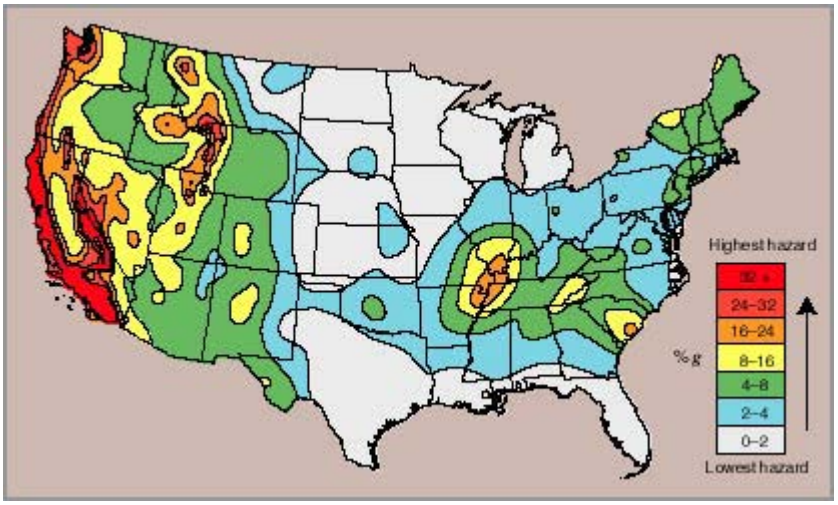
Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Western Portion along the Intermountain Seismic Belt will probably be the most affected. Ground shaking will be felt throughout the entire county. Surface fault rupture can be felt in areas of known historic fault zones. Liquefaction can be expected in areas of high to moderate liquefaction potential. See map in Section H.		
Seasonal Pattern or Conditions	Seasonal Pattern: There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during no, any, or all weather conditions. Conditions: Liquefaction Potential within high ground water table. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault, Weber Segment.		
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.		
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DESHS, AGRC.		

Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.5-7.7 Richter magnitude earthquake on average every 300-400 years. Within Weber County runs the Weber Segment of the Wasatch Fault Zone from North Salt Lake along the eastern edge of the valley to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years making it one of the most active fault segments. The Weber County segment of the Wasatch Fault could therefore create a magnitude 7.0 or above earthquake which would be very damaging to the entire county.

Two major earthquakes have struck the Ogden City area with a Richter magnitude between 5.0 and 5.5 since 1894. Weber County has also felt earthquakes that did not have their epicenters within the county. According to the Weber County Emergency Operations Plan in 1962 an earthquake with its epicenter in Richmond, along the Cache fault, produced a 5.7 Richter magnitude earthquake. Others include a 6.0 in the Pocatello Valley along the Hansel Valley Fault in 1975, and another on the same fault in 1934 with a magnitude of 6.6, yet another in 1909 with a 6.0 magnitude. Four earthquakes had their epicenters in Salt Lake between 1910 and 1962 that produced magnitude 5.0-5.2 earthquakes. The following hazard map identifies northern Utah as having a moderate to high percent of ground motion hazard (Figure 11-1).

Figure 11-1 Probabilistic Seismic Hazard Map provided by USGS



Using latitude and longitude, earthquake ground motion can be looked up on the USGS website for each city within Weber County. This table identifies ground motion hazard values, Peak Ground Acceleration (PGA), expressed as a percent of the acceleration of gravity (%g). These will be expressed as 0.2-second period spectral acceleration (SA), 0.3 second period acceleration, and 1.0 second period acceleration for a 10%, 5%, and 2% probability of exceedence (PE) in 50 years (Table 11-4).

Peak Ground Acceleration is used because of the relation to building codes, which prescribe how much horizontal force a building should withstand during an earthquake. Spectral Acceleration is what a building experiences during an earthquake, but of course is only approximate due to building design and demand. The probability of exceedence is based on average probability per year, all probabilities are added, and a total probability corresponding to a given probability in a particular period of time is the probability of exceedence. Peak Acceleration is said to have a probability of exceedence in a certain number of years. The values listed are for the nearest grid point in decimal degrees range from 40.90000 to 41.00000 latitude and –68.20000 to -68.70000 longitude.

For a more detailed explanation of values used and metadata refer to the USGS Earthquake Hazards Program website listed in the works cited appendix. The 10%g score was used because on average it corresponds to the Modified Mercalli Intensities VI and VII, which are levels of threshold damage. The city of Marriott-Slaterville's was unable to be identified for earthquake probabilistic hazard values.

Table 11-4 Earthquake Probabilistic Hazard- Ground Motion Values

Pleasant View City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9317178	1.488349	2.553365
0.2 sec SA	2.415735	3.756257	6.646093
0.3 sec SA	2.220395	3.529207	6.014318
1.0 sec SA	0.9748755	1.729893	3.281561
Plain City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9021723	1.410087	2.470716
0.2 sec SA	2.347333	3.661370	6.320310
0.3 sec SA	2.150422	3.434498	5.699156
1.0 sec SA	0.9396642	1.688893	3.178224

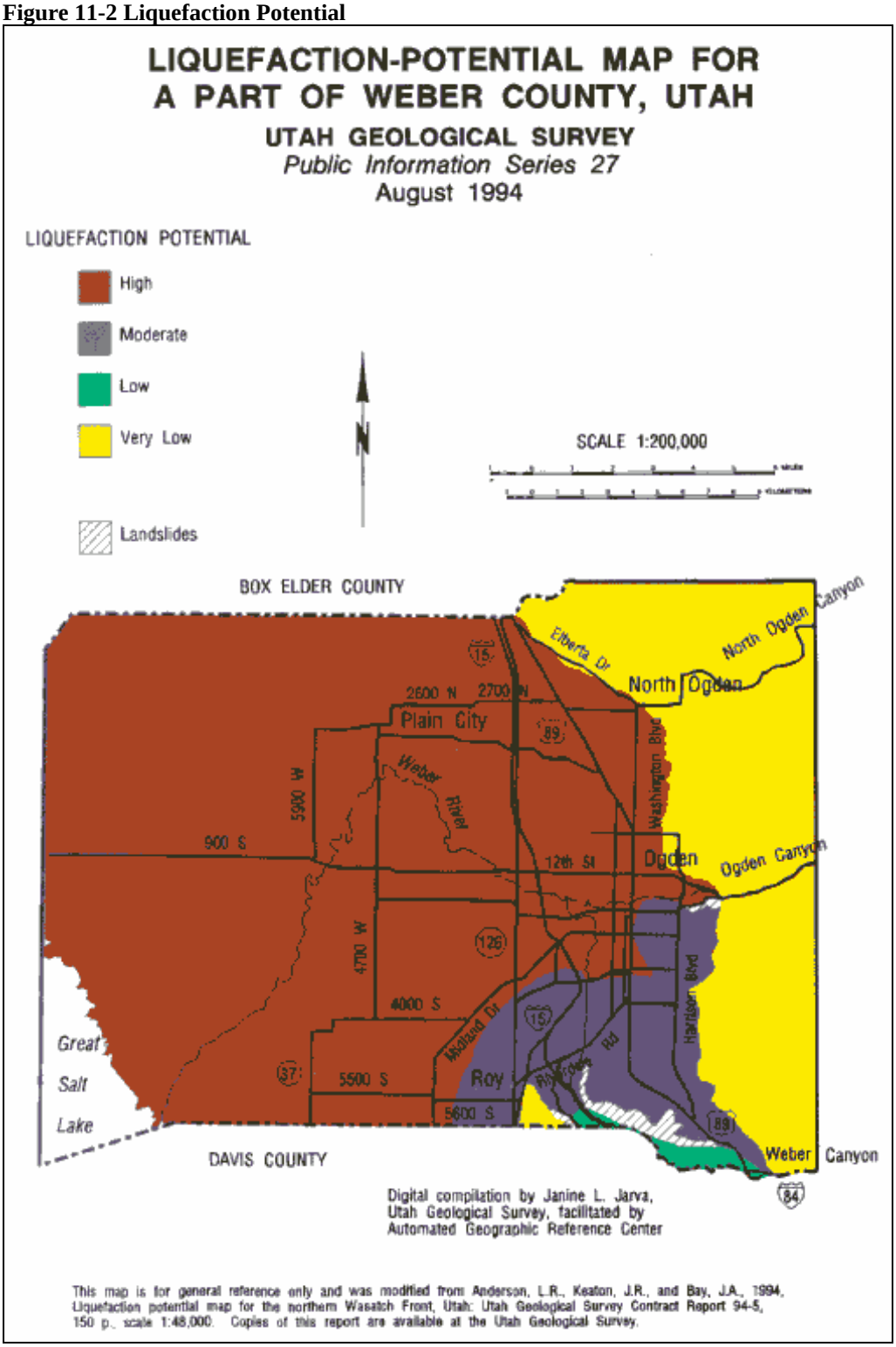
North Ogden City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9612721	1.566727	2.637966
0.2 sec SA	2.483814	3.936054	6.971746
0.3 sec SA	2.289441	3.623435	6.329513
1.0 sec SA	1.008761	1.769674	3.382588
Ogden City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8952948	1.395749	2.459433
0.2 sec SA	2.329926	3.641713	6.267258
0.3 sec SA	2.130496	3.410842	5.675544
1.0 sec SA	0.9277532	1.675351	3.145885
Roy City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8643962	1.344493	2.372246
0.2 sec SA	2.258103	3.541866	5.919023
0.3 sec SA	2.056691	3.310885	5.557192
1.0 sec SA	0.8905621	1.632116	3.036700
Hooper City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8306169	1.303367	2.272849
0.2 sec SA	2.179690	3.431073	5.638390
0.3 sec SA	1.976373	3.200925	5.425649
1.0 sec SA	0.8507870	1.585771	2.918750
Huntsville City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	1.053631	1.707152	2.925023
0.2 sec SA	2.720260	4.384018	7.544168
0.3 sec SA	2.416321	3.795420	6.872267
1.0 sec SA	1.071235	1.843178	3.568560
City of Harrisville	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9260030	1.478219	2.548031
0.2 sec SA	2.400999	3.741378	6.613659
0.3 sec SA	2.202933	3.509743	5.964895
1.0 sec SA	0.9633222	1.717045	3.252022
Farr West City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9317178	1.488349	2.553365
0.2 sec SA	2.415735	3.756257	6.646093
0.3 sec SA	2.220395	3.529207	6.014318
1.0 sec SA	0.9748755	1.729893	3.281561

Cities of Riverdale & Washington Terrace	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8952948	1.395749	2.459433
0.2 sec SA	2.329926	3.641713	6.267258
0.3 sec SA	2.130496	3.410842	5.675544
1.0 sec SA	0.9277532	1.675351	3.145885
South Ogden City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.9260030	1.478219	2.548031
0.2 sec SA	2.400999	3.741378	6.613659
0.3 sec SA	2.202933	3.509743	5.964895
1.0 sec SA	0.9633222	1.717045	3.252022
Town of Uintah	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8864052	1.376026	2.442762
0.2 sec SA	2.308044	3.615665	6.192405
0.3 sec SA	2.106282	3.381259	5.644844
1.0 sec SA	0.9136880	1.659383	3.107541
West Haven City	10% PE in 50 Year	5% PE in 50 Year	2% PE in 50 Year
PGA	0.8643962	1.344493	2.372246
0.2 sec SA	2.258103	3.541866	5.919023
0.3 sec SA	2.056691	3.310885	5.557192
1.0 sec SA	0.8905621	1.632116	3.036700

Weber County is located atop an ancient Lake Bonneville, which is made up of very weak soils. The area is also subject to shallow ground water and a relatively high earthquake threat. The secondary threat, liquefaction associated with an earthquake could have a higher impact on the county than the surrounding areas. For a further explanation of liquefaction see Map 11.1.2 titled Weber County Liquefaction Potential. The regional hazard identification section also explains liquefaction in a narrative form.

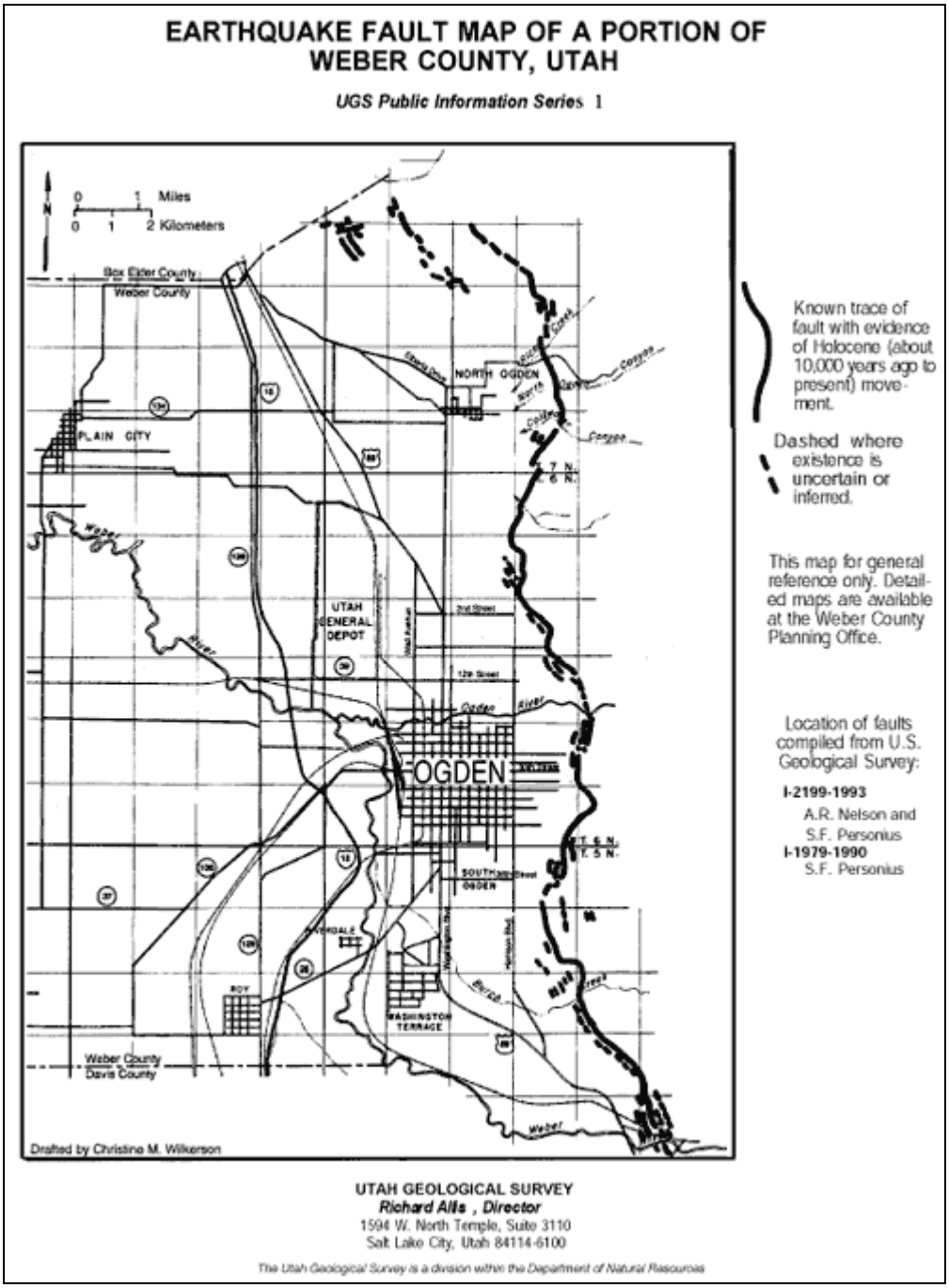
The following figures identify Weber County liquefaction potential recognized by the Utah Geological Survey (Figure 11-2), and a Weber County Fault Map (Figure 11-3).

Figure 11-2 Liquefaction Potential



Source: Utah Geological Survey. Geologic Hazards- Liquefaction. 2003. State of Utah <http://geology.utah.gov/online/images/pi-27.gif>.

Figure 11-3 Weber County Fault Map



Source: Earthquake Fault Map of a Portion of Weber County. Utah Geological Survey. Public Information Series 1. Richard Alfs. 2003. < http://geology.utah.gov/online/images/pi-1.gif>.

Vulnerability Assessment
The potential loss estimate tables below include the type and number of residential, commercial, and critical facilities located in the earthquake hazard area, as well as the population affected (Tables 11-5, 11-6, 11-7, 11-8).

Table 11-5 Inventory of Critical Facilities Located in Earthquake Fault Zones

Facility Type	Name	City
Communication Facility	KWCR-FM Ch 201	Ogden
Waste Water Facility	Plain City Corporation	Plain City
Care Facility	McKay-Dee Hospital Center	Ogden
Fire Station	Uintah Fire Dept	Ogden
School	St Joseph High School	Ogden
School	St Joseph Catholic Elementary	Ogden
School	St Paul Lutheran School	Ogden
School	Horizon Educational System	Ogden
School	Children's Classic	South Ogden
School	McKay Dee School	Ogden
School	School For The Deaf	Ogden
School	School For The Blind	Ogden
School	Lincoln School	Ogden
School	Lynn School	Ogden
School	Mound Fort Middle	Ogden
School	Mount Ogden Middle	Ogden
School	Ogden High	Ogden
School	Polk School	Ogden
School	Carl H Taylor School	Ogden
School	Thomas O Smith School	Ogden
School	Wasatch School	Ogden
School	Early Childhood	Ogden
School	Observ/Assess - Yic	Ogden
School	Ben Lomond High	Ogden
School	Bonneville School	Ogden
School	Central Middle	Ogden
School	Edison School	Ogden
School	Gramercy School	Ogden
School	Grandview School	Ogden
School	Highland Middle	Ogden
School	Horace Mann School	Ogden
School	Washington High	Ogden
School	Bates School	Ogden
School	Green Acres School	Ogden
School	Lomond View School	Ogden
School	Canyon View School	Ogden
School	Uintah School	Ogden
School	Weber High	Ogden

Table 11-6 Property Inventory within Fault Zones

City Name	City Area (Acres)	Acres in Fault Zone	Acres in Liquefaction Zone	Number of property structures within Fault Zones		Number of Structures within Liquefaction Zones		Population in Hazard Areas	
				Commercial/ Annual Sales	Residential/ Value	Commercial/ Annual Sales	Residential/ Value	Earthquake	Liquefaction
Farr West City	3,621	640	3483	6 / $14,300,000	132 / $16,654,808	63 / $151,500,000	849 / $104,082,386	155	1,485
Harrisville	1,641	216	468	38 / $26,200,000	149 / $14,651,241	24 / $14,100,000	225 / $18,688,944	753	169
Huntsville	498	0	0	0	0	0	0	0	0
North Ogden City	4,274	3,551	0	156 / $94,900,000	3687 / $443,417,723	0	0	9,941	0
Ogden City	17,137	9,224	8904	1306 / $1,801,700,000	16379 / $1,563,474,984	2319 / $4,108,300,000	6801 / $440,786,350	48,865	24,578
Plain City	2,509	3,778	2509	0	0	56 / $67,200,000	1071 / $119,568,186	0	1,904
Pleasant View	4,450	0	709	82 / $65,400,000	1365 / $203,012,929	11 / $11,000,000	36 / $3,660,083	3,414	40
Riverdale	2,664	0	2007	0	$0	258 / $615,500,000	1628 / $176,719,167	0	5,352
Roy City	4,959	0	4796	0	0	668 / $695,300,000	9423 / $904,483,132	0	25,695
South Ogden	2,078	325	12	85 / $97,100,000	935/ /$78,294,338	2 / $800,000	4 / $217,447	1,332	0
South Weber	10	3	0	0	0	0	0	0	0
Uintah	540	240	0	16 / $16,700,000	111 / $12,142,760	0	0	249	0
Washington Terrace	1,228	0	0	0	0	0	0	0	0
West Haven	6,559	0	6559	0	0	274 / $418,100,000	1193 / $158,118,781	0	3,016

Table 11-7 Infrastructure in Earthquake Area

Item	Length (Miles)	Replacement Cost
Local Roads	11.41	$22,820,000
State Highways	31.74	$76,604,490
US Highways	1.47	$3,543,259
US Interstates	2.22	$7,985,160
Power Lines	105.83	$5,109,472
Gas Lines	0.00	$0

Table 11-8 Infrastructure in Liquefaction Area

Item	Length (Miles)	Replacement Cost
Local Roads	62.14	$124,280,000
State Highways	139.82	$337,464,500
US Highways	5.53	$13,358,481
US Interstates	16.98	$61,141,680
Power Lines	339.94	$16,412,303
Gas Lines	0.00	$0

HAZUS MH Vulnerability Assessment

HAZUS MH shorthand for Hazards United States Multi-Hazard was used to determine vulnerability as it relates to seismic hazards for the study area. The HAZUS MH Earthquake Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for earthquake risk mitigation, emergency preparedness, response and recovery. The methodology deals with nearly all aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within HAZUS MH, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The HAZUS MH methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS MH Earthquake Model, possibly at best a factor of two or more. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past earthquakes. However, limited and incomplete data about actual earthquake damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the HAZUS MH Earthquake Model has provided a credible estimate of such aggregated losses as the total cost of damage and numbers of casualties. The Earthquake Model has done less well in estimating more detailed results - such as the number of buildings or bridges experiencing different degrees of damage. Such results depend heavily upon accurate inventories. The Earthquake Model assumes the same soil condition for all locations, and this has proved satisfactory for estimating regional losses. Of course, the geographic distribution of damage may be influenced markedly by local soil conditions. In the few instances where the Earthquake Model has been partially tested using actual inventories of structures plus correct soils maps, it has performed reasonably well. The following numbers were based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model. Table 11-9 identifies the probable casualties during an earthquake.

Table 11-9 Casualties

Casualties	Nighttime –Minor	2,731
	Nighttime –Major	77
	Nighttime -Fatalities	149
	Daytime –Minor	3,381
	Daytime –Major	133
	Daytime- Fatalities	255
	Commute –Minor	3,049
	Commute –Major	112
	Commute-Fatalities	212

Building Damage by Count
HAZUS MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 11-10 lists the number buildings by occupancy that are estimated to have moderate to complete levels of damage. Table 11-11 identifies the critical facilities affected by an earthquake.

Table 11-10 Building Damage by Count with Moderate to Complete Damage

Category	**Number of Structures**
Residential	4,569
Commercial	458
Industrial	61
Totals	37,783*

*****Includes all building categories with moderate to complete damage

Table 11-11 Critical facilities

Classification	**Total**	**Least Moderate Damage >50%**	**Complete Damage > 50%**	**Functionality > 50% at day 1**
Hospitals	2	2	0	0
Schools	78	71	0	0
Emergency Operations Centers	0	0	0	0
Police Stations	8	8	0	0
Fire Stations	8	8	0	0

Debris Removal
Table 11-12 shows how much debris would be generated by the earthquake and how many loads it would take to remove the debris, based on 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons (50,000) at a weight to volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Table 11-12 Debris Generated (millions of tons)/Loads to Remove Debris

Debris Generated	1
Loads (25 tons per load)	40,000

Fire Following
The Great San Francisco Earthquake of 1906 illustrated the hazard a city could face from fire following an earthquake. Multiple ignitions and broken water mains conspired to make firefighting nearly impossible. HAZUS MH uses the estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 11-13 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Table 11-13 Fire Following Event, Population Exposed, and Building Stock Exposed

Ignitions	25
People Displaced	426
Value Exposed (mill. $)	20

These numbers were derived from a HAZUS MH run based on a probabilistic 2500-year event with a magnitude 7.0 running the soils portion of the model.

2. Dam Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
	X	Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Dam locations are mainly in the central and western portion of the county.		
Seasonal Pattern or Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure happens with no warning at all can happen at anytime.		
Duration	Hours, Days. Depends on spillway type and area, maximum cfs discharge, overflow or breach type, dam type. Refer to Dam Inventory for more information.		
Analysis Used	Review of BOR inundation maps and plans, FIS, Water Rights.		

Description of Location and Extent

Fifteen dams are located in Weber County with eight dams listed as having a high hazard threat meaning if they fail they have a high probability of causing loss of life and extensive economic loss. Seven dams are listed as being moderate meaning if they fail they have a low probability of causing loss of life but would cause appreciable property damage. None of Weber County's dams have a low hazard threat, which means if they were to fail there would be a minimal threat to life and economic losses would be minor and the damage would be limited to the owner of the dam. (Table 11-10).

It should be noted that Dam Safety hazard classifications are in the event of the failure of a dam, based upon the consequences of failure of the dam given by the State Engineer. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Vulnerability Assessment

A vulnerability assessment for dam failure was difficult to analyze due to the quality and age of the dam inundation maps from the Dam Safety Section of Utah Water Rights. Critical facilities were identified that were within the inundation areas for the high hazard dams and these facilities are listed in Table 11-14. However, due to the lack of digitized dam inundation maps, potential losses not able to be identified. Refer to Map 11.2.1 Weber County Dam Hazard for dam locations. Moderate Hazard Dams include Ogden City Beus Pond, Uintah Mountain Stream, Utaba Retarding, Kelly Canyon, Pleasant View Reservoir, Fourmile Debris Basin- Harrisville Dam, and Sourdough Wilderness Ranch.

Table 11-14 Dam Inventory of High and Moderate Hazard Dams

Causey Dam	
Owner	Department Of Interior Bureau of Reclamation- Federal. Operated by Weber Basin Water Conservancy District
River	South Fork Ogden River
Near City/ Distance	Huntsville/ 11
Year Completed	1965
Dam Length	845
Dam Height	195

Max Discharge	13450
Max Storage	8730
Normal Storage	7870
Surface Area	175
Drainage Area	81
Spill Type/ Width/ Volume	U/ 25/ 1,400,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	5/25/1993
Critical Facility in Inundation Area	Property and infrastructure below dam. No identifiable critical facility in inundation zone

Pineview	
Owner	Department Of Interior Bureau of Reclamation- Federal. Operated by the Ogden River Water Users Association
River	Ogden River
Near City/ Distance	Hermitage/ 2
Year Completed	1937
Dam Length	600
Dam Height	95
Max Discharge	10000
Max Storage	116150
Normal Storage	110150
Surface Area	2920
Drainage Area	298
Spill Type/ Width/ Volume	C/ 24/ 418,000
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	10/24/1990
Critical Facility in Inundation Area	Homes and property below dam. No identifiable critical facility in inundation zone

North Ogden City Coldwater Canyon	
Owner	North Ogden City- Local Government
River	Coldwater Creek
Near City/ Distance	North Ogden City/ 0.1
Year Completed	1983
Dam Length	1200
Dam Height	38
Max Discharge	872
Max Storage	11
Normal Storage	5
Surface Area	0
Drainage Area	2
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	04/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

Ogden City- Sullivan Hollow	
Owner	Ogden City Corporation- Local Government
River	Sullivan Hollow
Near City/ Distance	Ogden/ 0.1
Year Completed	1974
Dam Length	405
Dam Height	18
Max Discharge	515
Max Storage	21
Normal Storage	19
Surface Area	2
Drainage Area	4
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/29/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

South Ogden City Burch Creek Debris	
Owner	South Ogden City- Local Government
River	Burch Creek
Near City/ Distance	South Ogden - 0.1
Year Completed	1985
Dam Length	330
Dam Height	56
Max Discharge	420
Max Storage	122
Normal Storage	80
Surface Area	4
Drainage Area	4
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

North Ogden City Coldwater Desilting	
Owner	North Ogden City- Local Government
River	Coldwater Creek
Near City/ Distance	North Ogden- 0.1
Year Completed	1986
Dam Length	325
Dam Height	20
Max Discharge	104
Max Storage	20
Normal Storage	15
Surface Area	2
Drainage Area	2.5

Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

South Ogden City Burch Creek / Glasmann	
Owner	South Ogden City- Local Government
River	Burch Creek
Near City/ Distance	South Ogden/ 0.5
Year Completed	1992
Dam Length	713
Dam Height	34
Max Discharge	1550
Max Storage	42
Normal Storage	2
Surface Area	0
Drainage Area	3.8
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

North Ogden Orton Park/ 2100 North	
Owner	North Ogden City- Local Government
River	Coldwater Creek/ Fourmile
Near City/ Distance	North Ogden/ 0.1
Year Completed	1990
Dam Length	2340
Dam Height	8
Max Discharge	400
Max Storage	3
Normal Storage	2
Surface Area	8
Drainage Area	10
Spill Type/ Width/ Volume	
Hazard Rating	High
Emergency Action Plan	No
Inspection Date	4/21/1994
Critical Facility in Inundation Area	Elementary School on Monroe Blvd and 2025 North.

Northwest	
Owner	Northwest Irrigation Co
River	Cottonwood Creek
Near City/ Distance	Mountain Green/ 2
Year Completed	1940

Dam Length	800
Dam Height	36
Max Discharge	30
Max Storage	603
Normal Storage	523
Surface Area	25
Drainage Area	0
Spill Type/ Width/ Volume	B/ 0/ 0
Hazard Rating	High
Emergency Action Plan	Yes
Inspection Date	
Critical Facility in Inundation Area	No identifiable critical facility in inundation zone.

Other dams outside the County boundaries could also affect Weber County. Echo Dam, located between Morgan and Park City; The Wanship Dam - Rockport Reservoir, located upstream from Echo Dam; East Canyon Dam, south of Morgan City; and Lost Creek Dam northeast of Morgan City; as well as AV Watkins Dam - Willard Reservoir/ Willard Bay, located in Box Elder County on the northern border of Weber County. Willard Bay is a diked bay of the Great Salt Lake that holds over 215,000 acre-feet of water. If it were to breach, water from the reservoir could flood much of the northwestern portion of Weber County.

If an earthquake with a magnitude of 6.0 or greater were to occur within 14 miles of epicenter latitude of 41.18333 and epicenter longitude of 111.93667 the dams in Table 11-15 Earthquake Dam Hazard would be affected.

Table 11-15 Earthquake Dam Hazard

Dam Name	**Hazard Rating**	**Miles from Epicenter**	**County**
Combe Equalizing Reservoir	High	1.29	Weber
S. Ogden City Burch Creek- Glasmann	High	1.35	Weber
S. Ogden City Burch Creek Debris	High	1.65	Weber
Ogden City- Sullivan Hollow	High	2.06	Weber
Spring Creek- Weber		2.64	Weber
Military Springs		4.21	Weber
Sinclair Oil Corp		4.62	Weber
Sinclair Oil Corp		4.62	Weber
Forest Service		5.63	Weber
Hobbs	High	5.83	Davis
Davis/ Weber County Canal Co. Sunset Pond	High	5.89	Davis
Davis/ Weber County Canal Co. Layton Pond	High	6.84	Davis
Pineview	High	7.00	Weber
Clinton Detention Basin		7.49	Davis
N. Ogden City Orton Park/ 2100 North	High	7.79	Weber
Adams	High	7.82	Davis
Holmes	High	7.90	Davis
Northwest	High	8.88	Morgan
Davis/ Weber County Canal Co. Kaysville	High	9.01	Davis
Davis County- Holmes Creek Detention Basin	High	9.02	Davis
Hawk’s Landing #4 Gate Pond		9.07	Weber
Hawk’s Landing #1 Church Pond		9.07	Weber
Hawk’s Landing #2 Middle Pond		9.07	Weber

Hawk's Landing #3 Old Storage Pond		9.07	Weber
Carrigan and Bowman		9.17	Morgan
Kaysville	High	9.32	Davis
Wilkinson- Harry	High	9.55	Morgan
Babcock, Mike		9.66	Morgan
N. Ogden Pond #2		9.90	Weber
Haight Creek, Lower	High	10.15	Davis
Nibley, Preston and Elizabeth		10.61	Weber
Haight Creek, Upper	High	10.65	Davis
Ken Gardner/ John Lewis		10.98	Weber
Eden Pond		11.04	Weber
N. Ogden Pond #1		11.08	Weber
Wolf Creek Reservoir	High	11.14	Weber
Bartons Pond- Bountiful Blvd Detention Basin		11.27	Davis
Hirschi, Scott and Tod Jones		11.61	Davis
Whitear		12.00	
Davis County- Shepard Creek Detention Basin	High	12.32	Davis
Farmington Equalizing Reservoir	High	12.96	Davis
Arthur V. Watkins		13.57	Box Elder
Davis County- Farmington Pond	High	13.59	Davis
Farmington Irrigation- Reservoir B	High	13.73	Davis

3. Flood

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Flooding mainly takes place in the western portion of the county where the land is flat.		
Seasonal Pattern or Conditions	Spring, Cloudburst Storms and Heavy Snowfall Runoff.		
Duration	Flooding can last anywhere from hours to days and even months.		
Analysis Used	Review of FIS, FIRM, Army Corp of Engineers Flood Study		

Description of Location and Extent

The greatest flood risk in the past in Weber County is associated with cloudburst storms. In the future this will also be the main threat. Cloudburst storms generally result in flash flooding in very localized areas. Rapid snowpack melt is another significant flood threat that results in unusually heavy water.

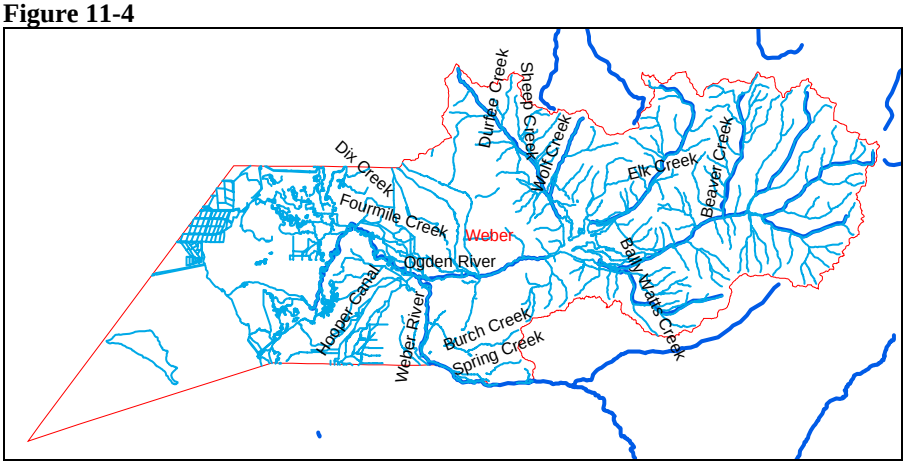
The greatest flood potential is within western Weber County, Ogden, and the Weber River in Uintah City, as well as locations away from the foothills where the land is flat. The Weber and Ogden Rivers can experience flooding, however the threat is fairly low due to the dams located above stream. The dams can control the floodwater and therefore most of the flood potential can be mitigated. Other smaller creeks that can create flood problems within the county include North Fork Ogden River, South Fork Ogden River, Upper Valley, Taylor Canyon Creek, Wolf Creek, Waterfall Canyon Creek, Beus Canyon Creek, Burch Creek, Cold Water Canyon Creek, Four Mile Creek, Six Mile Creek, and Hot Springs Creek. The Weber River drainage is approximately 2,460 square miles (Weber County Emergency Operations Plan). The Warren area could experience flooding on agricultural lands and some homes from the confluence of the Weber and Ogden Rivers. In the past businesses and roads were damaged from flooding between 1990 West and 1300 South near SR89 in Warren. Refer to Figure 11-4 for a map of the larger streams in the County.

Two irrigation canals within Weber County affect the flood threat, the Weber-Davis Canal and the Ogden-Bingham Canal. The Weber-Davis Canal breached in1999 and flooded over 70 homes. This event was declared as a city, county, and state disaster. The Ogden-Bingham Canal has also breached, caused by a rockslide in 1979. Since 1853 the county experienced over 360 flash floods and more than 170 snow melt floods.

Vulnerability Assessment

At this time, a vulnerability assessment was unable to be performed due to the lack of digitized floodplain maps and datasets used to conduct the assessments for the other natural hazards that affect the county. However, current mapping projects are being completed by the State that will result in better data and therefore a greater understanding of risk. The county would like to continue to work with the state to understand their threats; therefore general mitigation goals have been included. A Flood Hazard Identification Study has also been compiled by the Army Corps of Engineers in 2003, this study can be found in Appendix G.

Figure 11-4


Dix Creek
Fourmile Creek
Weber
Ogden River
Hooper Canal
Weber River
Burch Creek
Spring Creek
Durfee Creek
Sheep Creek
Wolf Creek
Elk Creek
Beaver Creek
Bally Watts Creek

4. Wildland Fire

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	URWIN zones near the foothills and in forested areas. See map in Section H.		
Seasonal Pattern or Conditions	Summer months. Areas affected by drought and/ or heavily overgrown and dry brush and debris. Lightning and human triggers.		
Duration	Wildfires typically last days but can last months, depending on climate and fuel load as well as resources (financial, manpower) to extinguish the fire.		
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DESHS.		

Description of Location and Extent

Potential wildfire hazard within Weber County is growing as population growth is spreading into wildland areas known as Urban-Wildland Interface Zones. Over the past 30 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property. According to the County Emergency Operations Plan the upper valley of Weber County will have one fire for every 80-100 years. However, humans have played a role in the fire cycle increasing the rotation to one for every 8-10 years. The county faces 50 fires in the wildland areas every year; 20% of which are caused by lighting, and 80% by humans. Most fires can be contained in a quarter-acre to one-acre area if they have not traveled into the wildland zones higher in the mountains, which are harder to fight due to steep mountain terrain.

Wildfire threat within the county is most severe in the Uintah Highlands area, east of Weber State University, the mouth of Ogden Canyon, Coldwater Canyon, upper east area of Harrison Blvd, North Ogden, Pleasantview, Wolf Creek, Powder Mountain, Maple Canyon, South Fork, and Snow Basin.

Wildfire maps were created using GIS and can be viewed in Section H Map 11.4.1 Weber County Wildfire Risk. The map layers were provided by DESHS and show three categories of wildfire risk:

- Extreme
- High
- Medium

These ratings cover all of Weber County and are based on the type and density of vegetation in each area. Additional factors influencing wildfires such as weather conditions, wind speed and direction are not considered in this risk assessment.

Vulnerability Assessment

The following table includes the number of commercial, and residential structures inside extreme, high and moderate wildfire risk areas within the county. The population within each of the areas is also included (Table 11-16). The critical facilities and infrastructure within the wildfire area can be found in Tables 11-17, and 11-18. Table 11-19 Wildfire Risk Area contains the number of acres in each wildfire risk area, within the municipal boundaries of the following cities in the county. Historical wildfires are referred to in Table 11-20.

Table 11-16 Structures and Population in Wildfire Area

City Name	City Area (Acres)	Acres in Extreme	Acres in High	Acres of Moderate	Number of Structures within Wildfire Risk Area		Population in Hazard Areas
					Commercial/ Annual Sales	Residential/ Replacement Value	
Farr West City	3,621	0	102	0	2 / $12,700,000	11 / $1,600,799	6
Harrisville	1,641	0	4	227	6 / $7,000,000	116 / $12,476,082	101
Huntsville	498	0	0	1	0	0	0
North Ogden City	4,274	744	350	7	8 / $2,900,000	395 / $69,318,084	734
Ogden City	17,137	354	550	567	23 / $10,400,000	620 / $149,725,574	1,045
Plain City	2,509	0	0	38	0	0	0
Pleasant View	4,450	675	348	304	1 / $400,000	171 / $39,590,966	122
Riverdale	2,664	18	367	34	51 / $165,100,000	81 / $8,185,550	31
Roy City	4,959	0	0	0	0	0	0
South Ogden	2,078	0	2	8	0	10 / $809,192	0
South Weber	10	0	10	0	0	0	0
Uintah	540	0	29	36	0	40 / $5657362	36
Washington Terrace	1,228	23	45	248	11 / $7500000	219 / $34,343,916	144
West Haven	6,559	0	0	14	0	0	0

Table 11-17 Critical Facilities Within Wildfire Area

Facility Type	Name	City	Wildfire Risk
School	Weber High	Ogden	Extreme
School	Snowcrest Jr High	Eden	Moderate
Police Station	Riverdale Police Dept	Riverdale	High

Table 11-18 Infrastructure in Wildfire Area

Item	Length (Miles)	Replacement Cost
Local Roads	5.59	$11,180,000
State Highways	0.12	$289,620
US Highways	5.53	$13,358,481
US Interstates	1.31	$4,725,360
Power Lines	75.49	$3,644,657
Gas Lines	0.00	$0

Table 11-19 Wildfire Risk Area

City Name	Acres of Extreme	Acres of High	Acres of Moderate
Farr West City	0.00	102.34	0.00
Harrisville	0.00	4.34	227.00
Huntsville	0.00	0.00	0.93
North Ogden City	744.12	350.02	6.77
Ogden City	354.08	549.77	566.81
Plain City	0.00	0.00	38.25
Pleasant View	675.06	348.06	304.28
Riverdale	17.77	367.03	34.48
Roy City	0.00	0.00	0.00
South Ogden	0.00	2.42	8.19
South Weber	0.00	10.10	0.34
Uintah	0.04	28.87	36.43
Washington Terrace	23.20	45.49	248.27
West Haven	0.00	0.00	13.75

Table 11-20 Historical Wildfires

Date	Fire Name	Cause	Size
8/13/88	Sawmill Ii	Lightning	300 - 999 Acres
7/31/90	Long Bench	Children	300 - 999 Acres
8/5/91	Weber Canyon	Railroad	300 - 999 Acres
6/26/94	Middle Fork	Campfire	300 - 999 Acres
6/29/94	Maple Canyon	Children	300 - 999 Acres
7/2/94	Little Mt	Cigarette	300 - 999 Acres
8/4/94	Uintah Fire	Railroad	300 - 999 Acres
10/6/96	Spillway	Debris Burn	300 - 999 Acres
8/24/99	Beaver Creek	Debris Burn	300 - 999 Acres
8/24/88	Powder Mtn.	Equipment	1000 - 4999 Acres
8/30/94	Gun Range	Incendiary	1000 - 4999 Acres
7/29/95	Wolf Creek Fire	Children	1000 - 4999 Acres
8/7/00	Eagle Fire	Lightning	1000 - 4999 Acres

5. Landslide/ Slope Failure

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
	X	Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
		Likely	
	X	Possible	
		Unlikely	
Location	See map in Section H. Generally occur in canyon mouths and foothill areas.		
Seasonal Pattern or Conditions	Spring and Summer usually caused by the stress release of over-weighted soils and or loosening of rock and debris.		
Duration	Landslides generally last hours or days, but some can last weeks.		
Analysis Used	Information and maps provided by UGS, DESHS, AGRC.		

Description of Location and Extent

Future landslide areas are usually located in the areas of historical landslides, which are well-defined localized areas. Historically landslides have been one of the most naturally re-occurring hazards within Weber County. The homes found along the benches in the canyons have the greatest risk of rockfalls, debris flows, landslides, and other types of slope failure.

Within Weber County landslides have been identified in Ogden Canyon and Washington Terrace. The Ogden Canyon slide is south of the canyon mouth and forms a 200 foot high bluff above the south bank of the Ogden River, over 90 acres in size. Washington Terrace has a series of landslides four miles long, starting two miles west of the mouth of Weber Canyon and ending on the northwest side of Washington Terrace. Landslides can also be found in Ogden Canyon between the mouth and Pineview Dam. North Ogden Pass has evidence of sliding as well.

East of Plain City and Harrisville there is evidence of lateral spread more than 2000 ft. North central portion of the county there is evidence of slumps and earth flows and other deep-seated landslides. Extending north to south in the central portion of the county there are smaller (less than 2000 ft) lateral spread landslides. The eastern portions of the county exhibit rockfall, colluvial, talus, glacial, and soil-creep landslides larger than 2000 ft.

Three prominent rockslide areas are within the county. The North Ogden rockslide is 100 acres in size and is one mile northwest of the mouth of North Ogden Canyon. The College slide is another area that has slid in the past. The College rockslide is about 80 acres in size and is located east of the Weber State University campus. The third main rockslide area is known as Beus Canyon. This slide is one half mile square and is located immediately south of the College slide. Ogden Canyon, north of the mouth, is home to smaller rockslides. North of Taylor Canyon potential rockslide hazards exist.

Debris flows and mudslides are possible from the mouth of Weber Canyon to Riverdale, which could affect railroads, utilities, storm drainage lines, and residential property. Landsliding in the past has damaged several homes in this area. Erosion is a threat from Weber Canyon westward including the towns of Uintah and Riverdale. Homes, utilities, and bridges are at risk.

Hazard Assessment

The number of residential structures contained within the landslide hazard risk may capture more or less structures than are actually at risk from landslides. In order to accurately capture landslide risks in these areas an assessment has been conducted using parcel data that identifies the people and property at risk including critical facilities and other types of infrastructure (Table 11-21, 11-22, and 11-23). The map 11.5.1 Weber County Landslide Hazard shows the locations at high-risk for landslides.

Table 11-21 Inventory of Properties Located in High Landslide Risk Area in Weber County

City Name	City Area (Acres)	Acres in Landslide Area	Population in Landslide Area	Number of property structures	
				Commercial/ Annual Sales	Residential/ Replacement Value
Farr West City	3,621	260	0	3 / $6,900,000	5 / $375,562
Harrisville	1,641	1425	2,328	96 / $63,300,000	1059 / $101,988,391
Huntsville	498	0	0	0	0
North Ogden City	4,274	1546	3,270	113 / $120,700,000	1523 / $151,291,224
Ogden City	17,137	5368	26,659	1,934 / $2,704,500,000	7711 / $727,072,328
Plain City	2,509	0	0	0	0
Pleasant View	4,450	1055	110	50 / $41,200,000	218 / $27,087,052
Riverdale	2,664	585	436	112 / $190,800,000	283 / $30,298,627
Roy City	4,959	0	0	0	0
South Ogden	2,078	992	4,567	194 / $169,000,000	2035 / $198,382,602
South Weber	10	0	0	0	0
Uintah	540	102	62	4 / $600,000	29 / $4,892,881
Washington Terrace	1,228	411	1,055	32 / $17,400,000	506 / $49,295,645
West Haven	6,559	0	0	0	0

Table 11-22 Critical Facilities within Landslide Risk Areas

Facility Type	Name	City
Communication Facility	KWCR-Fm Ch 201	Ogden
Waste Water Facility	Plain City Corporation	Plain City
Care Facility	McKay-Dee Hospital Center	Ogden
Fire Station	Ogden Fire Marshal	Ogden
Fire Station	North View Fire Station	Ogden
Fire Station	South Ogden Fire Station 1	Ogden
Police Station	Police Dept-Records	Ogden
Police Station	Washington Terrace Police	Ogden
Police Station	South Ogden Police Dept	Ogden
Police Station	Police Station	Ogden
School	St Paul Lutheran School	Ogden
School	Lincoln School	Ogden
School	Mount Ogden Middle	Ogden
School	Thomas O Smith School	Ogden
School	Wasatch School	Ogden

School	Edison School	Ogden
School	Grandview School	Ogden
School	Hillcrest School	Ogden
School	Lewis School	Ogden
School	Majestic School	Ogden
School	Club Heights School	Ogden
School	Green Acres School	Ogden
School	Marlon Hills School	Ogden
School	South Ogden Jr High	Ogden
School	Valley School	Huntsville

Table 11-23 Infrastructure and Landslide Area

Item	**Length (Miles)**	**Replacement Cost**
Local Roads	8.33	$16,660,000
State Highways	33.89	$81,794,239
US Highways	1.93	$4,652,021
US Interstates	0.86	$3,084,480
Power Lines	50.92	$2,458,418
Gas Lines	0.00	$0

F. Hazard History

Within the mitigation planning process it is important to remember that the past is the key to the future. Identifying past hazard events is key in predicting where future events could potentially occur. Table 11-24 identifies historic events with as much relevant information as was available including date, location, area impacted, and damage costs.

Table 11-24 Hazard Histories

Hazard	Date	Location	Critical Facility/ Area Impacted	Comments
Earthquake	July 18, 1894	Ogden		Richter magnitude 5.0
Avalanche	March 2, 1899	Ogden Canyon		Property Damage.
Earthquake	May 13, 1914	Ogden	Felt area 21,000 Sq. Kilometers	Richter magnitude 5.5 +/-
Flood	August 13, 1923		Tributaries between Ogden and Salt lake City	Intense thunderstorms. Seven deaths, $3,000,000 in damage.
Drought	1930-1936	countywide		Recurrence Interval greater than 25 years.
Cloudburst	August 8, 1941	Ogden	Washington Ave, 24 and 25th streets	Extensive flooding, damage to business establishments and homes.
Flash Flooding	May 17, 1949	Pleasant View	Ogden Valley	$30,000 damage to farmlands and crops.
Flooding	April-June, 1952	Ogden	Ogden, Weber	Melting of snowpack. Declared Disaster.
Drought	1953-1965	countywide		Recurrence Interval 10-25 years.
Cloudburst	July 28, 1956	Ogden	East Bench, Weber Canyon	Flooding of homes and streets. Earthslides in canyon.
Avalanche	March 9, 1958	Snow Basin		Two deaths.
Lightning	June 10, 1960	Ogden		Two deaths.
Avalanche	March 29, 1964	Snow Basin		One death.
Thunderstorm	June 6, 1964	Ogden	Five Points area	Damage to homes and roads. Nordic Valley road flushed out.
Flooding from heavy rains	May 10-12, 1966	Ogden	North Fork of the Ogden River, North Ogden, east bench of Ogden	Damage to homes and streets.
Earthquake	March 5, 1967	Huntsville epicenter		Richter magnitude 3.0
Earthquake	December 7, 1967	Huntsville		Richter magnitude

		epicenter		3.6
Tornado	August 14, 1968	West Weber		F2. Property damage $50,000 and one injury.
Lightning	June 10, 1969	Ogden		Two deaths.
Earthquake	September 23, 1971	East of Huntsville		Richter magnitude 3.1
Drought	1974-1978	countywide		Recurrence Interval 10-25 years.
Flooding	April-June 1983	Ogden	Tributaries between Ogden and Salt lake City	Rapid snowpack melt. Presidential Disaster Declaration.
Flooding	1983-1984	countywide		750 million in property loss. 3 deaths.
Waterspout	September 30, 1986	Great Salt Lake	North end of Antelope Island	
Waterspout	August 15, 1987	Great Salt Lake		
Tornado	April 23, 1990	Ogden	Farr West	Property damage.
Flood	09/1991	North Ogden		8.6 inches in less than 24 hours.
Mudslide/ Debris Flow	1991	North Ogden		Damaged more than 400 homes.
Tornado	December 5, 1995	Pleasant View		Property damage.
Tornado	May 29, 1996	North Ogden	West side of Washington Blvd.	F1. $500,000 property damage. One injury.
Tornado	May 21, 1998	Roy		Property damage.
Tornado	August 20, 1998	Causey	Weber Memorial Campground	F0-F1. Property damage and seven people injured.

G. Mitigation Goals, Objectives, and Actions

Weber County
Pre-Disaster Mitigation FY 2003
(PDM03 Workbook)

County: Weber
Address: 721 West 12th Street
City: Ogden, UT
Zip Code: 84404

Point of Contact: Lance Peterson
Phone: 801-778-6682

Signature: _____
County/Tribal Emergency Management Director

Establish a County/Tribal Pre Disaster Mitigation (PDM) Working Group. Members of this group will assist in the review and evaluation of mitigation projects identified in the Regional Hazard Mitigation Plans.

Members of the County/Tribal PDM Working Group:

Name:	Lance Peterson	Title:	Emergency Manager
Name:	George Burbidge	Title:	Weber County Stormwater
Name:	Chuck Stokes	Title:	Weber Fire Department
Name:	Jack Lucero	Title:	Weber Fire District
Name:	Curtis Christenson	Title:	Weber County Engineering
Name:	Jay Miller	Title:	Emergency Manager
Name:	Delon Atkinson	Title:	Emergency Services Director

Attend PDM Planning Meetings with Regional Association of Governments (AOG's) Planner(s). Include additional sheets of information as needed.

Date: November 4, 2003
Time: 2:00 pm
Place: Weber County Sheriff's Office

Purpose of Meeting:
Discuss mitigation strategies for natural hazards in Weber County

List of Attendees:
Lance Peterson
Nancy Barr
LaNiece Dustman
Jim Boes
George Burbidge
Chuck Stokes
Jack Lucero
Curtis Christenson
Jay Miller
Delon Atkinson

Summary of Meeting:
The work group brainstormed and came up with mitigation goals and objectives for the county and its jurisdictions. The group then identified actions to accomplish the goals and objectives.

Outcome of Meeting:
Created a working group and mitigation workbook for future hazards.

*The term "countywide" shall include the following jurisdictions: Farr West City, City of Harrisville, Hooper City, Huntsville City, Marriott-Slaterville, North Ogden City, Ogden City, Plain City, Pleasant View City, Riverdale City, Roy City, South Ogden City, Town of Uintah, city of Washington Terrace, and West Haven City.

HAZARD: EARTHQUAKE

PROBLEM IDENTIFICATION: Non-structural hazards in the Weber County schools are a threat to students, facility, and employees and cause an increase in recovery activities following an earthquake.

OBJECTIVE: Reduce the impact of non-structural events following an earthquake

ACTION: Develop and implement a manual similar to Salt Lake City school districts.

Category	Property Protection and Emergency Services
Time Frame	Immediate
Funding Source Responsibility	School Districts, State Earthquake Program Grant School Districts, County Emergency Management
Estimated Cost	Minimal if using SLC School District template
Background	Train and exercise local school districts on the non-structural methods identified in the document.
Priority	**HIGH**

ACTION 2: Develop a training document for schoolteachers showing non-structural mitigation activities for classrooms.

Category	Property Protection and Emergency Services
Time Frame	Ongoing
Funding Responsibility	County Emergency Services, State Earthquake Program County Emergency Services, School District
Estimated Cost	Minimal
Background	Show methods, techniques, and equipment and associated costs for non-structural mitigation in the classroom.
Priority	**HIGH**

PROBLEM IDENTIFICATION: Critical facilities (public safety, utilities, water/waster water/sewer, schools, hospitals), need to be made less vulnerable from the impacts of earthquakes to allow to a more timely and efficient response and recovery.

OBJECTIVE: Reduce the impact of non-structural events following an earthquake.

ACTION: Develop an earthquake vulnerability study for identified critical facilities.

Category	Emergency Services
Time Frame	Ongoing

Funding Responsibility	County Emergency Services, (FEMA Grants) County Emergency Services and other County/City Agencies
Estimated Cost	Unknown and dependent on scope of project.
Background	Identify critical infrastructure and rank accordingly to assist in upgrades to facilities.
Priority	**HIGH**

PROBLEM IDENTIFICATION: Areas of high liquefaction (western Weber county: Hooper, Far West, West Warren, West Haven, Marriott-Slaterville, Plain City) are experiencing increased growth.

OBJECTIVE: Increased awareness of high liquefaction areas

ACTION: Include current liquefaction maps on the County website.

Category	Emergency Services, Public Information and Prevention
Time Frame	Within the year
Funding Responsibility	County Emergency Services and County Engineer County Emergency Services, County Engineer, GIS and Web
Estimated Cost	Minimal.
Background	Public information on hazard and risk.
Priority	**HIGH**

PROBLEM IDENTIFICATION: Development on identified fault traces increase the risk to life and property.

OBJECTIVE: Promote natural hazards ordinance limiting development in high-risk areas.

ACTION: Make available copy of county natural hazards ordinance for cities within the county.

Category	Prevention
Time Frame	Within the year
Funding Responsibility	County Emergency Services and County Engineer County Emergency Services and County Engineer

Estimated Cost	Minimal.
Background	Weber County has a Natural Hazard Ordinance to address development in high-risk areas. Cities within the County should be made aware of this Ordinance and hopefully implement the same regulatory ordinance in their community.
Priority	**HIGH**

HAZARD: FLOOD

PROBLEM IDENTIFICATION: Communities not involved in the NFIP.

OBJECTIVE: Have federal flood insurance available within communities and adopt flood loss prevention ordinances.

ACTION: Encourage the communities of Washington terrace and Huntsville to participate in the NFIP.

Category	Prevention
Time Frame	Ongoing
Funding Responsibility	None required State Floodplain Manager, City Officials, Building Officials
Estimated Cost	None
Background	This will make FEMA review and identify flood hazards in the area and will allow for a more accurate flood risk assessment. It will also allow citizens to buy federal flood insurance.
Priority	**MEDIUM**

PROBLEM IDENTIFICATION: Stormwater issues continue to be a critical flood issue in the county.

OBJECTIVE: Implement and fund identified stormwater projects to lessen impact of flooding in the county.

ACTION: Include current stormwater plans and projects in hazard mitigation plan.

Category	Prevention
Time Frame	Ongoing
Funding	Project specific, funding from County, Stormwater, State and Federal Programs.

Responsibility	County Stormwater, County Engineer
Estimated Cost	Depending on project.
Background	Weber County's Stormwater Program is actively involved and promotes sound land use planning and flood loss reduction activities. The long-term plan and identified projects will help alleviate flooding in the County and Cities within County. The County Master Plan has identified areas of concern and the "Regional Storm Water Management Plan" has addressed those areas with a detailed list of projects.
Priority	**MEDIUM**

PROBLEM IDENTIFICATION: Weber County has an extensive canal system and canal breach or overtopping has and will continue to create a significant flood threat.

MITIGATION OBJECTIVE: Evaluate canals in the county that may cause flooding.

ACTION: Identify canals in the county that have the potential to cause damage due to flooding.

Category	Emergency Services
Time Frame	Two years
Funding Responsibility	County Emergency Management, State Mitigation Program Grant County Stormwater, County Engineer, County Emergency Services, State Hazard Mitigation Planner
Estimated Cost	Depends on scope of study
Background	City of Riverdale experienced a significant flood event from a canal breach. Other private canals may also be of concerns.
Priority	**LOW**

HAZARD: SEVERE WEATHER

PROBLEM IDENTIFICATION: Most disaster declarations are generated from weather related incidents. Weber County continues to be impacted by snowstorms, hail, thunderstorms/lightning, tornados, heavy rain, and avalanche.

MITIGATION OBJECTIVE: Reduce impact to life and property from severe weather related incidents

ACTION: Establish and support countywide National Weather Service Storm Ready program.

Category	Public Information
Time Frame	Two years
Funding Responsibility	County Emergency Management County Emergency Management, SLC NWS
Estimated Cost	Minimal, some cost for weather radios
Background	This is a proactive public information program that allows communities to be recognized for many weather related activities they are already doing.
Priority	**MEDIUM**

ACTION 2: Identify areas of avalanche risk and develop and post signs for avalanche danger

Category	Public Information
Time Frame	Ongoing
Funding Responsibility	County Emergency Management, County and City Planners, County and City Engineers, Road Dept/Public Works County/City Engineers and Road Dept./Public Works
Estimated Cost	Minimal, for signs and placement of signs.
Background	Avalanche danger in areas of North Ogden Divide and in the Ogden Valley will continue to threaten lives and property as people move and travel into areas of risk.
Priority	**LOW**

HAZARD: WILDLAND FIRE

PROBLEM IDENTIFICATION: Urban interface wildland fire continues to be of concern in areas of Uintah Highlands, Wolf Creek, North Ogden, and other areas of the Ogden Valley.

MITIGATION OBJECTIVE: Reduce impact to life and property from urban interface wildland areas

ACTION: Develop and implement a strong land use ordinance that addresses fuel reduction in areas at risk from fire.

Category	Prevention
Time Frame	Ongoing
Funding Responsibility	County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials County/City Emergency Management, Planning and Zoning, County and City Attorneys, Public Officials
Estimated Cost	Minimal - Time and involvement.
Background	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
Priority	**HIGH**

ACTION 2: Have communities participate in the Fire Wise Community programs.

Category	Property Protection
Time Frame	Ongoing
Funding Responsibility	Forestry Fire and State Lands, US Forest Service Contractors, County and City Fire, Local participation
Estimated Cost	Minimal - Time and involvement.
Background	Weber County and cities within the County continue to struggle with existing wildland fire interface communities such as Uintah Highlands. It is critical new developments in areas of risk are designed to lessen the impact from such fires.
Priority	**HIGH**

HAZARD: DAM FAILURE

PROBLEM IDENTIFICATION: Dam failure from federal, state and private dams can impact Weber County. Debris basin type dams are of concern at Birch Creek, Glassman Way, and on Harrison Blvd.

MITIGATION OBJECTIVE: Reduce the impact of catastrophic flooding due to dam failure

ACTION: Re-evaluate current high hazard dams and evaluate use of early warning sirens to warn public.

Category	Emergency Services
Time Frame	Ongoing
Funding Source: Responsibility:	Local and State County Emergency management
Estimated Cost	Unknown
Background	A catastrophic dam failure can impact a significant population in the County. Evaluating the risk and vulnerability will allow for a more efficient emergency response.
Priority	**MEDIUM**

ACTION 2: Identify and then fund dams needing armored concrete chutes.

Category	Prevention

Time Frame	Unknown and based on funding
Funding Source: Responsibility:	Local and State Stormwater Management, County Engineer, State Engineer
Estimated Cost	Unknown
Background	A catastrophic dam failure can impact a significant population in the County. Armored concrete chutes are an approved structural mitigation measure.
Priority	**MEDIUM**

HAZARD: LANDSLIDES

PROBLEM IDENTIFICATION: Weber County has significant areas of landslides.

OBJECTIVE: Re-evaluate current landslide map

ACTION: Update current landslide map and supporting data

Category	Prevention
Time Frame	Unknown and based on funding
Funding Source: Responsibility:	Local and State County and City Engineering
Estimated Cost	Unknown
Background	Current landslide maps include data that does not necessarily reflect areas at risk.
Priority	**LOW**

MITIGATION OBJECTIVE: Monitor landslide movement in areas that impact infrastructure and population.

ACTION: Evaluate landslide areas where parameters can be used

Category	Property Protection
Time Frame	Unknown and based on funding
Funding Source:	Local and State

Responsibility:	County and City Engineering, UGS
Estimated Cost	Unknown
Background	Area of Bear Hollow and the mouth of Weber Canyon have active landslides and can impact roads and population.
Priority	**LOW**

Weber County - Risk Assessment Summary
(From Weber County EOP – February 2000)

	Consequences / Impact of an Event		
Probability of an Event	**Severe**	**Moderate**	**Limited**
High	Earthquake ***High Risk***	Wildland/Urban Fire ***High Risk***	Tornado Storm Flooding Small Hazmat Spill ***Moderate Risk***
Moderate	Large Hazmat Spill ***High Risk***	Drought Mudslide ***Moderate Risk***	Strong Wind Micro-burst Ground Transportation-Accident Winter Storm Event ***Low Risk***
Low	Nuclear Attack Dam Break Air Transportation-Accident ***Moderate Risk***	Civil Unrest ***Low Risk***	Extreme Heat Lightning Avalanche Landslide Canal Break Explosive Devices ***Low Risk***

Risk Assessment Methodology – Weber County EOP – February 2000

A complete hazard analysis should identify the range of possible risks that might impact a jurisdiction and/or the surrounding area. The emergency response system and the jurisdiction should be prepared to manage disasters from the least to most serious within the identified range.

The hazard identification and risk assessment should identify what can occur, when, or how often it is likely to occur (also referred to as frequency or probability of occurrence), and how bad the effects could be (impact or consequences). For some of the hazards identified, it will not be necessary to carry out a full analysis. These are hazards for which no further action is required. For some hazards, inclusion in a mitigation planning section will be required. Development of a specific annex for response and recovery efforts may also be required depending on the hazard and the specific risks it brings to the county or specific operational considerations. In short, based upon this hazard analysis, some hazards will require nothing more than the identification of their existence, while some hazards will require specific planning efforts for response, recovery, mitigation, and preparedness. All of this is based upon risk.

Risk is the combination of probability/frequency and impact/consequences. A hazard with a high probability and high impact on the community would naturally be categorized as a High Risk hazard. Conversely, a hazard with a low probability and low impact on the community would naturally be categorized as a Low Risk hazard. The matrix that follows is an attempt to graphically present the definitions used in the hazard analysis into a single risk code. Hazard risk priorities of High, Medium and Low are indicated for each hazard.

The matrix is comprised of a vertical axis, which categorizes the probability or frequency of a hazard creating an incident, and a horizontal axis, which categorizes the impact or consequences of a hazard. In an effort to more clearly define the probabilities and consequences associated with hazards in our county, definitions of impact and probability are given here.

Impact is defined as the effect of a hazard on the community, or the consequences of an event on a community. For this analysis, both impact and consequences are being used synonymously.

Each hazard has been defined as having a Limited, Moderate or Severe impact or consequence upon the community. The consequences have been categorized based upon the impact or consequences of the hazard in each of six impact areas. These six areas are: Public Health, Responder Safety, Property, Facilities/Infrastructure, Environment, and Economical/Financial.

Limited, Moderate and Severe impact levels have been defined as follows:

Limited Impact - Any hazard with a limited impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -
   Treatable injuries through first aid. Loss of quality of life.

2. Responder Safety-
   No significant threat to responder safety. Treatable first aid injuries if any.

3. Property-
   Only properties located in close proximity to the hazard/incident are affected. No more than 5% of the property located nearby is severely damaged.

4. Facilities / Infrastructure-
   Complete shutdown of facilities and critical services for less than 24 hours. May only be in isolated areas of community.

5. Environment-
   Release into the environment such that there is no measurable impact to the environment. High amount of the release is contained, very little damage to water or air. Very low threat to health, safety, or the environment based upon type of release, quantity, and location. Meets threshold of reportable quantities reporting requirements.

6. Economic / Financial-
   Minor loss to financial base. Non-incapacitating losses. Funding not available within first 12-24 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of Limited Impact.

Moderate Impact - Any hazard with a moderate impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -
   Long-term minor quality of life loss. Major injuries, some deaths.

2. Responder Safety-
   Threat to responder safety. Treatable injuries that may require transport. Site Safety Plans required, implemented. After-action review.

3. Property-
   Properties located in close proximity to the hazard/incident are affected. Other property located nearby is also slightly affected. No more than 20% of the property located in close proximity is severely damaged.

4. Facilities / Infrastructure-
   Complete shutdown of facilities / critical services for 24-48 hours. May be community wide effect.

5. Environment-
   Release into the environment such that there is a measurable impact to the environment. Release not necessarily contained, threatens water and/or air, will require detailed remediation (short-term process). Definite threat to health, safety, and/or the environment based upon type of release, quantity, and location. Requires protective actions for population.

6. Economic / Financial-

Loss to financial base. Some incapacitating losses. Funding not available within first 24-36 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of Moderate Impact. Moderate Impact events, or hazards with the potential for moderate impact on the community will be evaluated upon the six criteria or descriptions of impact listed above.

Severe Impact Definitions- Any hazard with a limited impact designation may have consequences upon the community as defined within the six major impact areas in the following manner:

1. Public Health -

Long-term quality of life loss. Major injuries, numerous deaths.

2. Responder Safety-

Major concerns for responder safety. Treatable injuries that require transport. Site Safety Plans required, implemented. After-action review. Extraordinary precautions.

3. Property-

Property located throughout the community is affected. Impact on property regardless of location. However, no less than 20% of the property located in close proximity to the incident is severely damaged.

4. Facilities / Infrastructure-

Complete shutdown of facilities / critical services for more than 48 hours.

5. Environment-

Release into the environment such that there is a substantial impact to the environment. Much of the release may not be contained, threatens water and/or air, will require extensive remediation (long-term process). Serious threat to health, safety, and/or the environment based upon type of release, quantity, and location. Requires protective actions for population with long-term consequences.

6. Economic / Financial-

Major loss to financial base. Incapacitating losses. Funding not available within first 36-48 hours to initiate recovery efforts.

Any hazard with the potential impact or consequences as defined above will be given the designation of High Impact. Each hazard in the County must be categorized by its impact on the community. Once impact, or consequences are understood for each hazard, it is equally important to understand probability, or frequency ratings.

Hazard probability is the likelihood that an identified hazard will result in an incident. Hazard probability or frequency has been used to help understand the overall risk to a community. For planning and analysis purposes, the probability ratings of High, Moderate/ Medium, and Low have been used for our model. These probability, or frequency ratings, make the potential impacts clearer to decision makers. These three ratings have been given the following definitions:

High = 1) A hazard whose potential impact is very probable at anytime during the next 12 months, 2) A hazard that occurs frequently based upon historical data, 3) A hazard that occurs infrequently yet is beyond its time line of expectancy for the next occurrence, 4) A hazard with an 80 - 99% probability of occurrence.

Moderate = 1) A hazard whose potential impact is very probable at anytime during the next 12

to 36 months, 2) A hazard that occurs occasionally based upon historical data, 3) A hazard that occurs infrequently but is nearing its time line of expectancy for the next occurrence, 4) A hazard with more than a 50% probability of occurrence.

Low = 1) A hazard whose potential impact is not very probable at anytime during the next 36 months, 2) A hazard that does not occur frequently based upon historical data, 3) A hazard that is not near or beyond its time line of expectancy for the next occurrence, 4) A hazard with less than a 50% probability of occurrence.

The definitions given have multiple examples, or denotations, to assist in the overall understanding of each probability, or frequency rating.

The Risk Assessment Matrix is as follows:

Risk Assessment Matrix

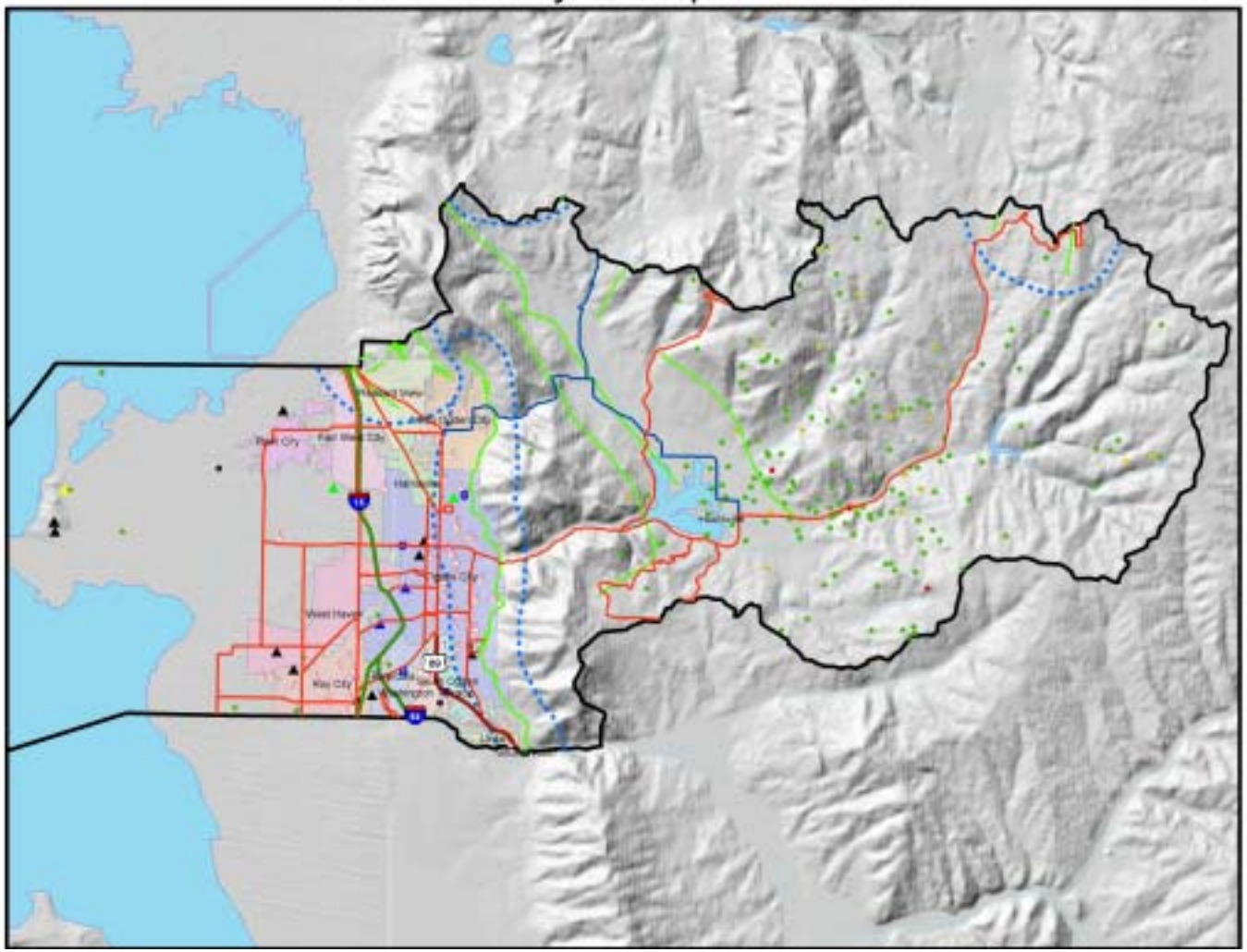
	Consequences / Impact of an Event		
Probability of an Event	**Severe**	**Moderate**	**Limited**
High	High Probability Severe Consequences ***High Risk***	High Probability Moderate Consequences ***High Risk***	High Probability Limited Consequences ***Moderate Risk***
Moderate	Moderate Probability Severe Consequences ***High Risk***	Moderate Probability Moderate Consequences ***Moderate Risk***	Moderate Probability Limited Consequences ***Low Risk***
Low	Low Probability Severe Consequences ***Moderate Risk***	Low Probability Moderate Consequences ***Low Risk***	Low Probability Limited Consequences ***Low Risk***

H. Maps

All of the following maps have been created for the purposes related to PDM using the best available data at the time of the creation of this plan. WFRC and its staff members cannot accept responsibility for any errors, omissions, or positional accuracy; therefore there are no warranties, which accompany the maps.

Map 11.1.1 Weber County Earthquake Threat
Map 11.1.2 Weber County Liquefaction Potential
Map 11.2.1 Weber County Wildfire Risk
Map 11.4.1 Weber County Landslide Hazard
Map 11.5.1 Weber County Dam Hazard

Weber County Earthquake Hazard



Fault zones
Faults
Magnitude
1 - 2
2 - 3
3 - 4
Fire Station
Police Station
School
Care Facility
Waste Water Facility
Potable Water Facility
Oil Facility
Electric Power Facility
Communication Facility

N
W E
S

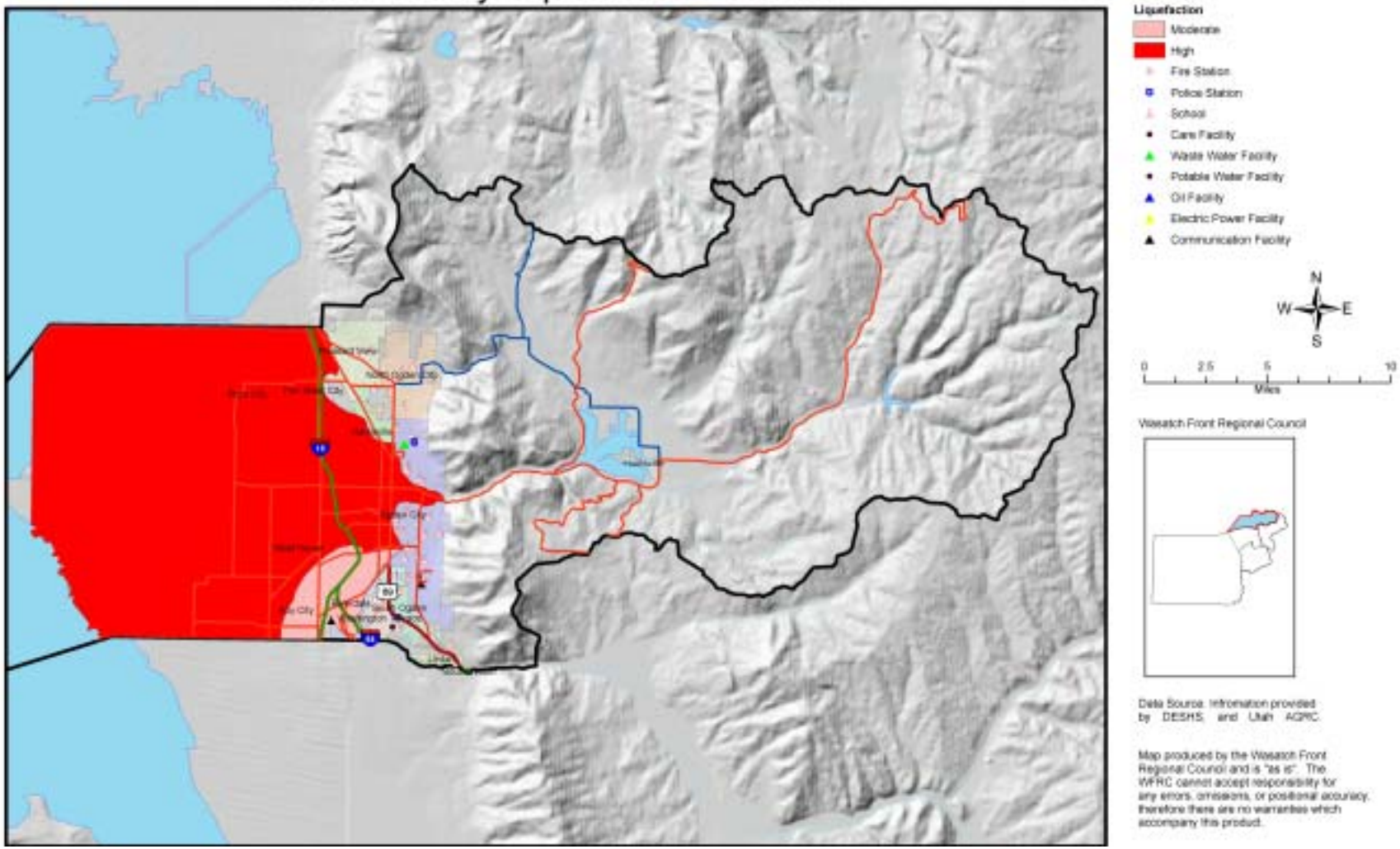
0 2.5 5 10
Miles

Wasatch Front Regional Council

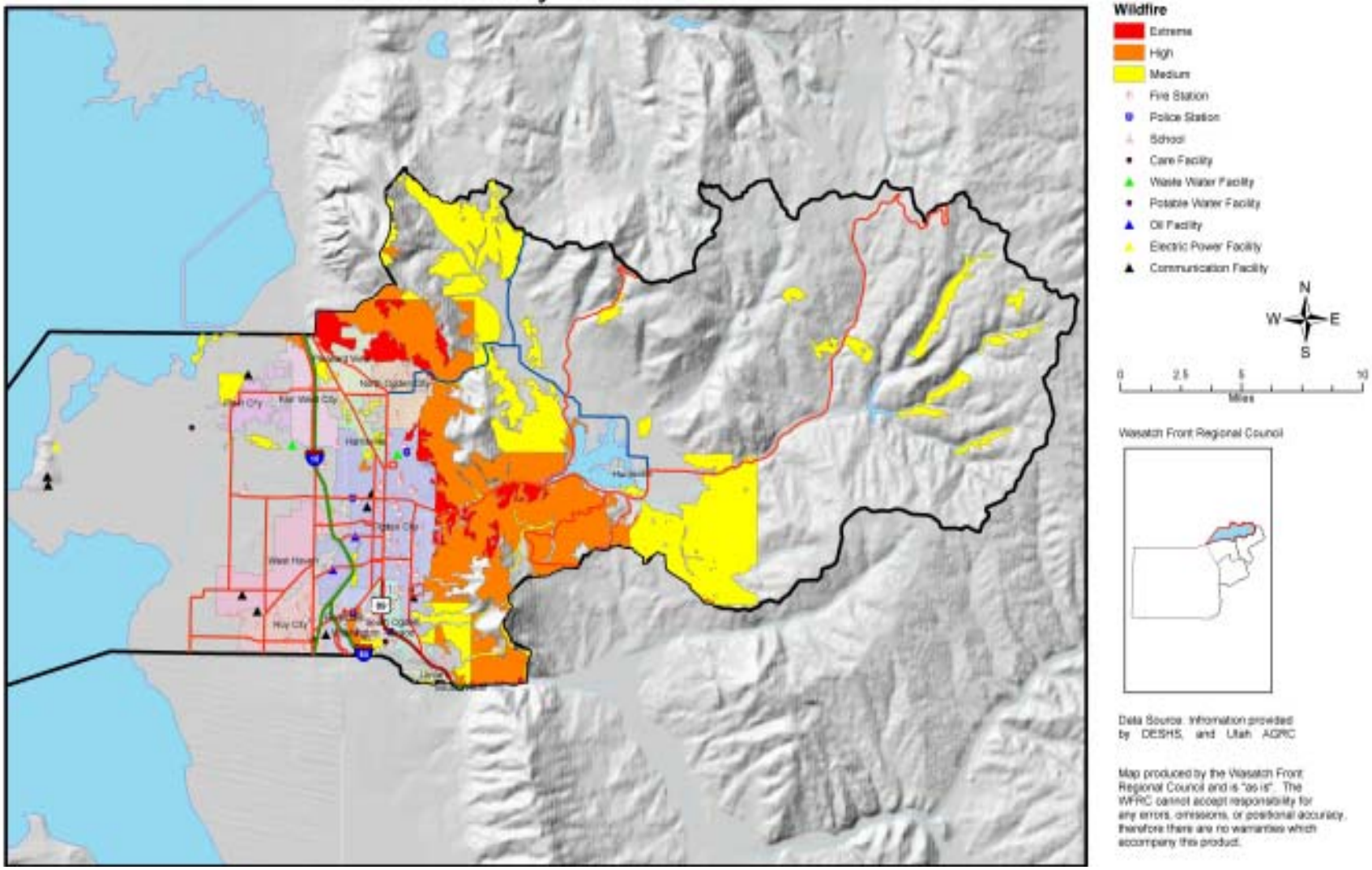
Data Source: Information provided by DESHS and Utah AGRC.

Map produced by the Wasatch Front Regional Council and is "as is". The WFRC cannot accept responsibility for any errors, omissions, or positional accuracy, therefore there are no warranties which accompany this product.

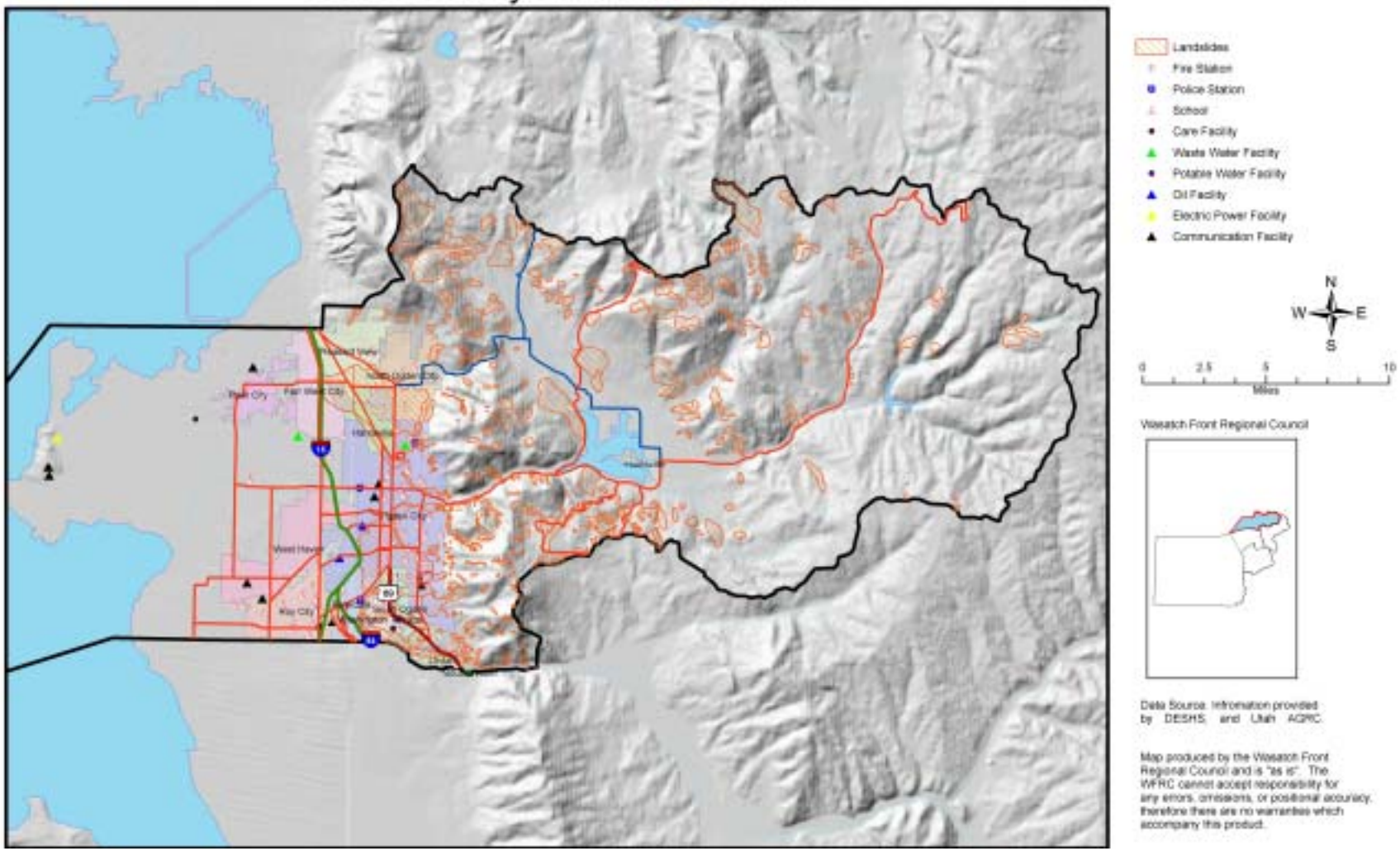
Weber County Liquefaction Potential



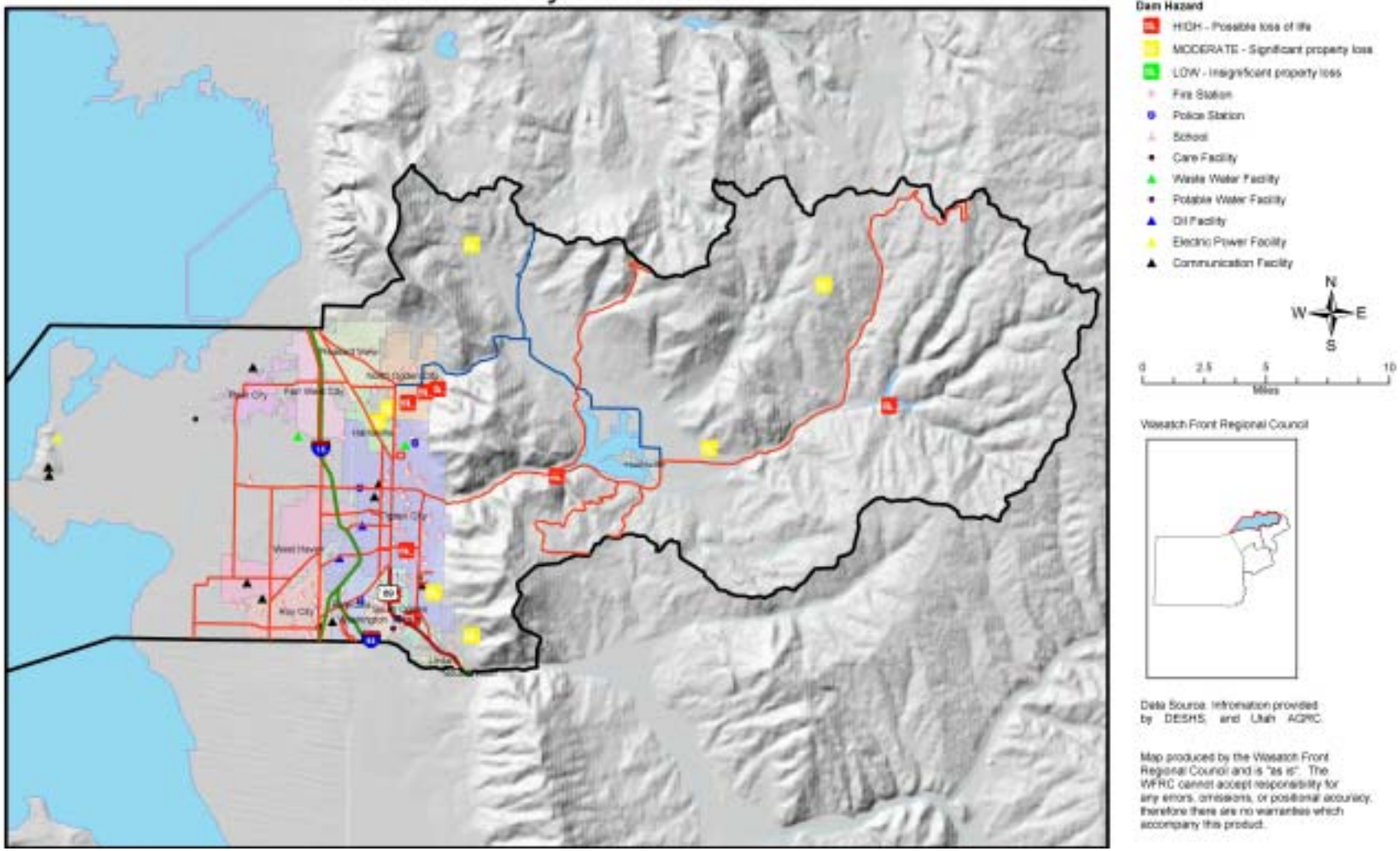
Weber County Wildfire Risk



Weber County Landslide Hazard



Weber County Dam Hazard



Part XII. Regional Hazards

Due to the geographic extent these hazards have not been mapped and risk assessments were unable to be compiled. Therefore all of the information for the following regional hazards is in the narrative below. The entire region is subject to these hazards with no unique risk affecting a single jurisdiction. Refer to each county section for a list of historical hazard events.

Severe weather includes High Winds, Severe Storms (Thunderstorms, Lightning, Hailstorms, Heavy Snow or Rain, Extreme Cold), Tornado, and Avalanche.

1. Severe Weather

Hazard Profile

Potential Magnitude	X	Negligible	Less than 10%
		Limited	10-25%
		Critical	25-50%
		Catastrophic	More than 50%
Probability	X	Highly Likely	
		Likely	
		Possible	
		Unlikely	
Location	Occur in very localized areas throughout the region, unable to identify exactly when and where the next event will take place.		
Seasonal Pattern or Conditions	Based on climate, elevation, and precipitation.		
Duration	Severe Weather hazards generally last hours and can last days.		
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah DESHS, local input, and review of historic events and scientific records.		

High Winds

High winds can occur with or without the presence of another storm and are determined to be unpredictable in regards to time and place. Each of the five counties that make up the Wasatch Front has experienced high winds in the past, generally during the spring and summer months. These counties can expect regional high wind events in the future.

Canyon winds can bring wind gusts of more than 100 mph through the canyon mouths into the populated areas of the Wasatch Front. Winds are usually strongest near the mouths of canyons and have resulted in the loss of power and the inability to heat homes and businesses. Winds in the past have damaged roofs, destroyed and knocked down large trees and fences, overturned tractor -trailers, railroad cars, and small airplanes.

Severe Storm

Severe storms can include thunderstorms, hailstorms, heavy snow or rain, and extreme cold. They are generally related to high precipitation events during the summer and winter months. Severe storms can happen anywhere in the region and the damage can be extensive especially for agriculture, farming, and transportation systems. They can also disrupt business due to power outages.

Thunderstorms

A thunderstorm is a storm made up of heavy rain or hail along with thunder and lightning resulting from strong rising air currents. Based on historical evidence thunderstorms can strike anywhere in the region mainly during the spring and summer months

Lightning
Lightning is the electric discharge accompanied by light between clouds or from a cloud to the earth. In Utah, lightning is the number one natural hazard killer. Lightning can also start wildland fires, which could be potentially fatal or disruptive.

Hailstorms
Hailstorms occur when freezing water in thunderstorm type clouds accumulates in layers around an icy core generally during the warmer months of May through September. Hail causes damage by battering crops, structures, and automobiles. When hailstorms are large (especially when combined with high winds), damage can be extensive. The risk of hailstorms is not targeted to any particular areas within the region.

Heavy Snow or Rainfall
Heavy amounts of precipitation from rain or snow can result in flash flood events. Historically, The Wasatch Front has been susceptible to these types of storms because of close proximity to the mountain ranges. Major winter storms can produce five to ten times the amount of snow in the mountains than in the valley locations.

Most of the valley's development occurs on old alluvial fans from the canyon mouths. During heavy precipitation flood waters and debris will occur on these same alluvial fans, damaging residential and commercial property along with infrastructure. The associated threat with heavy snowfall is avalanches.

Extreme Cold
Sub-zero temperatures occur in the Wasatch Front during most winters, however prolonged periods of extremely cold weather are infrequent. January is generally the coldest month of the year. Historically extreme cold in the region has disrupted agriculture, farming, and crops. Extreme cold also affects life, especially vulnerable are the young and elderly and animals.

Valley temperature inversions occur during the winter months and keep cold, foggy, moist air trapped to the Wasatch Front valley floor. This is a result of the high pressure trapping the air in the valley. The fog and smog can cause serious visibility restrictions and icy surfaces as well as health alerts. High winds are needed to clear the inversion.

Avalanche
Avalanches occur on steep slopes and therefore the mountainous areas as well as the foothills around the region are all vulnerable. Even though most avalanches occur on forested lands they affect mostly city and county dwellers. Therefore, avalanches should be given a priority in Utah due the number of historical occurrences. The money spent to respond, and recover from an avalanche in addition to the man-hours and property affected by a slide is usually on or given by the city and/ or county.

The probability of a future event is likely dependant on the amount of heavy snowfall during a given year. Most deadly avalanches occur in the backcountry away from developed areas. Avalanche control is performed regularly in developed ski areas to minimize the threat and increase awareness. The Avalanche Center was initiated as another resource for measuring risk and increasing awareness to the residents of the Wasatch Front region.

Tornado
Historically, atmospheric conditions have not been favorable for the development of tornadoes in Utah due to the dry climate and mountainous terrain. Utah averages about two tornados per year. Utah tornados are usually no more than 60 feet wide at the base and last up to 15 seconds. Tornadoes occur during the months of May, June, July, and August usually preceding a cold front. Utah is one of the lowest ranked nations for incidences of tornadoes with only one F2 or stronger tornado every seven years.

*On October 18, 1984, a "lake effect" snowstorm dropped 22 inches of snow in 24 hours on the east benches of the Salt Lake Valley. The man in this photo is Paul R. Rich of Holladay. (Photo by of the Salt Lake Tribune.) Source: http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html.

*At about 7:00 PM on January 10, 1964, forty mile-per-hour winds caused newly fallen snow to roll up like a lady's hand muff, creating an army of "snow rollers" that marched through Sugarhouse Park in Salt Lake City. (Photo by L.V. McNeely). Source: http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html.

*At about 3:00 AM, on August 12, 1985, a large lightning strike hit the southwestern part of the Salt Lake Valley. This picture was taken from Blue Fox Circle (at 6075 South and 3686 West) in Kearns. (Photo by Mike Rogers). Source: http://www.utahweather.org/UWC/weather_pictures/weather_photos_1900-2002.html.

2. Drought

Hazard Profile

Potential Magnitude		Negligible	Less than 10%
		Limited	10-25%
	X	Critical	25-50%
		Catastrophic	More than 50%
Probability		Highly Likely	
	X	Likely	
		Possible	
		Unlikely	
Location	Countywide		
Seasonal Pattern or Conditions	Summer		
Duration	Months, Years		
Analysis Used	National Weather Service, Utah Climate Center, National Geophysical Data center- Natural Hazards Database, Newspapers, Local input.		

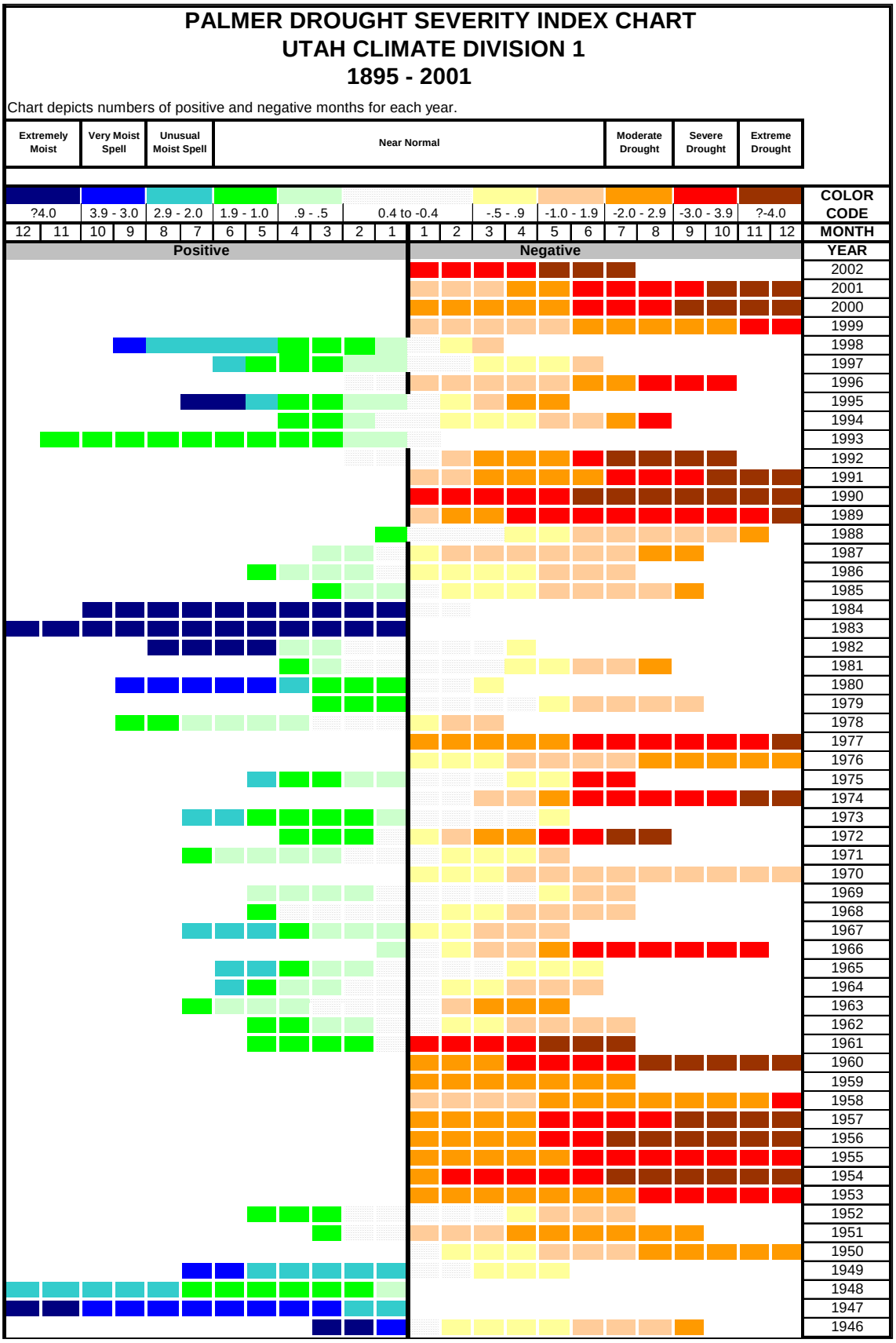
Drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. The entire region is currently experiencing a drought from 1999- present. Drought dramatically affects this area because of the lack of water for agriculture and industry, which limits economic activity, irrigation and culinary uses. The severity of the drought results in depletion of agriculture lands and deterioration of soils. In the Wasatch Front region the risk of drought is high.

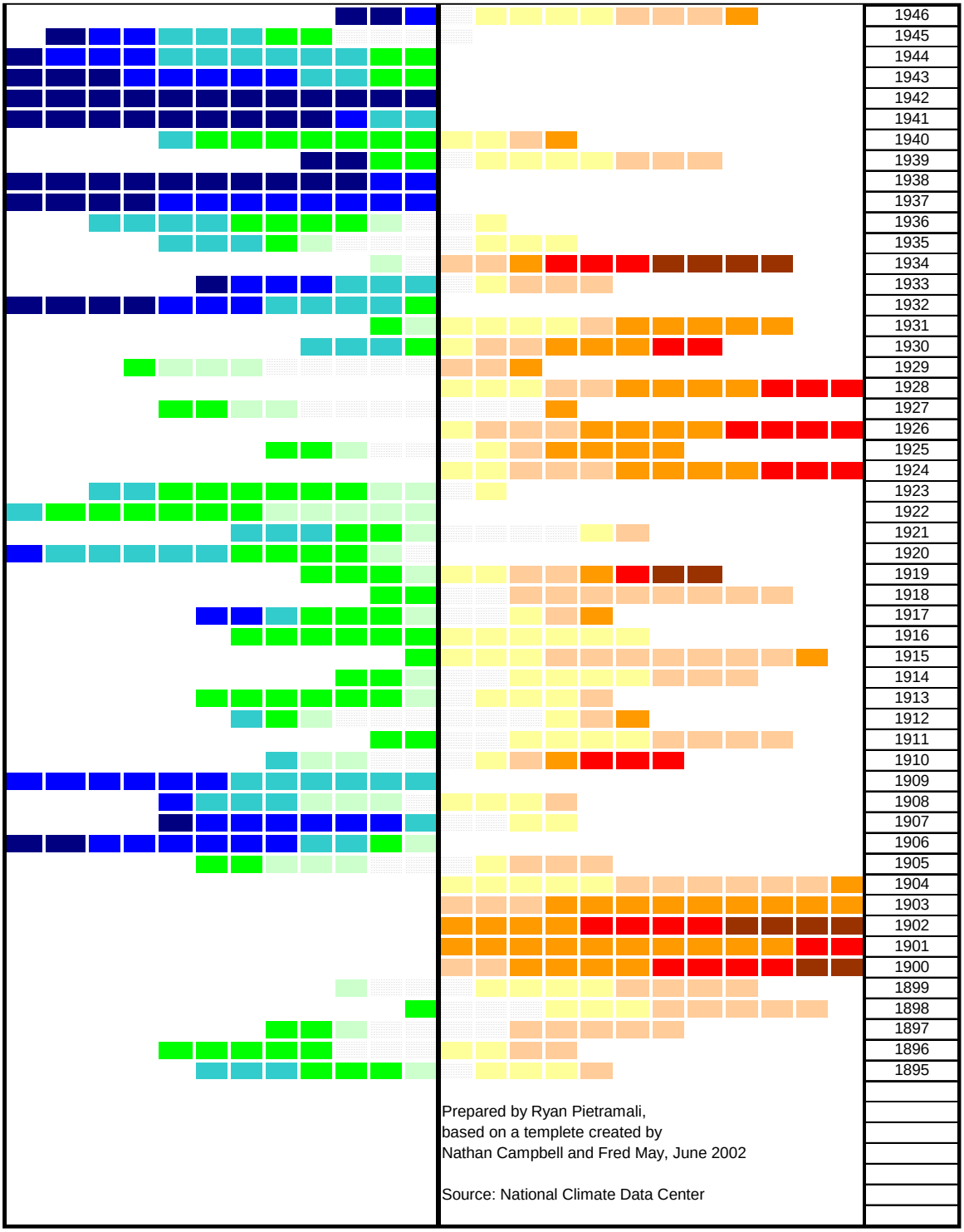
Drought is not targeted to any particular area within the region and the geographic extent of drought is hard to identify or map on a local or even county level. During the making of this plan, drought related GIS layers were unavailable to complete the mapping and analysis portions of the plan. Therefore, a vulnerability analysis including types and numbers of buildings, critical facilities, and infrastructure affected by drought were unable to be determined.

The secondary threats associated with drought include infestation and wildfire, all of which the region as historically been susceptible to. For a further explanation of infestation and wildfire refer to the Part VI Risk Assessment, Section E Hazard Description.

The Palmer Drought Severity Index developed by Wayne Palmer in the 1960's, measures drought severity using temperature and rainfall to determine dryness. The Palmer Drought Severity Index or (PDSI) has become the "semi-official" drought index as it is "standardized" to local climate and can be applied to any part of the country. The PDSI uses zero as normal and assigns a monthly numerical id between +6 and -6 with, server droughts having higher negative numbers. Thus, a moderate drought is minus 2, a sever drought minus 3, and extreme drought is minus 4. Excess rain is expressed using plus figures, with plus 2 representing moderate rainfall, etc. Refer to Figure 1 and 2.

Figure 1 Climate Division 1 Western

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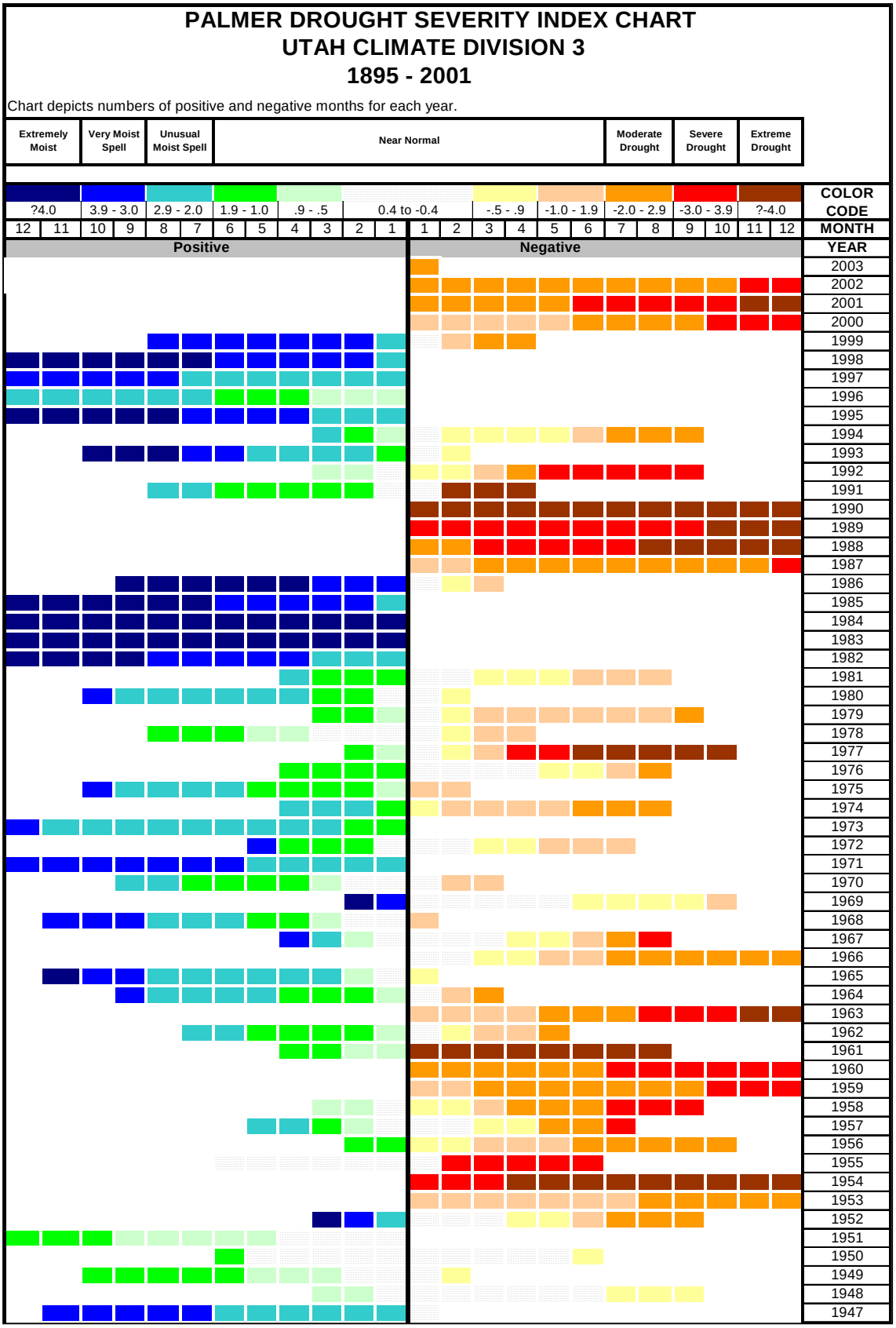
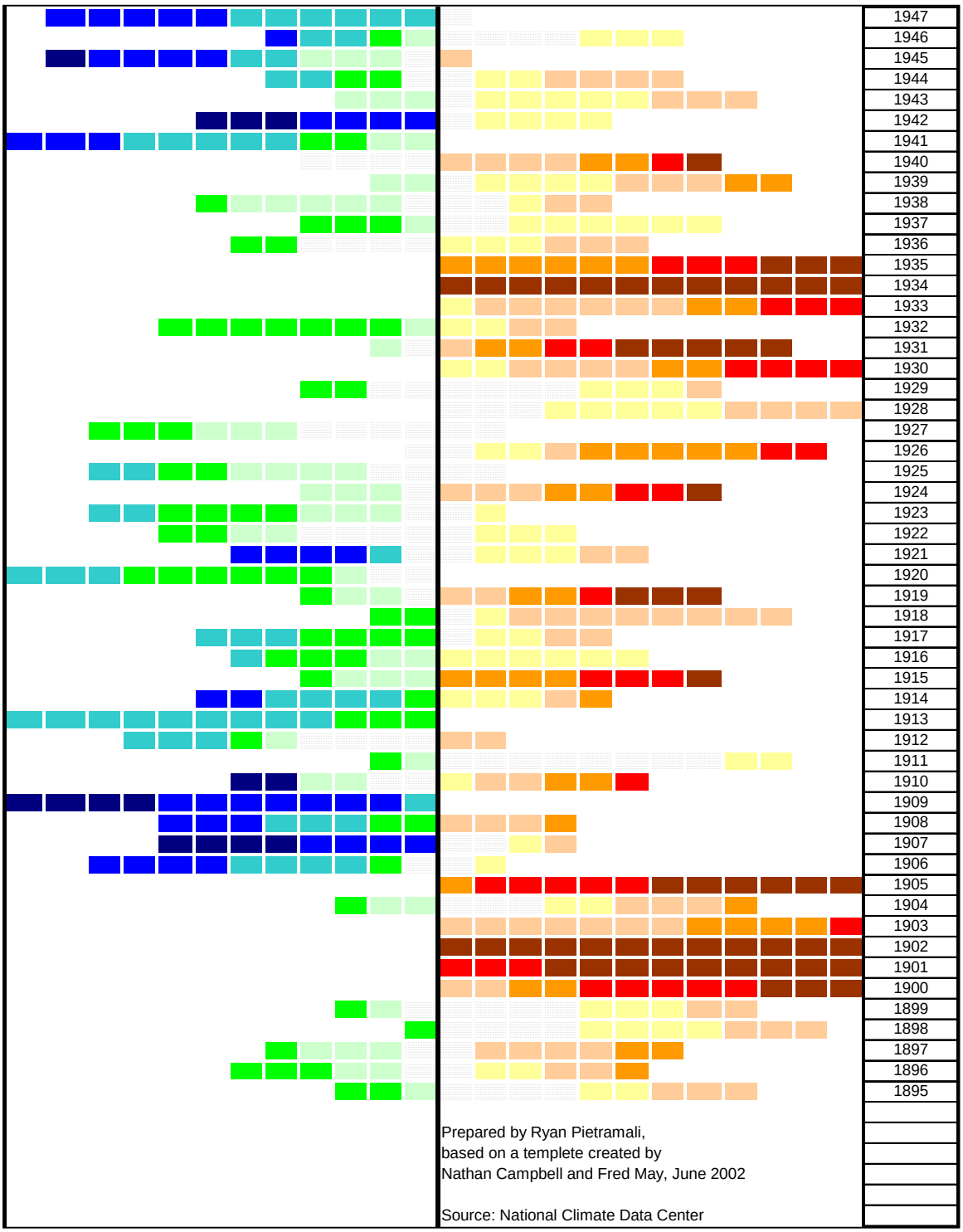
Prepared by Ryan Pietramali,
based on a templete created by
Nathan Campbell and Fred May, June 2002
Source: National Climate Data Center

Figure 2 Climate Division 3 North Central

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Prepared by Ryan Pietramali,
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Source: National Climate Data Center

Part XIII. Maintenance and Implementation Procedures

Monitoring, Evaluating and Updating the Plan
Periodic monitoring and reporting of this plan is required to ensure that the goals and objectives for the region are kept current and that local mitigation efforts are being carried out. This plan has therefore been designed to be user-friendly in terms of monitoring and implementing.

Annual Reporting Procedures
This plan shall be reviewed annually, as required by the Utah DESHS, or as situations dictate such as following a disaster declaration. Each year the Wasatch Front Regional Council, Community Development Department will review the plan and ensure the following:

1. The Executive Director of the WFRC will receive an annual report and/or presentation on the implementation status of the plan.

2. The report will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan.

3. The report will recommend, as appropriate, any required changes or amendments to the plan.

If the WFRC Executive Director, participating Jurisdictions, or Utah DESHS determines that a modification of the plan is warranted, an amendment to the plan may be initiated.

Revisions and Updates
Periodic revisions and updates, based on funding, of the plan are required to ensure that the goals and objectives for the region are kept current. More importantly, revisions may be necessary to ensure the plan is in full compliance with Federal regulations and State statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

Five (5) Year Plan Review
The entire plan including any background studies and analysis should be reviewed every five (5) years to determine if there have been any significant changes in the region that would affect the plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques and changes to Federal or State legislation are examples of changes that may affect the condition of the plan.

The Natural Hazard Pre-Disaster Mitigation Planning Committees, with a potential membership representing every jurisdiction in the WFRC area, will be reconstituted for the five (5) year review/update process. Typically, the same process that was used to create the original plan will be used to prepare the update.

Further, following a disaster declaration, the plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five (5) year review will be summarized in the annual report prepared for this plan under the direction of the Community Development Director. The annual report will include an evaluation of the effectiveness and appropriateness of the plan, and will recommend, as appropriate, any required changes or amendments to the plan.

If the WFRC Executive Director, participating jurisdictions, or Utah DESHS determines that the recommendations warrant modification to the plan, an amendment may be initiated as described below.

Plan Amendments

An amendment to the plan should be initiated by Utah DESHS, or the WFRC Executive Director, either at its own initiative or upon the recommendation of the State Hazard Mitigation Officer, Community Development Director or Mayor of an affected community.

Upon initiation of an amendment to the plan, WFRC will forward information on the proposed amendment to all interested parties including, but not limited to, all affected city or county departments, residents and businesses. Depending on the magnitude of the amendment, the full planning committee may be reconstituted or the WFRC Regional Growth Committee may review the amendment. At a minimum, the information will be made available through public notice in a newspaper of general circulation or on the WFRC website at www.wfrc.org.

Information will also be forwarded to the Utah DESHS. This information will be sent out in order to seek input on the proposed plan amendment for not less than a forty-five (45) day review and comment period.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to the Community Development Director for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. The Community Development Director will review the proposed amendment along with comments received from other parties and submit a recommendation to the Executive Director within sixty (60) days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the plan; and/or

2. New issues or needs have been identified which were not adequately addressed in the plan; and/or

3. There has been a change in information, data or assumptions from those on which the plan was based.

4. The nature or magnitude of risks has changed.

5. There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of the Executive Director or his/her designee, a public hearing will be held. The Executive Director will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Executive Director will take one of the following actions:

1. Adopt the proposed amendment as presented.

2. Adopt the proposed amendment with modifications.

3. Defer the amendment request for further consideration and/or hearing.

4. Reject the amendment request.

Implementation through Existing Programs

Once this plan is promulgated participating cities and counties will be able to include the valuable information in this plan into existing programs and plans. These can include the General or Master Plan, Capital Improvements Plan, Emergency Operations Plan, State Mitigation Plan, City Mitigation Plans.

Many of the mitigation actions developed by the cities and counties have elements of mitigation implementation including the NFIP, Fire Code, BCEGS, and CRS all of which have been implemented.

Process

It will be the responsibility of Mayor/Council/Commissioner(s) of each jurisdiction, as he/she/they see fit, to ensure these actions are carried out no later than the target dates unless reasonable circumstances prevent their implementation (i.e. lack of funding availability).

Funding Sources

Although all mitigation techniques will likely save money by avoiding losses, many projects are costly to implement. The WFRC jurisdictions will continue to seek outside funding assistance for mitigation projects in both the pre- and post-disaster environment. This portion of the plan identifies the primary Federal and State grant programs for WFRC jurisdictions to consider, and also briefly discusses local and non-governmental funding sources.

Federal Programs

The following federal grant programs have been identified as funding sources which specifically target hazard mitigation projects:

Title: Pre-Disaster Mitigation Program
Agency: Federal Emergency Management Agency

Through the Disaster Mitigation Act of 2000, Congress approved the creation of a national program to provide a funding mechanism that is not dependent on a Presidential Disaster Declaration. The Pre-Disaster Mitigation (PDM) program provides funding to states and communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage and destruction of property.

The funding is based upon a 75% Federal share and 25% non-Federal share. The non-Federal match can be fully in-kind or cash, or a combination. Special accommodations will be made for "small and impoverished communities", who will be eligible for 90% Federal share/10% non-Federal.

FEMA provides PDM grants to states that, in turn, can provide sub-grants to local governments for accomplishing the following eligible mitigation activities:

- State and local Natural Hazard Pre-Disaster Mitigation Planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

Title: Flood Mitigation Assistance Program
Agency: Federal Emergency Management Agency

FEMA's Flood Mitigation Assistance program (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the National Flood Insurance Program (NFIP). FMA was created as part of the National Flood Insurance Reform Act of 1994 (42 USC 4101) with the goal of reducing or eliminating claims under the NFIP.

FMA is a pre-disaster grant program, and is available to states on an annual basis. This funding is available for mitigation planning and implementation of mitigation measures only, and is based upon a 75% Federal

share/25% non-Federal share. States administer the FMA program and are responsible for selecting projects for funding from the applications submitted by all communities within the state. The state then forwards selected applications to FEMA for an eligibility determination. Although individuals cannot apply directly for FMA funds, their local government may submit an application on their behalf.

Title: Hazard Mitigation Grant Program
Agency: Federal Emergency Management Agency

The Hazard Mitigation Grant Program (HMGP) was created in November 1988 through Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistant Act. The HMGP assists states and local communities in implementing long-term mitigation measures following a Presidential disaster declaration.

To meet these objectives, FEMA can fund up to 75% of the eligible costs of each project. The state or local cost-share match does not need to be cash; in-kind services or materials may also be used. With the passage of the Hazard Mitigation and Relocation Assistance Act of 1993, federal funding under the HMGP is now based on 15% of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster.

The HMGP can be used to fund projects to protect either public or private property, so long as the projects in question fit within the state and local governments overall mitigation strategy for the disaster area, and comply with program guidelines. Examples of projects that may be funded include the acquisition or relocation of structures from hazard-prone areas, the retrofitting of existing structures to protect them from future damages; and the development of state or local standards designed to protect buildings from future damages.

Eligibility for funding under the HMGP is limited to state and local governments, certain private nonprofit organizations or institutions that serve a public function, Indian tribes and authorized tribal organizations. These organizations must apply for HMPG project funding on behalf of their citizens. In turn, applicants must work through their state, since the state is responsible for setting priorities for funding and administering the program.

Title: Public Assistance (Infrastructure) Program, Section 406
Agency: Federal Emergency Management Agency

FEMA's Public Assistance Program, through Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, provides funding to local governments following a Presidential Disaster Declaration for mitigation measures in conjunction with the repair of damaged public facilities and infrastructure. The mitigation measures must be related to eligible disaster related damages and must directly reduce the potential for future, similar disaster damages to the eligible facility. These opportunities usually present themselves during the repair/replacement efforts.

Proposed projects must be approved by FEMA prior to funding. They will be evaluated for cost effectiveness, technical feasibility and compliance with statutory, regulatory and executive order requirements. In addition, the evaluation must ensure that the mitigation measures do not negatively impact a facility's operation or risk from another hazard.

Public facilities are operated by state and local governments, Indian tribes or authorized tribal organizations and include:

- Roads, bridges & culverts
- Draining & irrigation channels
- Schools, city halls & other buildings
- Water, power & sanitary systems
- Airports & parks

Private nonprofit organizations are groups that own or operate facilities that provide services otherwise performed by a government agency and include, but are not limited to the following:

- Universities and other schools
- Hospitals & clinics
- Volunteer fire & ambulance
- Power cooperatives & other utilities
- Custodial care & retirement facilities
- Museums & community centers

Title: SBA Disaster Assistance Program
Agency: US Small Business Administration

The SBA Disaster Assistance Program provides low-interest loans to businesses following a Presidential disaster declaration. The loans target businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible, along with non-profit organizations.

SBA loans can be utilized by their recipients to incorporate mitigation techniques into the repair and restoration of their business.

Title: Community Development Block Grants
Agency: US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) program provides grants to local governments for community and economic development projects that primarily benefit low- and moderate-income people. The CDBG program also provides grants for post-disaster hazard mitigation and recovery following a Presidential disaster declaration. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and for the redevelopment of disaster areas.

State Programs

Local
Local governments depend upon local property taxes as their primary source of revenue. These taxes are typically used to finance services that must be available and delivered on a routine and regular basis to the general public. If local budgets allow, these funds are used to match Federal or State grant programs when required for large-scale projects.

Non-Governmental
Another potential source of revenue for implementing local mitigation projects are monetary contributions from non-governmental organizations, such as private sector companies, churches, charities, community relief funds, the Red Cross, hospitals, Land Trusts and other non-profit organizations.

Paramount to having a plan deemed to be valid is its implementation. There is currently no new fiscal note attached to the implementation of this plan.

Continued Public Involvement
Throughout the planning process, public involvement has been and will be critical to the development of the Plan and its updates. The plan will be available on the WFRC and Utah DESHS website's to provide opportunities for public participation and comment. The plan will also be available for review at the offices of the Wasatch Front Regional Council.

The Wasatch Front Regional Council has been designated as the lead agency in preparing and submitting the Wasatch Front Regional Council Natural Hazard Pre-Disaster Mitigation Plan, which includes coverage for all incorporated cities and counties within the five county region, i.e. Davis, Morgan, Salt Lake, Tooele,

and Weber Counties. The strategy of the Association of Governments in preparing the plan is to use available resources and manpower in the most efficient and cost effective manner to allow our cities and counties continued access to data, technical planning assistance and FEMA eligibility. In addition, the AOG will reach out to non-profits, public agencies, special needs organizations, groups and individuals in allowing them input and access to the plan. With limited resources, however, it becomes difficult to both identify and to individually contact the broad range of potential clients that may stand to benefit from the plan. This being the case, we have established the following course of action:

STEP 1. The AOG will publicly advertise all hearings, requests for input and meetings directly related to the Natural Hazard Pre-Disaster Mitigation Planning process. Meetings of the Wasatch Front Regional Council where plan items are discussed and where actions are taken will not receive special notifications as they are already advertised according to set standards. All interested parties are welcome and invited to attend such meetings and hearings, as they are public and open to all. Advertisement will be done according to the pattern set in previous years, i.e. the AOG will advertise each hearing and request for input at least seven days (7) in advance of the activity and will publish notices of the event in the Salt Lake Tribune and/ or Deseret News. The notices will advertise both the hearing and the means of providing input outside the hearing if an interested person is unable to attend.

STEP 2. The AOG has established a mailing list of many local agencies and individuals that may have an interest in the Natural Hazard Pre-Disaster Mitigation Plan. Each identified agency or person will be mailed a notice of the hearings and open houses.

STEP 3. Comments, both oral and written, will be solicited and accepted from any interested party. Comments, as far as possible, will be included in the final draft of the plan; however, the AOG reserves the right to limit comments that are excessively long due to the size of the plan.

STEP 4. Specific to risk assessment and hazard mitigation, needs analysis, and capital investment strategies, the AOG will make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources do not allow personal contact with other agencies or groups, however, comments and strategies are welcomed as input to the planning process from any party via regular mail, FAX, e-mail, phone call, etc. In addition, every public jurisdiction advertises and conducts public hearings on their planning, budget, etc. where most of these mitigation projects are initiated. Input can be received from these prime sources by the region as well.

STEP 5. The final draft of the Natural Hazard Pre-Disaster Mitigation Plan will be presented to the WFRC Executive Director for adoption and approval to submit the document to State authorities. WFRC policies on adoption or approval of items will be in force and adhered to. This document is intended to be flexible and in constant change so comments can be taken at any time of the year for consideration and inclusion in the next update. Additionally, after FEMA approval of the plan, the plan will be promulgated for each local jurisdiction for adoption by resolution.

STEP 6. The following policies will guide AOG staff in making access and input to the Natural Hazard Pre-Disaster Mitigation Plan as open and convenient as possible:

A. Participation:
All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. The AOG will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

B. Access to Meetings:
Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

C. Access to Information:

Citizens, public jurisdictions, agencies and other interested parties will have the opportunity to receive information and submit comments on any aspect of the Natural Hazard Pre-Disaster Mitigation Plan, and/or any other documents prepared for distribution by the AOGs that may be adopted as part of the plan by reference. The AOG may charge a nominal fee for printing of documents that are longer than three pages.

D. Technical Assistance:
Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. AOG staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. The AOG will be the sole determiner of the amount of assistance given all requests.

E. Public Hearings:
The AOG will plan and hold public hearings according to the following priorities:

1. Hearings will be conveniently timed for people who might benefit most from mitigation programs.
2. Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy).
3. Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including to: Identify and profile hazards, Develop mitigation strategies, and Review plan goals, performance, and future plans.

F. Future Revisions:
Future revisions of the plan shall include:

1. Expanded vulnerability assessments to include flood and dam failure inundation.
2. Continue the search for more specific mitigation actions.
3. An analysis of progress of the plan as it is revised.
4. Expanded look into how the identified natural hazards will affect certain populations including the young and elderly.

DAM REHABILITATION PRIORITY LISTING

#######

- Hazard Rading Downgraded
- Meet Minimum Standards
- Construction Completed
- Under Construction, Design Underway
- Report Complete, Drilled
- Planned or Started
- Storage Restricted, No Progress

NO.	ENGINEER	STATE FUNDS GRANT	CURRENT LOAN	COMMENTS	YEAR	NAME OF DAM	UTAH ID NO.	SPILL-WAY RATING 1 TO 5	10 SCORE	GUARD GATE RATING 1 TO 5	2 SCORE	PIPING RATING 1 TO 5	10 SCORE	SLOPE RATING 1 TO 5	4 SCORE	SEISMIC RATING 1 TO 5	5 SCORE	TOTAL FAILURE SCORE 0 To 155	HUMANS AT RISK SCORE 1 TO 5	TOTAL RISK SCORE 0 To 775
HAZARD RATING DOWNGRADED																				
27				NEW ANALYSIS-MOD	1992	OAKS PARK	234													
50				STABILIZED IN 1999	1992	WALL LAKE	313													
57				NEW ANALYSIS-MOD	1993	ETNA	319													
65				NEW ANALYSIS-MOD	1993	NORTH CREEK	229													
83				BREACHED	1994	BOX ELDER CREEK	50													
90				BREACHED TO NATURAL LAKE	1994	BIG ELK	35													
85				NEW ANALYSIS-MOD	1994	SKUTUMPAH	279													
107				SPILLWAY LOWERED	1995	ANDERSON (KENNETH)	351													
110				SPILLWAY LOWERED	1995	FERRON DEBRIS BASIN NO. 5	386													
153				NEW ANALYSIS-MOD	1997	NORTH OGDEN -COLDWATER	504													
135				SPILLWAY LOWERED	1996	CEDAR CITY-GREENS LAKE NO. 3	415													
152				SPILLWAY LOWERED	1996	CEDAR CITY-GREENS LAKE NO. 2	412													
176				SPILLWAY LOWERED	1997	CEDAR CITY-GREENS NO. 4	416													
112				NEW ANALYSIS-MOD	1995	BIRCH CREEK 1 - RICH	40													
123				NEW ANALYSIS-MOD	1995	BIGLOW DEBRIS BASIN	408													
127				NEW ANALYSIS-MOD	1996	KENNECOTT KESSLER NO. 10	485													
131				NEW ANALYSIS-MOD	1996	NEPHI CITY-MILLER DEBRIS	561													
138				NEW ANALYSIS-MOD	1996	KENNECOTT KESSLER NO. 11	486													
140				NEW ANALYSIS-MOD	1996	UTAH COUNTY-PAYSON	620													
153				NEW ANALYSIS-MOD	1997	NORTH OGDEN - COLDWATER	628													
159				NEW ANALYSIS-MOD	1997	KENNECOTT KESSLER NO. 6	484													
162				NEW ANALYSIS-MOD	1997	UTAH COUNTY-AMERICAN FORK	469													
171				NEW ANALYSIS-MOD	1997	FARMINGTON CITY - RUDD	336													
177				NEW ANALYSIS-MOD	1997	FRUIT HEIGHTS - DRY HOLLOW	712													
???																				
1	RB&G				1991	QUAIL CREEK MAIN DAM	514	0	0	0	0	0	0	0	0	0	0	0		0
2	ECI				1991	UP& L-CUTLER	79	0	0	0	0	0	0	0	0	0	0	0		0
5	D&M				1991	GUNLOCK	129	0	0	0	0	0	0	0	0	0	0	0		0
10	AGRA				1991	UP&L-ELECTRIC	100	0	0	0	0	0	0	0	0	0	0	0		0
11	RB&G				1991	QUAIL CREEK SOUTH DAM	710	0	0	0	0	0	0	0	0	0	0	0		0
12	Water Resources				1991	SMITH & MOREHOUSE	280	0	0	0	0	0	0	0	0	0	0	0		0
24	Water Resources				1991	GRANTSVILLE	343	0	0	0	0	0	0	0	0	0	0	0		0
37	D&M				1992	KENNECOTT - BINGHAM CREEK	39	0	0	0	0	0	0	0	0	0	0	0		0
45	CH2M				1992	TRIAL LAKE	301	0	0	0	0	0	0	0	0	0	0	0		0
101	ECI				1995	LAKE MARY-PHOEBE	172	0	0	0	0	0	0	0	0	0	0	0	0	0
89	Ros/Terracon				1994	PANGUITCH LAKE	238	0	0	0	0	0	0	0	0	0	0	0		0
44	AGRA				1992	WITT LAKE	330	0	0	0	0	0	0	0	0	0	0	0		0
68	NRCS				1993	CITY CREEK DB- ST GEORGE	680	0	0	0	0	0	0	0	0	0	0	0		0
76	C&N				1994	COTTONWOOD DETENTION	644	0	0		0		0		0		0	0	0	0

DAM REHABILITATION PRIORITY LISTING

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- Meet Minimum Standards
- Construction Completed
- Under Construction, Design Underway
- Report Complete, Drilled
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NO.	ENGINEER	STATE FUNDS GRANT	CURRENT LOAN	COMMENTS	YEAR	NAME OF DAM	UTAH ID NO.	SPILL-WAY RATING 1 TO 5	10 SCORE	GUARD GATE RATING 1 TO 5	2 SCORE	PIPING RATING 1 TO 5	10 SCORE	SLOPE RATING 1 TO 5	4 SCORE	SEISMIC RATING 1 TO 5	5 SCORE	TOTAL FAILURE SCORE 0 To 155	HUMANS AT RISK SCORE 1 TO 5	TOTAL RISK SCORE 0 To 775
55	NA				1993	WARNER DRAW	396	0	0	0	0	0	0	0	0	0	0	0		0
35	WWC				1992	SOUTH CREEK (WASHINGTON)	588	0	0		0		0		0		0	0	0	0
	Hughes				1996	HAIGHT CREEK (UPPER)	63	0	0	0	0	0	0	0	0	0	0	0		0
163	Terracon				1997	DWCCC-KAYSVILLE	736	0	0	0	0	0	0	0	0	0	0	0		0
						???														
4	ECI	$598,609		Overtopping Modifications	1991	MOUNTAIN DELL	221	5	50	0	0	0	0	0	0	0	0	50	5	250
23	WEST	$250,000		Stability Berm-Abutment	1991	LLOYDS LAKE (MONTICELLO)	349	0	0	0	0	3	30	0	0	0	0	30	3	90
28	Terracon	$168,000	$19,000	Stability Berm-Dam	1992	HUNTINGTON	144	0	0	0	0	5	50	2	8	1	5	63	3	189
33	ECI	$1,132,000		Concrete Repair	1992	TWIN LAKES (SALT LAKE)	304	1	10	0	0	0	0	2	8	0	0	18	2	36
42	BOR	$0	$0	REBUILT- BOR DAM NOW	1992	WASHINGTON	315													
43	Terracon	$1,296,000	$144,000	Total Replacement	1992	HOLMES	142	5	50	5	10	5	50	3	12	5	25	147	4	588
47	EWP	$22,000		Spillway, Outlet	1992	ADAMS	2	1	10	0	0	1	10	5	20	4	20	60	4	240
69	D&M	$480,000		New Core Wall	1993	IVINS BENCH	149	0	0	5	10	5	50	5	20	5	25	105	2	210
72	WWC	$936,000	$56,000	RCC Overtopping	1993	MONA	215	3	30	2	4	2	20	3	12	3	15	81	3	243
81	JONES	$0	$0	Guard Gate, Drainage	1994	MANTUA	196	0	0	0	0	3	30	0	0	0	0	30	3	90
166	RB&G	$72,000		Spillway, Drain	1997	LINDON CITY-DRY CANYON	638	2	20	0	0	4	40	0	0	0	0	60	2	120
14	Terracon	$4,670,000	$233,500	Spillway, Slope Flattening	1991	PORCUPINE	251	3	30	2	4	5	50	5	20	4	20	120	4	480
20	R.B&G	$1,144,750	$60,250	Upstream Slope,Spillway	1991	FORSYTH	117	3	30	2	4	2	20	5	20	5	25	99	2	198
71	F&N/WWC	$2,109,000	$111,000	Spillway,Drain,Gate	1993	OTTER CREEK	235	3	30	5	10	2	20	3	12	4	20	92	3	276
21	R.B&G	$1,550,000	$150,000	Spillways,Drains	1991	ROCKY FORD (BEAVER)	259	3	30	2	4	5	50	3	12	5	25	121	3	363
61	DMJM	$3,320,000			1993	LOGAN FIRST DAM	380	5	50	0	0	0	0	5	20	5	25	95	4	380
64	J & D	$1,368,000	$152,000	Spillway,Drains,Gate	1993	GUNNISON	130	5	50	5	10	3	30	0	0	0	0	90	4	360
13	F&N			Guard Gate, Upstream Face	1991	PIUTE(Phase I)	249	5	50	5	10	3	30	3	12	5	25	127	5	635
9	B&C			Guard Gate, Upstream Face	1991	SEVIER BRIDGE(Phase I)	272	2	20	5	10	0	0	0	0	5	25	55	4	220
	Water Resources	$600,000		Tunnel Repairs	2000	UTAH COUNTY-THISTLE	713	0	0	0	0	0	0	0	0	5	25	25	2	50
87	BOR	$0	$0	REBUILT - BOR DAM NOW	1994	LOST LAKE	184													
134	STRATA	$752,000		Upstream Cutoff, Outlet	1996	DAVIS COUNTY-FARMINGTON	692	1	10	5	10	4	40	2	8	5	25	93	3	279
7	WWC	$5,007,200		Secant Wall,Drains,Spillway	1991	LONG PARK (DAGGETT)	365	0	0	0	0	5	50	5	20	2	10	80	2	160
						UNDER CONSTRUCTION														
141	IGES				1996	TONY GROVE	10110	1	10	5	10	2	20	0	0	5	25	65	2	130
8	CH2M Hill			Enlargement	1991	BIG SAND WASH	37	0	0		0		0		0		0	0	0	0
						FINAL DESIGN														
170	JUB			Plans App 10/17/01 Reduce to Mod	1997	LINDON CITY-SQUAW HOLLOW														
114	BOR			Spillway , Drains	1995	RED BUTTE DAM	10101	0	0	0	0	0	0	5	20	0	0	20	4	80
	s					**PRELIMINARY DESIGN**														
9	B&C			Spillway , Drains	1991	SEVIER BRIDGE(Phase II)	272	2	20	0	0	0	0	0	0	0	0	20	4	80
13	F&N			Spillway , Drains	1991	PIUTE(Phase II)	249	5	50	0	0	3	30	0	0	0	0	80	5	400
17	Water Resources				1991	MILL MEADOW	208	3	30	5	10	3	30	0	0	0	0	70	2	140
39	F&N			Replacement	1992	WIDE HOLLOW	325	2	20	5	10	3	30	3	12	5	25	97	3	291
93	B&C				1994	DMAD	80	5	50	0	0	5	50	0	0	5	25	125	2	250

DAM REHABILITATION PRIORITY LISTING

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136	B&C				1996	GUNNISON BEND	131	5	50	0	0	3	30	4	16	5	25	121	2	242
						REPORT COMPLETE														
	Terracon				1993	MILLER FLAT	210	0	0	0	0	5	50	4	16	4	20	86	3	258
75	Water Resources				1993	MILL HOLLOW	207	3	30	5	10	4	40	4	16	4	20	116	2	232
88	Water Resources				1994	THREE CREEKS (BEAVER)	298	2	20	5	10	4	40	3	12	5	25	107	2	214
84	T Hughes				1994	KAYSVILLE	160	5	50	0	0	3	30	0	0	5	25	105	2	210
125	D&M				1995	RED PINE	256	4	40	5	10	2	20	4	16	3	15	101	2	202
25	Terracon				1991	CLEVELAND	71	0	0	0	0	4	40	3	12	3	15	67	3	201
22	Water Resources				1991	KOLOB CREEK	164	0	0	5	10	3	30	0	0	5	25	65	3	195
102	Terracon				1995	FAIRVIEW LAKE	103	0	0	5	10	5	50	4	16	4	20	96	2	192
41	AGRA				1992	BLUE CREEK	44	3	30	5	10	5	50	0	0	1	5	95	2	190
188	RB&G				1998	BOYER	52	2	20	5	10	4	40	2	8	3	15	93	2	186
100	Klienfelder				1994	KOOSHAREM	165	3	30	5	10	4	40	1	4	1	5	89	2	178
109	Lynn Wall				1995	UTAH COUNTY-HOBBLE CREEK	613	5	50	0	0	3	30	2	8	0	0	88	2	176
86	Kleinfelder				1994	MANDERFIELD	194	2	20	5	10	3	30	4	16	2	10	86	2	172
129	Water Resources				1996	BULLOCK DRAW	58	0	0	3	6	4	40	3	12	5	25	83	2	166
185	IGES				1998	DAVIS COUNTY-RICKS CREEK	171	4	40	0	0	3	30	3	12	0	0	82	2	164
183	IGES				1998	DAVIS COUNTY-BARTON CREEK	152	4	40	0	0	1	10	1	4	0	0	54	3	162
97	Kleinfelder				1994	TROPIC	302	3	30	0	0	2	20	2	8	4	20	78	2	156
15	Water Resources				1991	NEWCASTLE	227	1	10	5	10	0	20	3	12	3	15	67	2	134
73	BM				1993	NORTHWEST	232	0	0	5	10	3	30	4	16	4	20	76	2	152
96	GBES				1994	CENTER CREEK NO. 2	65	2	20	5	10	3	30	4	16	0	0	76	2	152
31	CH2M				1992	LAPOINT	624	0	0	0	0	5	50	0	0	0	0	50	3	150
116	Terracon				1995	DEER VALLEY	116	2	20	0	0	3	30	0	0	5	25	75	2	150
	Hughes				1996	HAIGHT CREEK (LOWER)	378	1	10	0	0	3	30	2	8	0	0	48	3	144
118	GBES				1995	CENTER CREEK NO. 3	66	2	20	5	10	3	30	3	12	0	0	72	2	144
122	Kleinfelder				1995	PAYSON CITY-WINWARD (PETE)	244	3	30	5	10	3	30	0	0	0	0	70	2	140
181	IGES				1998	DAVIS COUNTY-PARRISH CREEK	170	4	40	0	0	2	20	2	8	0	0	68	2	136
168	Kleinfelder				1997	NUCCD-BATTLE CREEK	585	2	20	0	0	4	40	2	8	0	0	68	2	136
117	Kleinfelder				1995	MAPLE LAKE	197	1	10	5	10	3	30	3	12	1	5	67	2	134
182	IGES				1998	DAVIS COUNTY-STONE CREEK	564	3	30	0	0	1	10	1	4	0	0	44	3	132
91	J&D				1994	GLENWOOD DEBRIS	340	0	0	0	0	4	40	1	4	0	0	44	3	132
77	GBES				1994	CENTER CREEK NO. 1	64	0	0	5	10	4	40	0	0	3	15	65	2	130
58	Kleinfelder				1993	BEAVER CREEK (LOWER) BOX	24	4	40	5	10	4	40	5	20	4	20	130	1	130
18	RB&G				1991	WHITNEY	324	0	0	0	0	4	40	4	16	1	5	61	2	122
126	J&D				1996	SAND H DEBRIS	533	0	0	0	0	4	40	0	0	0	0	40	3	120
139	Terracon				1996	UTAH COUNTY-SANTAQUIN	387	3	30	0	0	3	30	0	0	0	0	60	2	120
38	RB&G				1992	ENTERPRISE (LOWER)	189	5	50	0	0	0	0	2	8	0	0	58	2	116
67	Terracon				1993	ROLFSON	260	2	20	5	10	1	10	2	8	2	10	58	2	116
121	F&N				1995	PALISADES LAKE	119	0	0	5	10	4	40	0	0	0	0	50	2	100

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111	Kleinfelder				1995	PAYSON CITY-BOX LAKE	652	1	10	0	0	4	40	0	0	0	0	50	2	100
180	IGES				1998	DAVIS COUNTY-HOOPER DRAW	648	5	50	0	0	0	0	0	0	0	0	50	2	100
32	EWP				1992	HOBBS	140	0	0		0		0		0	5	25	25	4	100
143	RB&G				1996	PROVO CITY-SLATE NO. 2	470	3	30	0	0	0	0	0	0	0	0	30	3	90
16	Water Resources				1991	RED CREEK (IRON)	255	2	20	0	0	1	10	0	0	0	0	30	3	90
108	Lawrence				1995	SETTLEMENT CANYON	270	0	0	0	0	0	0	1	4	5	25	29	3	87
150	IGES				1996	DAVIS COUNTY-HOLMES DEBRIS	461	1	10	0	0	3	30	0	0	0	0	40	2	80
155	RB&G				1997	PROVO CITY-SLATE NO. 3	471	2	20	0	0	2	20	0	0	0	0	40	2	80
178	AGEC			Outstandind Issues	1997	SL COUNTY-ROTARY GLEN	647	2	20	0	0	3	30	3	12	0	0	62	2	124
104	Kleinfelder				1995	SANTA CLARA	443	1	10	0	0	3	30	0	0	0	0	40	2	80
59	Kleinfelder				1993	BEAVER CREEK (UPPER)- BOX	25	1	10	5	10	0	0	2	8	2	10	38	2	76
167	AGEC				1997	SL COUNTY-CHANDLIER	529		0	0	0	2	20	4	16	0	0	36	2	72
172	AGEC				1997	SL COUNTY-SCHOOL POND	530	2	20	0	0	0	0	3	12	0	0	32	2	64
175	C&N				1997	DAIRY CANYON	627	0	0	0	0	5	50	3	12	0	0	62	1	62
124	Terracon				1995	N UCCD-TIBBLE FORK	299	2	20	0	0	0	0	0	0	0	0	20	3	60
157	AGEC				1997	SL COUNTY-SHRINERS	528		0	0	0	3	30	0	0	0	0	30	2	60
128	RB&G				1996	PROVO CITY-ROCK	524	2	20	0	0	0	0	0	0	0	0	20	3	60
119	AGEC				1995	SL COUNTY-SUGARHOUSE	539	3	30	0	0	0	0	0	0	0	0	30	2	60
95	Kleinfelder				1994	PAYSON CITY-BIG EAST	34	0	0	0	0	3	30	0	0	0	0	30	2	60
46	CH2M				1992	PARADISE PARK	240	0	0	0	0	3	30	0	0	0	0	30	2	60
133	AGEC				1996	SL COUNTY-BIG COTTONWOOD	90	3	30	0	0	0	0	0	0	0	0	30	2	60
169	AGEC				1997	SL COUNTY-FEDERAL HEIGHTS	527	3	30	0	0	0	0	0	0	0	0	30	2	60
52	Terracon				1993	COTTONWOOD	390	0	0	0	0	0	0	0	0	5	25	25	2	50
54	Terracon				1993	BROUGH	353	0	0	0	0	0	0	0	0	3	15	15	3	45
158	AGEC				1997	S L COUNTY-CREEKSIDE	531	2	20	0	0	0	0	0	0	0	0	20	2	40
40	EWP				1992	MONTES CREEK	216	0	0	5	10	3	30	0	0	0	0	40	1	40
113	Kleinfelder				1995	NUCCD-DRY CREEK	472	0	0	0	0	2	20	0	0	0	0	20	2	40
130	Kleinfelder				1996	NUCCD-GROVE	584	2	20	0	0	0	0	0	0	0	0	20	2	40
187	IGES				1998	DAVIS COUNTY-SHEPARD CREEK	563		0	0	0	0	0	4	16	0	0	16	2	32
48	CH2M				1992	CHEPETA	69	0	0	0	0	3	30	0	0	0	0	30	1	30
62	Terracon				1993	N UCCC-SILVER LAKE FLAT	276	1	10	0	0	0	0	0	0	0	0	10	3	30
6	Water Resources				1991	RECAPTURE CREEK	517	1	10	0	0	0	0	4	16	0	0	26	1	26
60	AGRA				1993	TWIN POTS	306	0	0	0	0	0	0	0	0	5	25	25	1	25
103	Kleinfelder				1995	PAYSON CITY-DRY LAKE	93	0	0	5	10	0	0	0	0	0	0	10	2	20
29	AGRA				1992	NINEMILE	138	0	0	0	0	1	10	0	0	0	0	10	2	20
160	AGEC				1997	SL COUNTY-SCOTT AVENUE	645	1	10	0	0	0	0	0	0	0	0	10	2	20
						DRILLED/UNDERWAY														
56	ALPHA				1993	BAKER	618	3	30		0		0		0		0	30	0	0
165	Earthtec				1997	WASATCH COUNTY-LAKE CREEK	650	3	30		0		0		0		0	30	0	0
120	Klienfelder				1995	THREE CREEKS (SEVIER)	354													

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30	RB&G				1992	ENTERPRISE (UPPER)	309													
74	RB&G				1993	YANKEE MEADOW	335	0	0		0		0		0		0	0	0	0
3	RB&G				1991	MILLSITE	212	1	10		0		0		0		0	10	0	0
49	RB&G				1992	STARVATION CANYON	199	0	0		0		0		0		0	0	0	0
146	Somas				1996	DEUEL CREEK (FORMER BOR)	701	0	0		0		0		0		0	0	0	0
26	RB&G				1992	KENS LAKE	393	0	0		0		0		0		0	0	0	0
51	RB&G				1993	BROWNS DRAW	394	0	0		0		0		0		0	0	0	0
98	RB&G				1994	LINDSAY (BENNETT) LOWER	176	1	10		0		0		0		0	10	0	0
79	RB&G				1994	JOHNSON	153	1	10		0		0		0		0	10	0	0
92	RB&G				1994	WHITE PINE	321	0	0		0		0		0		0	0	0	0
99	RB&G				1994	JONES	156	0	0		0		0		0		0	0	0	0
80	IGES			IGES Letter UT00233	1994	OAK CREEK (UPPER BOWNS)	233	0	0		0		0		0		0	0	0	0
184	Western				1998	MOAB CITY-WHITE CANYON	553		0		0		0		0		0	0	0	0
186	Western				1998	MOAB CITY-TUSHER CANYON	566		0		0		0		0		0	0	0	0
106	Terracon				1995	CLIFF LAKE (DUCHESNE)	72	0	0		0		0		0		0	0	0	0
82	Water Resources				1994	KENTS LAKE NO. 2 (MIDDLE)	162		0		0		0		0		0	0	0	0
36	Water Resources				1992	BIRCH CREEK NO. 2	41	2	20		0		0		0		0	20	0	0
34	Water Resources				1992	RED CREEK (DUCHESNE)	254	0	0		0		0		0		0	0	0	0
66	Water Resources				1993	EAST PARK	98	0	0		0		0		0		0	0	0	0
19	Water Resources				1991	WOODRUFF CREEK	332	1	10	0	0		0		0		0	10	0	0
						???														
63	RB&G				1993	ASH CREEK	10	1	10		0		0		0		0	10	0	0
147	RB&G			Letter 10/8/03 60 Days or Restrict	1996	PERRY CITY-THREEMILE CREEK	573	3	30		0		0		0		0	30	0	0
148	Psomas		Reply	Letter 10/8/03 60 Days or Restrict	1996	OGDEN CITY-SULLIVAN HOLLOW	505	0	0		0		0		0		0	0	0	0
132			Reply	Letter 10/8/03 60 Days or Restrict	1996	SOUTH OGDEN -BURCH CREEK	580	2	20		0		0		0		0	20	0	0
173	???		Reply	Letter 10/8/03 60 Days or Restrict	1997	NORTH OGDEN CITY-ORTON	714	2	20		0		0		0		0	20	0	0
						STORAGE RESTRICTED														
115	Sunrise	ORDER	Outlet Open	Leave Gate Open	1995	CORN CREEK	322	0	0		0		0		0		0	0	0	0
94		ORDER		15 feet deep maximum	1994	WILKINSON (HARRY)	327	1	10		0		0		0		0	10	0	0
						NO PROGRESS														
154				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-ALTA CANYON	519	5	50		0		0		0		0	50	0	0
161				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-FALCON PARK	590	2	20		0		0		0		0	20	0	0
164				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-WILLOW CREEK	164	0	0		0		0		0		0	0	0	0
174				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-BUTTERCUP	672		0		0		0		0		0	0	0	0
178A				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-FLAT IRON	746	4												
178B				Letter 04/01/04 30 Days For Plan	1997	SANDY CITY-STORM MOUNTAIN	734	4												
105	Terracon			Roadless Area-No Access	1995	WHITEROCKS LAKE	323	0	0		0		0		0		0	0	0	0
70	???			Wilderness Area-No Access	1993	EAST TIMOTHY	99	1	10		0		0		0		0	10	0	0

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		GRANT	LOAN			OF DAM	ID	WAY	10	GATE	2		10		4		5	FAILURE	AT RISK	RISK
							NO.	RATING	SCORE	RATING	SCORE	RATING	SCORE	RATING	SCORE	RATING	SCORE	SCORE	SCORE	SCORE
								1 TO 5		1 TO 5		1 TO 5		1 TO 5		1 TO 5		0 To 155	1 TO 5	0 To 775

TOTALS	$25,475,559	$925,750

APPROPRIATIONS

1997	$3,200,000
1998	$4,363,000
1999	$4,363,000
2000	$4,363,000
2001	$4,363,000
2002	$4,363,000
2003	$2,800,000
TOTAL	$25,015,000

UPSTREAM GUARD GATE

RANKING CRITERIA

PERSONS AT RISK	SCORE
OVER 10000	5
1000 TO 10000	2
100 TO 1000	3
10 TO 100	4
LESS THAN 10	1
NONE	0

GUARD GATE	SCORE
NO GATE	5
IN-PLACE	0

SLOPE INSTABILITY	SCORE
OBSERVED	5
HIGH	4
MOD	3
LOW	2
MINOR	1
NONE	0

SPILLWAY ADEQUACY PERCENT OF IDF/SEP	SCORE
0 TO 23	5
23 TO 32	4
32 TO 44	3
44 TO 57	2
57 TO 100	1
OVER 100	0

PIPING PROBLEMS	SCORE
OBSERVED	5
HIGH	4
MODERATE	3
LOW	2
MINOR	1
NONE	0

SEISMIC INSTABILITY	SCORE
OBE FAIL	5
HIGH	4
MOD	3
LOW	2
MINOR	1
NONE	0

THE FEASIBILITY OF COLLECTING ACCURATE LANDSLIDE-LOSS DATA IN UTAH

by

Francis X. Ashland

OPEN-FILE REPORT 410 March 2003
UTAH GEOLOGICAL SURVEY
a division of
UTAH DEPARTMENT OF NATURAL RESOURCES

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ABSTRACT

Whereas estimated landslide losses nationwide exceed $1.2 billion, annual landslide losses in Utah are poorly documented. This study evaluated the feasibility of collecting more accurate landslide-loss data in Utah. Currently, most local jurisdictions and state agencies do not systematically collect landslide-loss data, although some loss/cost data exist. Media reports provide unreliable and incomplete loss data. Analysis of media coverage of losses from recent damaging landslides indicates that losses may be underestimated by more than 50 percent using media-generated information. Less than 25 percent of the documented 2001-02 landslides were reported in the media, and less than half of the media reports contained loss information. Combining media reports with tax assessor's records provides somewhat more complete information. State agencies currently do not track landslide losses to utility lifelines and transportation corridors. However, some documentation regarding the costs of landslide stabilization projects exists in various agencies.

A lack of landslide-loss information in most of the state poses a serious challenge to accurate landslide-loss estimation in Utah. Statewide landslide-loss estimates would require extrapolation using data from jurisdictions where losses are reasonably well documented. Jurisdictions lacking loss data would need to be ranked based on landslide susceptibility, the amount of building inventory at risk, median property values, and other factors. Ideally, statewide landslide-loss estimation may be accomplished using a Geographic Information Systems approach.

Retrospective landslide-loss estimation was evaluated using the well-documented 1983 Thistle landslide. Whereas direct costs of the landslide were known within a year of the event, significant uncertainty in the more substantial indirect costs remained more than five years after the landslide disaster.

Obstacles to accurate landslide-loss estimation in Utah include the lack of coordinated inventorying of damaging landslides by state and federal agencies and local jurisdictions, transitory losses, damages caused by recurrent and ongoing landslide movement, the inability to differentiate damage resulting from landslides in multi-hazard areas, and trans-jurisdictional landslide losses. Another obstacle is the reluctance of government officials and homeowners to report losses because of perceived negative impacts.

INTRODUCTION

Nationwide, estimated losses from damaging landslides range from $1.2 to $2.4 billion annually (Schuster, 1996). In Utah, documented losses from damaging landslides in 2001 exceeded $3 million, including the costs to repair and stabilize hillsides along state and federal highways. The total losses caused by landslides in 2001 are, however, unknown because of the incomplete documentation of active landslides and a lack of loss data for all documented landslides that year.

This report evaluates the feasibility of collecting more accurate landslide-loss (cost) estimates in Utah. The majority of the report focuses on the current availability of landslide-loss data and uses case histories of recent damaging landslides. This report also compares the accuracy and availability of landslide-loss data from a variety of sources including media reports, county tax assessor's records, building permits, and estimates by local government officials and affected property owners. In addition, this report evaluates the potential for retrospective landslide-loss estimation using publications on the 1983 Thistle landslide, the most costly historical landslide in the United States.

SCOPE OF THIS STUDY

As part of this study, the Utah Geological Survey (UGS) performed the following:

- contacted local jurisdictions in landslide-prone areas to discuss current methods of tracking landslide losses and to assess the feasibility of more accurately estimating landslide losses,
- discussed the collection of landslide-related cost data with staff at the Utah Department of Transportation, Utah Division of Water Resources, and Utah Division of Emergency Services,
- evaluated landslide-loss information in media reports for recent landslides,
- evaluated the potential for retrospective landslide-loss estimation of well-documented, major landslide events, and
- identified potential obstacles to collecting accurate landslide-loss data.

CURRENT TRACKING OF LANDSLIDE LOSSES BY LOCAL JURISDICTIONS AND STATE AGENCIES

Landslide losses are currently not tracked in a systematic way by most local jurisdictions or state agencies affected by landslides. The methods used by local jurisdictions to track losses vary significantly as listed in table 1. In general, local jurisdictions that more systematically collected landslide-loss information were either large communities or communities that had recently been affected by either widespread or ongoing damaging landslides. State agencies also do not systematically track landslide costs.

Table 1.

Summary of current tracking of landslide costs by local jurisdictions and state agencies.

Local Jurisdiction	Department/Division	Cost Tracking System	Sources of Data	Limitations	Recent Damaging Landslides
Salt Lake City	Building Services and Inspections	Building permit-based database identifies cause of damage or distress.	Database, staff knowledge	Database incomplete. Unknown percentage of repairs without permit.	1000 E. Capitol Blvd-City Creek (1998-present) landslide
Layton	Community Development	Director began tracking landslide damage in 2001.	Staff knowledge	Data exist only for 2001 Heather Drive landslide.	2001 Heather Drive landslide, 1998 Sunset Drive landslide
Provo	Community Development Public Works/Engineering	Building distress/repair database	Database, staff knowledge	Database incomplete. Unknown percentage of repairs without permit. Hillside stabilization does not require permit.	Sherwood Hills landslide(s)
Salt Lake County	Public Works/Planning	None	None	Not applicable	Emigration Canyon landslides
Morgan County	Planning	None	None	Not applicable	2001 Frontier Drive landslide
Duchesne County	County Road	Reports documents road repair costs from landslide damage.	Report files, staff knowledge	-- -- --	1997 and 1999 Bluebell Road landslides
Weber County	Engineering	Some records on file	Building permits	Provides estimated costs for only retaining walls	1999 Eden water tank landslide

State Agency	Cost Tracking System	Sources of Data	Limitations
Department of Transportation	None	Major project contracts, staff knowledge	Contract costs overlap into successive calendar years. Landslide damage repairs contained within maintenance budgets.
Division of Water Resources	None	Major project contracts, staff knowledge	Landslide-related costs not readily discernable in contracts. Losses to water facilities tracked mostly by private companies.
Division of Emergency Services	None	Reports for federally declared disasters	None since 1983 Thistle landslide

Salt Lake City

Salt Lake City is Utah's largest city and state capital. Few landslides exist within the city limits, but certain hillside areas on the north and east sides of the city have been affected by historically active landslides. Damaging landslides occurred in the City Creek area northeast of the capitol building in the early- to mid-1980s and late-1990s. Losses caused by landsliding in Salt Lake City have included:

1. home equity losses,
2. hillside stabilization costs,
3. building repair costs, and
4. utility repair and replacement costs.

Mr. Harvey Boyd, Deputy Director of Salt Lake City Building Services and Inspections, indicated that hillside stabilization and building repair costs are typically recorded in a database along with a building permit number. Landslide repair and stabilization costs are identified in the database. Mr. Boyd indicated, however, that not all property owners obtain permits for such work. In addition, the city has in the past exempted property owners from obtaining a permit, if the costs of the repair or stabilization work are excessive, to reduce the overall expense to the affected individual. In these cases, the lack of a permit prevents the cost data for some of the most expensive repairs from being included in the database because the current tracking system is permit-referenced.

One recent example is the cost of hillside stabilization for a residential lot threatened by the 1998 Capitol Boulevard-City Creek landslide (figure 1). A line of drilled piers was installed in the crown of the landslide to protect a nearby house from enlargement of the active landslide directly downslope. Whereas typically these measures would have required a city permit, the city exempted the property owner from applying for one. The basis of the city's decision was to eliminate the expense of the permit from the cost to stabilize the property, which was about $250,000, the most significant documented landslide-related cost in Salt Lake City in the late-1990s. However, because no permit was required, the costs and details of this project are not in the city's database.

Mr. Boyd also indicated that numerous landslide-related repairs likely go undocumented in the City Creek area of Salt Lake City. He speculated that many homeowners are reluctant to admit that their properties are being affected by landsliding, and thus do not apply for building permits. The costs of these repairs are therefore undocumented. Building inspectors make periodic visits to properties in the City Creek area to identify potential problems or building distress. Currently the field inspection information is not included in the city database unless the information relates directly to a permit number. Salt Lake City is in the process of implementing a new database system that will incorporate the field inspection information, facilitating the recognition of landslide-related damage and distress. The new data, however, will not include a cost estimate.

Layton City

Layton is the largest city in Davis County, with an estimated population over 58,000. In 1998 and 2001 damaging landslide movement affected several residential hillside areas in Layton. In August 2001, movement of the Heather Drive landslide destroyed three houses (figure 2) and forced the relocation of three others, and total losses exceeded $1 million (Giraud, 2002). During this landslide, Mr. J. Scott Carter, Community Development Director, compiled accurate and comprehensive loss-estimate data that included the following:

1. home equity losses,
2. losses to mortgage companies,
3. emergency response costs,
4. landslide investigation costs, and
5. costs to relocate buried utilities.

Mr. Carter provided this loss-estimate data to the media, as well as to state and Layton City officials.

Prior to the Heather Drive landslide, Layton City officials did not systematically document such losses. The UGS (Giraud, 1999a; Ashland, 2003) estimated losses from the 1998 Sunset Drive landslide, which destroyed one house, using media reports and information from Layton City officials. Mr. Carter has individual knowledge of certain other landslide-related losses in Layton, but the Davis County tax assessor's records and media reports are the only written documentation.

Provo City

Provo is the largest city in Utah County as well as the third largest in Utah. Landslide deposits underlie several areas along the east side of Provo. The Sherwood Hills subdivision sits atop a large complex of landslide deposits that has undergone local damaging movement in the early- to mid-1980s and mid- to late-1990s. Two houses in the subdivision have been destroyed by landslide movement since the mid-1990s (figure 3). Landslide movement has also caused local building distress requiring repair and hillside stabilization and damaged roads and underground utilities. Losses in the Sherwood Hills subdivision attributable to landslides include the following:

1. home equity losses,
2. losses to mortgage companies (destroyed houses),
3. hillside stabilization costs,
4. building repair costs,
5. costs to repair and replace roads and utilities,
6. lot-specific landslide investigations costs (property owners),
7. subdivision-wide landslide investigation costs (Provo City), and
8. losses in tax revenues from distressed and destroyed properties.

Figure 1. *Damage caused by movement of Capitol Boulevard-City Creek landslide to rear of lot at 1000 E. Capitol Boulevard, Salt Lake City in 1998.*

Figure 2. *Damage to one of three houses destroyed by movement of the Heather Drive landslide, Layton in 2001.*

Figure 3. Damage to a house caused by movement of upper part of the Sherwood Hills landslide in Provo. House was condemned in January 2000.

The Provo City Engineer and Chief Building Official are both familiar with specific losses in the Sherwood Hills subdivision and elsewhere in Provo. Documented building distress is recorded in a database by city building inspectors. Possible geologic causes of any distress are recorded by a code, but landsliding is not currently differentiated from other geologic processes that might cause distress. Whereas the costs of repairs are included in the database, certain costs such as hillside stabilization costs that do not require a city permit are not. Building permit records also do not differentiate between landslide repairs and standard remodeling. Mr. Chuck Hugo, Chief Building Official, estimates that a large percentage of repairs are made by property owners without obtaining a building permit.

Other Local Jurisdictions and Statewide Estimates

Most other jurisdictions generally lack the staff or procedures for documenting landslide losses. In these jurisdictions, the only landslide-loss information is personal knowledge of local government staff members. The likelihood that the costs of major landslide damage will be documented increases in areas where landslides are relatively rare. In Duchesne County, the county road department has been able to document costs to repair roads damage by landslides and rock falls because of the small number of recent events. In most other jurisdictions, building permitting procedures do not identify landslide repairs or document costs. In some cases potential landslide-related costs are not documented because of a lack of rigorous code enforcement due to inadequate government staff or resources. Due to the general lack of uniform loss documentation by most local governments, significant changes in procedures would be required before accurate statewide landslide-loss estimates could be achieved in Utah. The state, most likely the UGS, would need to coordinate and facilitate implementation of landslide-loss documentation procedures, but cooperation of all jurisdictions is unlikely.

The extent and total dollar value of landslide losses in a jurisdiction depends mainly on landslide susceptibility, the extent of hillside development, and property values. Landslide-loss information is lacking in most of the state and thus estimating statewide losses would require extrapolation using data from jurisdictions where losses are reasonably documented. Jurisdictions lacking loss data would need to be ranked based on landslide susceptibility, the amount of building inventory at risk, median property values, and other factors. Ideally, statewide landslide-loss estimation may be accomplished using a Geographic Information Systems approach.

Utah Division of Water Resources

The Utah Division of Water Resources funds water projects including the repair and replacement of dams and canals damaged by landslides. Table 2 describes the status of landslide-loss information available from the Utah Division of Water Resources. Dr. Ben Everitt, a geologist with the division, has individual knowledge of specific landslide problems, but the division does not systematically compile landslide-loss data for dams, canals, and other water-delivery facilities. The division also funds and performs geological and geotechnical investigations of certain facilities, such as an ongoing

landslide investigation for the Recapture Dam. Contracts for these investigations are filed with the division, but differentiating landslide investigations from other geotechnical investigations would require thorough evaluation of the contract and related documents. Dr. Everitt indicated that additional costs could be inferred for dam safety investigations of dams on landslides. However, the exact additional costs are unknown. Losses from landslide damage to canals are substantial, but are not tracked by the division. Most canals are privately owned, and are not required to report losses or repair costs to any government agency.

Table 2.
Status of landslide-loss data available at the Utah Division of Water Resources.

Type of Data	Limitations
Staff knowledge	Limited to specific projects
Contracts	Do not directly specify whether work is landslide-related
Feasibility reports (for proposed projects requesting funding)	Loss data may be part of documentation; tracking of annual losses to canals and water-distribution facilities is the responsibility of private companies

Utah Department of Transportation

The Utah Department of Transportation constructs, maintains, and upgrades Utah's state and interstate highways. As part of this responsibility, the department repairs road damage caused by landslides, and takes various measures to reduce landslide damage or stabilize cut slopes. Ms. Leslie Heppler, a geologist with the Geotechnical Division, and division engineers have individual knowledge of specific landslide problems along Utah highways, but the department does not systematically compile landslide-loss data. Ms. Heppler has individual knowledge of costs associated with recent major landslide stabilization and repair projects. Contracts for this work are also filed with the department. However, the costs of most minor landslide repairs (removal of rock-fall debris, periodic cleaning of ditches and catchments, pavement repair, placement of roadside barriers, etc.) are included within the annual maintenance budgets. In general, annual highway maintenance costs attributable to landslide damage are undocumented.

Utah Division of Emergency Services

The Utah Division of Emergency Services (DES) coordinates emergency management activities in the state. As part of this responsibility, DES staff occasionally document geologic hazards or request such documentation by other state or federal agencies such as the UGS or Natural Resources Conservation Service, respectively. Dr. Fred May, former State Hazards Mitigation Officer, indicated that the division generally only documents losses associated with federally declared disasters or in preparation for

substantiating that a disaster qualifies for federal assistance. No landslide-caused federally declared disasters have occurred since 1983 in Utah.

THE AVAILABILITY OF LANDSLIDE-LOSS ESTIMATES IN MEDIA REPORTS

Although media reports exist for many newsworthy landslides, media coverage of damaging landslides in Utah is inconsistent and sporadic. Table 3 lists the nine documented active/damaging landslides in Utah in 2001 and 2002, the potential and estimated actual costs, and the number of news articles covering each event. Media reports exist for only two of these landslides, most notably the 2001 Heather Drive landslide (see case history below). The absence of media reports for most landslides suggests that media coverage is an unreliable information source for preparing accurate landslide-loss estimates. Whereas the losses at most of these landslides remain undocumented, estimated losses at the 2001 Frontier Drive landslide (figure 4), for which no media reports exist, total nearly $752,000. In general, homeowners and local jurisdictions do not encourage media attention and in many cases prefer to avoid it. The only landslides in 2001-02 covered by the media were either large and newsworthy (Heather Drive landslide) or were brought to the attention of the media by the UGS (Capitol Blvd-City Creek landslide) to highlight scientific investigations.

Table 3.
Active landslides of 2001 and 2002, potential and estimated losses, and number of media reports.

Landslide	Year(s) Active	Estimated Losses	Specific or Potential Losses (Costs)	Media Reports
Capitol Blvd.- City Creek	2001, 2002	na	Home equity losses, movement monitoring, infrastructure relocation/repair	1 (2001)
4229 Southridge Ct.	2002	na	Home equity loss, landslide investigation, slope repair	none
I-80 Milepost 131.15	2002	na	Highway maintenance, damage to biostabilization measures	none
I-80 Lambs Canyon exit	2001, 2002	na	Highway maintenance	none
Sherwood Hills – Mile High and Windsor Drives	2001, 2002	na	Home equity losses; repairs to roads, utilities, and houses	none
Truman Drive	2002	na	Home equity loss, landslide investigation, slope repair	none
Green Hollow-High Mountain View Circle	2001, 2002	na	Home equity loss, landslide investigation, slope stabilization	none
Frontier Drive	2001	$751,500	Home equity loss, landslide investigation, slope stabilization	none
Heather Drive	2001	$1,092,000	Home equity loss, landslide investigation, slope stabilization, emergency response	20 (2001-2002)

Figure 4. *Damage to the rear of a lot caused by movement of the Frontier Drive landslide, Mountain Green in 2001. Losses and stabilization costs of this landslide exceeded $750,000.*

THE POTENTIAL USE OF MEDIA REPORTS AND TAX ASSESSOR RECORDS TO ESTIMATE LANDSLIDE LOSSES

The 2001 Heather Drive landslide in Layton, Utah destroyed three houses and forced the relocation of three others. The damaging landslide movement generated considerable media coverage by local newspapers and television. Twenty newspaper and television website articles on the landslide that cover a period between August 20, 2001, and April 5, 2002, were reviewed to determine the completeness of the landslide-loss data (table 4). Eleven of these articles are subsequent to August 29, 2001, the date by which most of the landslide damage had occurred. In this section, landslide-loss data from media reports are compared to detailed cost estimates by Layton City and to estimates based on county tax assessor's records.

Table 4.
Extent of media coverage of losses caused by the Heather Drive landslide.

Description	Number
Total news articles	20
Total with loss data	9
Articles with itemized loss information	5
Articles after August 29, 2001	11
Total post-8/29/01 articles with loss data	7

On August 30, 2001, Layton City provided the local media with an estimate of the landslide losses of around $1 million. A subsequent refinement of this estimate was included in a UGS report (Giraud, 2002) on the landslide and subsequently cited (directly or indirectly) in three newspaper articles. Table 5 summarizes Layton City's landslide-loss estimate as of late April 2002.

Table 5.
Heather Drive landslide losses estimated by Layton City.

Description	Estimate
Home equity losses	$590,000
Mortgage company losses	$450,000
Layton City's emergency response	$28,000
Utility relocation	$24,000
Total	**$1,092,000**

County tax assessor's records allow estimation of some of the losses to residential properties on the landslide. Table 6 summarizes the loss estimates using these records. A significant difference exists between the total estimated property losses using the county tax assessor's records ($690,910) and the property losses estimated by Layton City ($1.04 million). The estimate based on the county tax assessor's records is only about two-thirds the more detailed estimate made by Layton City. The differences likely are due to the following:

1. county-assessed property values may not accurately reflect pre-landslide market value and underestimate home equity losses, and
2. losses to mortgage companies in Layton City's estimate included interest due on the principal.

Table 6.
Inferred property losses from the Heather Drive landslide based on county tax assessor's records.

Description	Recorded Value
House and lot – 1369 E.	$154,040
House and lot – 1393 E.	$218,880
House and lot – 1417 E.	$111,700
Lot – 1381 E.	$37,990
Lot – 1423 E.	$34,240
Lot – 1431 E.	$32,000
Lots – 1456 Tartan Way	$102,060
Total	**$690,910**

Several newspaper articles itemized certain landslide losses resulting from the 2001 Heather Drive landslide. Table 7 summarizes these losses that total about $520,000. Thus, newspaper articles documented specific details for only about half of the total losses estimated by Layton City. In addition, differences exist between newspaper accounts and county tax assessor records for specific losses such as the value of the 1369 E. and 1393 E. properties destroyed by the landslide. Also, certain losses, such as reduced tax revenues and charitable contributions to the affected families, are not included in Layton City's landslide-loss estimate.

By combining landslide-loss data from the county tax assessor's records with specific loss information reported in newspaper articles, a more complete list of losses associated with the Heather Drive landslide is obtained that can then be compared with the detailed loss estimate compiled by Layton City. Table 8 summarizes the combined landslide-loss estimates using both the county tax assessor's records and specific landslide-loss information in newspaper articles.

Table 7.
Summary of itemized Heather Drive landslide-loss information in newspaper articles.

Description	Reported Cost
House and lot – 1369 E.	$175,000
House and lot – 1393 E.	$200,000
Helical anchors – 1369 E.	$80,000
Charitable contributions to families	$21,000
Layton City emergency response	$19,800
Landslide investigation	$14,000
County tax revenue losses	$10,000
Total	**$519,800**

Table 8.
Heather Drive landslide-loss estimate using county tax assessor's records and itemized loss information in newspaper articles.

Description	Reported Cost
House and lot – 1369 E.	$154,040
House and lot – 1393 E.	$218,880
House and lot – 1417 E.	$111,700
Lot – 1381 E.	$37,990
Lot – 1423 E.	$34,240
Lot – 1431 E.	$32,000
Lots – 1456 Tartan Way	$102,060
Helical anchors – 1369 E.	$80,000
Charitable contributions to families	$21,000
Layton City emergency response	$19,800
Landslide investigation	$14,000
County tax revenue losses	$10,000
Total	**$835,710**

Table 9 compares the available estimates of landslide losses caused by the 2001 Heather Drive landslide and shows the variation between the detailed landslide-loss estimate compiled by Layton City and the other estimates. The total losses based on specific information in newspaper articles, county tax assessor's records, or a combination of these sources range from about 45 to 77 percent of the total losses estimated by Layton City. The table shows that the exclusion of certain losses (county tax revenues, charitable contributions) in Layton City's estimate accounts for only a small fraction of the difference. As stated above, specific information on losses in newspaper accounts is incomplete and thus the ratios shown in table 9 are solely for this case and are included for comparison purposes only. County tax assessor records show only the losses to the affected residential property, may poorly reflect equity losses, do not show interest due to mortgage companies, and exclude other losses. The comparison

shows that in the absence of a detailed audit of landslide losses as was performed by Layton City, information from newspaper articles and county tax assessor's records can also be used to estimate landslide losses. However, in this case, the total losses were significantly underestimated using these two sources.

Table 9.
Comparison of Heather Drive landslide-loss estimates using different sources.

Source(s)	Estimated Losses	Ratio[1] (percent)	Notes
Layton City	$1,092,000	na	Excludes charitable contributions, tax revenue losses, and losses at 1456 Tartan Way
	$1,040,000	na	Losses to residential property only
County tax assessor records	$690,910	66	Losses to residential properties only
Newspaper articles	$519,800	48	Specific information on losses
Newspaper articles	$488,800	45	Specific information on losses excluding charitable contributions and tax revenue losses
Combined tax records and newspapers	$835,710	77	More accurate estimate used
Modified combined	$804,710	74	Excludes charitable contributions and tax revenue losses

[1]Relative to appropriate Layton City estimate.

THE FEASIBILITY OF RETROSPECTIVE LANDSLIDE-LOSS ESTIMATION

The 1983 Thistle landslide (figure 5) in Utah County is North America's most costly individual landslide (Schuster, 1996) and an ideal case history for evaluating retrospective landslide-loss estimation. Numerous published accounts (Kaliser, 1983; Anderson and others, 1984; University of Utah, 1984; Schuster, 1985, 1996; Duncan and others, 1986; Kaliser and Fleming, 1986; Kaliser and Slosson, 1988; Kaliser, 1989; Slosson and others, 1992) exist of the landslide event. Reported direct and indirect costs were evaluated to examine the variation and reliability of loss estimates for this major and well-documented landslide event.

Table 10 summarizes the published direct and indirect cost estimates for the 1983 Thistle landslide. Direct costs include the replacement of the railroad line and highway destroyed by the landslide, losses to the town of Thistle, and costs to stabilize and investigate the stability of the landslide. Indirect costs include lost revenue to the Denver & Rio Grande Railroad from loss of the rail line, lost coal-mining revenues from mines isolated from their market, and economic losses to local communities isolated by the loss of the transportation routes.

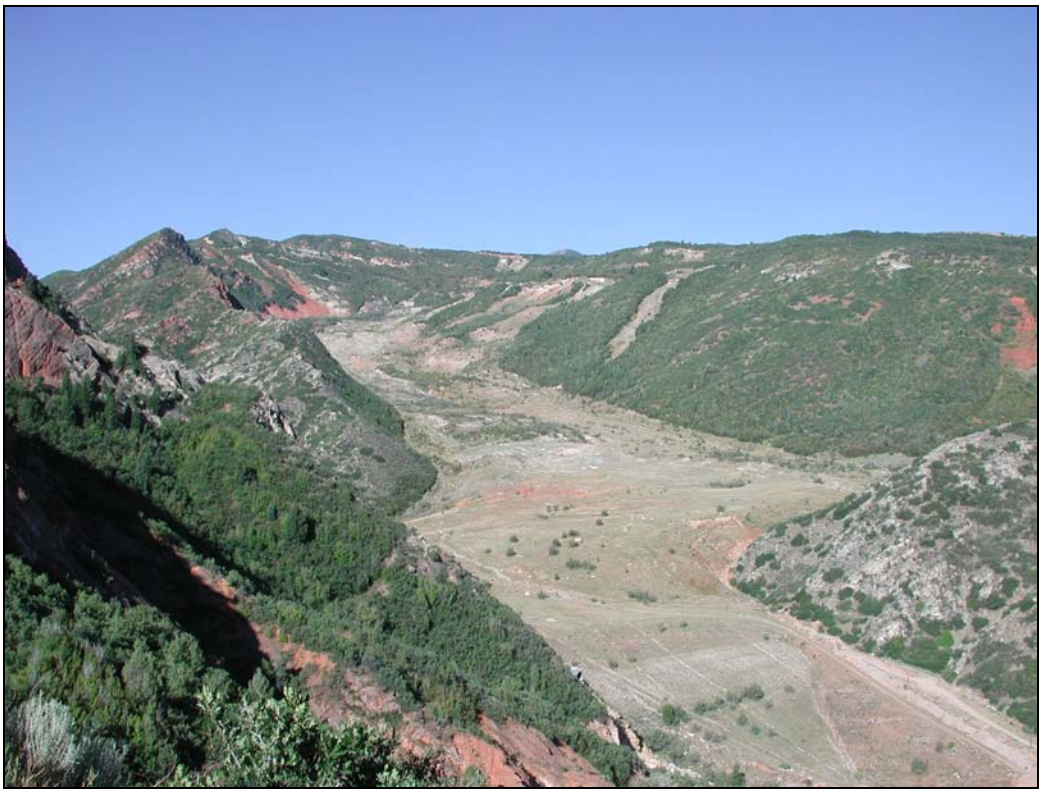

Figure 5. *View of the Thistle landslide, Utah County. Direct costs associated with movement in 1983 exceeded $200 million. The landslide also reactivated in 1997 and 1998.*

Table 10.
Comparison of direct and indirect cost estimates for the 1983 Thistle landslide.

Estimated Cost	Cost Type	Literature	Source cited
$200+ million	Direct	Kaliser, 1983; Duncan and others, 1986	Kaliser, 1983
$200 million	Direct	Schuster, 1985, 1996; Kaliser and Fleming, 1986; Slosson and others, 1992	University of Utah, 1984
$250+ million	Unspecified	Christenson and others, 1987	None
$337 million	Combined	Kaliser and Slosson, 1988; Kaliser, 1989	Stephens, 1984

Four reports (Schuster, 1985, 1986; Kaliser and Fleming, 1986; Slosson and others, 1992) list the direct costs at about $200 million. Three of these (Schuster, 1985, 1996; Kaliser and Fleming, 1986) cite the University of Utah (1984) report as the source of the direct cost estimate, while Slosson and others (1992) credit the estimate to Fleming and Schuster (1985). Three reports (Kaliser, 1983; University of Utah, 1984; Duncan and others, 1986) indicate that direct costs exceeded $200 million, but do not provide specific direct cost estimates. Duncan and others (1986) cite the Kaliser (1983) publication as the source of the estimate. Christenson and others (1987) indicate the cost of the landslide exceeded $250 million, but do not specifically indicate whether the figure refers to direct or combined direct and indirect costs. Kaliser (1989) indicates that the combined direct and indirect costs of the 1983 Thistle landslide were about $337 million and provides some details on the specific costs that account for the majority of the estimated costs. The earliest reported estimates (Kaliser, 1983) of direct costs associated with the 1983 Thistle landslide preceded completion of some of the major transportation lifeline relocation projects. While later reports were published following completion of most of the work related to relocation of transportation lifelines, most cite direct cost figures from earlier published reports.

Indirect costs of the 1983 Thistle landslide were not readily available directly after the event and remain difficult to assess even today. The University of Utah (1984) report indicated that indirect costs were pervasive in Utah's economy, but did not provide specific estimates. Kaliser and Slosson (1988) reported the combined direct and indirect costs reached about $337 million, but added that comprehensive knowledge of the indirect costs of the 1983 Thistle landslide was still lacking at the time of their report five years following the event. By subtracting the estimated $200 million in direct costs reported in the University of Utah (1984) report from the estimated combined costs of $337 million in the Kaliser and Slosson (1988) report, total indirect costs can be inferred to be about $137 million. However, Kaliser (1989) reported indirect costs of at least $122 million from lost coal mining revenues alone. In addition, Schuster (1996) reported railroad revenue losses of about $81 million. These two indirect costs total $203 million and exceed the inferred indirect costs based on the estimated combined cost of Kaliser and Slosson (1988).

Certain costs associated with the 1983 Thistle landslide still remain unrealized. The abandonment of the Sanpete line of the Utah railway in 1983 disrupted coal shipments from the Wasatch Plateau mining areas to various markets. Following abandonment of the line, some coal was transported by truck to a railroad loading facility in Juab County.

The possibility of constructing a replacement railroad that avoids the Thistle area is currently being considered (Oberbeck, 2002). Ultimately, if the railroad line is built, at least part of the cost, estimated at about $70 million (Oberbeck, 2002), could be associated with the 1983 Thistle landslide.

This analysis of retrospective landslide-loss estimation using the 1983 Thistle landslide as a case history indicates the following:

1. Direct cost estimates became available within a year of the event, but later estimates relied considerably on the initial estimates and were not updated with more recent and accurate cost data.
2. Indirect cost estimates were difficult to obtain for several years following the landslide.
3. Even five years after the event, uncertainties existed in the indirect cost estimates.
4. Certain costs may still be unrealized more than two decades following the event.

POTENTIAL OBSTACLES TO ACCURATE LANDSLIDE-LOSS ESTIMATION

Estimating the Number of Damaging Landslides

While some recent landslides in the Wasatch Front area of Utah have been well documented (Ashland, 2003), significant uncertainty exists regarding the number of damaging landslides that occur each year. Currently, no coordination exists between local jurisdictions and state and federal agencies to share information on damaging landslides on an annual basis. Thus, the knowledge of any one agency or jurisdiction concerning statewide landslide losses is limited. In addition, rarely is loss data shared by private companies that operate critical lifelines that might be impacted by landslides. The uncertainty in the relation between the number of documented damaging landslides and the actual number of such landslides prevents a basis for estimating statewide losses.

Transitory Losses: the 1998 Sunset Drive Landslide, Layton

In 1999, estimated costs associated with the 1998 Sunset Drive landslide (figure 6) in Layton included the losses in equity and mortgage payments of two houses damaged by the landslide (table 11). One house was eventually demolished and the estimated loss proved to be real. However, the second house that had been abandoned at the time of the initial loss estimate was subsequently reoccupied by a new homeowner. If some equity loss is assumed for the second house, in this case 25 percent ($50,000), then the post-1999 direct losses total only $306,000 or about 67 percent of the 1999 estimate.

Figure 6. *Two houses damaged by movement of the Sunset Drive landslide, Layton in 1998. House on the right was subsequently condemned and demolished.*

Table 11.
Estimated direct losses at the Sunset Drive landslide.

Description of Loss	Estimated Losses (dollars)	Source of Loss Estimate
House at lot 105 (demolished)	$200,000	Deseret News, April 21, 1998
House at lot 104 (abandoned)	$200,000[1]	Deseret News, April 21, 1998
Demolition of house at lot 105	$ 10,000	Standard Examiner, October 20, 1998
Geotechnical slope-stability investigation	$ 40,000	Deseret News, October 15, 1998
Relocation fees for family at lot 105	$ 6,000	Standard Examiner, September 10, 1998
Subtotal Value of Direct Losses (as of March 1999)	***$456,000***	

[1]*House subsequently re-occupied and thus loss may be overestimated.*

Damage Caused by Recurrent or Ongoing Movement: the Sherwood Hills Landslide, Provo

Recurrent or ongoing movement at very or extremely slow rates results in widespread, but typically limited damage in the Sherwood Hills subdivision, Provo. The cumulative effects of movement, sometimes over several years, locally results in damages that require repair or result in severe distress. Assigning the costs of landslide damage to a specific calendar year may be difficult where movement and the resulting damage occurs gradually over two or more years. Landslide movement typically triggers in the fall and early winter and continues into the spring of the following year. Thus, landslide movement that triggered in one year causes damages that become severe enough to be documented in the following year.

Differentiating Landslide-Related Damage from Other Causes

Multi-hazard areas exist throughout Utah and complicate attempts to identify and quantify landslide damage. Other hazards that cause distress and damage to buildings, roads, and utilities include expansive and collapsible soils, piping, frost heave, and shallow ground water. Other causes of building distress include poorly compacted fill soils and poor preparation of footing and slab subgrade soils, settlement of excessive fills, and the use of inferior building materials and construction practices.

In several landslide areas, differentiating landslide-related damage from damage due to other causes posed a significant challenge for local and state officials. At the Sherwood Hills landslide prior to 1998, local officials attributed the majority of distress to causes other than landsliding, including settlement of excessive fills, expansive soils, and poor construction practices and foundation preparation. Appreciation of the landslide origin of the building distress in Sherwood Hills only followed detailed landslide

investigations and analysis of GPS survey and inclinometer data. In 1998, building distress in the Springhill subdivision in North Salt Lake could not be unequivocally attributed to landsliding based solely on geologic reconnaissance of the problem area (Giraud, 1999b). Subsequent geotechnical investigation including data from inclinometers (Terracon, 1998) was required before the cause of the distress was directly attributable to landsliding.

Trans-jurisdictional Landslide Losses

In some cases, lifelines may cross jurisdictional boundaries, including state lines, such that landslides on one side of the boundary create losses on the other. For example, the West Cache Canal in northern Utah and southern Idaho delivers about 95 percent of its irrigation water to Utah. Landslides in the upstream Idaho section of the canal have caused damages and disrupted the delivery of irrigation water. In 1995, landslide-induced failure of the canal caused estimated losses of about $875,000 (West Cache Irrigation Company, 1996) including the $125,000 cost to repair the canal. Most of the agricultural losses, about $712,500 of a total $750,000 in losses, were the result of reduced crop yields on Utah farms lacking critically needed irrigation water.

CONCLUSIONS

Currently, landslide losses in Utah are poorly documented. Most local jurisdictions and state agencies contacted as part of this study do not systematically track such losses. Databases in which landslide-related costs may be contained are commonly referenced to building permits, and thus track only a percentage of the actual damage repair and stabilization costs from landsliding. Also building permits commonly do not identify the causes of damage or list the cost of repairs. Media reports and other potential loss data such as tax assessor records provide only partial information on actual losses. State agencies currently do not track landslide losses to utility lifelines and transportation corridors. However, some documentation regarding the costs of landslide stabilization projects exists in various agencies.

A lack of landslide-loss information in most of the state poses a serious challenge to accurate landslide-loss estimation in Utah. Statewide landslide-loss estimates would require extrapolation using data from jurisdictions where losses are reasonably well documented. Jurisdictions lacking loss data would need to be ranked based on landslide susceptibility, the amount of building inventory at risk, median property values, and other factors. Ideally, statewide landslide-loss estimation may be accomplished using a Geographic Information Systems approach.

Retrospective landslide-loss estimation appears feasible for major landslides that are well documented, but uncertainties in the loss estimates pose a problem, particularly for indirect costs. Direct cost estimates were available for the 1983 Thistle landslide within a year of the event. Later articles that had access to more recent and thus likely more accurate direct costs relied on the initial estimates, however. Uncertainties existed in

indirect costs associated with the landslide more than five years after the event, and some possible indirect costs of the landslide still remain unrealized in 2002.

Several potential obstacles to accurate landslide-loss estimation were identified as part of this study by examining recent case histories of damaging landslides in northern Utah. These potential obstacles include the lack of coordinated inventorying of damaging landslides by state and federal agencies and local jurisdictions, transitory losses, damages caused by recurrent and ongoing landslide movement, the inability to differentiate damage resulting from landslides in multi-hazard areas, and trans-jurisdictional landslide losses. In addition, homeowners and local governments are often reluctant to report losses because of perceived negative effects.

RECOMMENDATIONS FOR MORE ACCURATE LANDSLIDE-LOSS ESTIMATION IN UTAH

Better coordination between state and federal agencies, local jurisdictions, lifeline companies, and other professionals is necessary to obtain more accurate landslide-loss estimates in Utah. Table 12 provides a list of state and federal agencies that should develop a cooperative program to document damaging landsliding in the state. In addition, local jurisdictions, lifeline companies, and other professionals should also participate in documenting or reporting damaging landslides or distress and/or damage in hillside settings. Table 13 lists other possible participants.

Table 12.
List of state and federal agencies that document landslides in Utah.

Type	Agency
State	Utah Geological Survey
	Division of Water Resources
	Department of Transportation
	Division of Emergency Services
Federal	Natural Resources Conservation Service
	U.S. Forest Service (districts)
	Bureau of Land Management
	U.S. Geological Survey

To improve both the interest in and methods used to compile landslide-loss estimates, local jurisdictions need to be invited to further explore the need and ease of this effort. Certain local jurisdictions, most notably Salt Lake City and Layton City, have staff with individual interests in more accurate landslide-loss data. By providing these individuals the opportunity to share their thoughts and experience with other local jurisdictions, more interest in compiling landslide-loss estimates may develop at a local level. In addition, a proposed database that will be implemented by Salt Lake City appears suitable for accurate loss estimation at a local level. The database will identify repair costs related to

landsliding and will not be restricted by a permit-referenced system. Thus, the database will likely include more information than other databases currently used at a local level and ease access by the user to landslide-loss data.

Table 13.
List of possible participants to document damaging landslides in Utah.

County governments	Road departments, planners, engineers, and building officials
City governments	City engineers and building officials
Universities	Geology departments (faculty)
Lifeline companies	Questar Gas Utah Power Petroleum pipeline companies Water districts
Canal companies	Various
Geotechnical consultants	Engineers and geologists

However, a fundamental change in the documentation procedures of many local governments would be a prerequisite for implementing a database such as Salt Lake City's. The UGS would likely need to undertake a significant effort to increase awareness and educate local government officials of the benefits, if any, of making such changes. Initially, only a few jurisdictions may be willing to participate based on the level of interest expressed by officials contacted as part of this study.

ACKNOWLEDGMENTS

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Jordan Valley Water Conservancy District

Hazard Mitigation Strategy

Prepared with the assistance of:

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Jordan Valley Water Conservancy District Hazard Mitigation Strategy

DISTRICT BACKGROUND

Jordan Valley Water Conservancy District (JVWCD) is a political subdivision of the State of Utah. It was created in 1951 under the Water Conservancy Act and was called the Salt Lake County Water Conservancy District. The original Board of Directors was made up of community leaders in Salt Lake County, outside the Salt Lake City service area, including the mayors of Sandy and Midvale, a state legislator and other community leaders. Jordan Valley remains under the administrative jurisdiction of the Third District Court of the State of Utah.

On June 4, 1999, Jordan Valley's name was changed from Salt Lake County Water Conservancy District to Jordan Valley Water Conservancy District to eliminate confusion with Salt Lake County governments and to better reflect Jordan Valley's service area, which includes most of Salt Lake County and a small portion of northern Utah County.

Jordan Valley is governed by a board of eight trustees who represent seven geographical divisions. They are nominated by either the Salt Lake County Council or a city council, depending upon the division they represent. Each trustee is appointed by the Governor for a four-year term.

Jordan Valley is primarily a wholesaler of water to cities and improvement districts within Salt Lake County. It also has a retail service area in unincorporated areas of the county. Jordan Valley is now the largest municipal water district in Utah, with 90% of its municipal water delivered on a wholesale basis to cities and water districts and 10% on a retail basis to unincorporated areas of Salt Lake County. In addition, Jordan Valley treats and delivers water to Metropolitan Water District of Salt Lake & Sandy for delivery to Salt Lake City and Sandy City, even though neither city is within Jordan Valley's service boundaries. Jordan Valley also delivers untreated water to irrigators in Salt Lake and Utah Counties to meet commitments under irrigation exchanges.

HAZARD MITIGATION STRATEGY

Table 1 summarizes the priorities, schedule and funding sources for implementing JVWCD's hazard mitigation measures. A Planning Committee consisting of JVWCD personnel and ABS

Consulting risk assessment engineers assembled Table 1. The components of the table are as follows:

- The first column lists the hazards that were selected in consensus with the District that represent credible potential natural hazard threats to JVWCD's operation.
- The second column is a line number used for reference purposes.
- Overall perceived risk is documented in the third column of the table and was developed based on the consensus of the Planning Committee. The factors considered in assessing risk were: estimated frequency of occurrence, vulnerability/fragility, and consequences.
- The fourth column of the Table lists the actions identified by the Committee that will mitigate the risks associated with the hazards.
- The priority of each action is listed in the fifth column. All mitigation actions identified in this plan were prioritized according to a benefit-cost analysis, with a focus on how effective the actions are expected to be with respect to their cost. The top three priorities are listed as "H1", "H2", and "H3".
- The results of the benefit-cost analysis are shown in the sixth column. Benefit-cost ratios were calculated where possible using the following approach:

  Benefit-cost ratio estimations for facilities other than the water treatment plants did not lend themselves well to quantitative evaluation, since the impact to system capacity and operation for facility loss was not readily quantifiable, and was therefore qualitatively assessed at this time.

  For the two water treatment plants, benefit-cost ratios were quantified using the following relationship (see Table 2 for documentation of the actual calculations).

  Benefit-Cost Ratio = (Probability for Significant Earthquake Event * Deferred Cost)/Cost for Mitigation

  Where:

  Probability for Significant Earthquake Event is assumed to be 10%, the probability for a 475-year earthquake over a 50-year time span, which was used in the *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report,* May 28, 2003.

  Deferred Cost (avoided loss) is the estimated loss of business commerce revenue in the JVWCD service area following the given earthquake event. The loss of business revenue is based on an examination of the annual

Utah State Domestic Product (SDP). Of the total $70.4 billion annual Utah SDP, the JVWCD service area was estimated to contribute approximately $15.2 billion, or $41.8 million on a daily basis. (See Table 3 for calculations of the estimated SDP produced in the JVWCD service area.) Based on the percent of total system capacity, the JVWTP provides approximately 70% of the total capacity and the SERWTP provides approximately 10%, with the system wells providing the remaining 20%. Therefore, the JVWCD total water supply capacity would be reduced by 70% if a critical structure at the JVWTP is rendered inoperable following the event. Similarly, the total water supply capacity would be reduced by 10% if a critical structure at the SERWTP were rendered inoperable. Based on an evaluation of outage impact factors (*Applied Technology Council, (1991), Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States, ATC-25, Redwood City, California: Applied Technology Council*), the estimated daily loss of commerce revenue within the JVWCD service area would be $9.9 million and $0.8 million for the loss of the capacity provided by the JVWTP or SERWTP, respectively. (See Table 4 for calculations of the daily loss of commerce revenue.) The daily loss of revenue due to the reduced water supply is multiplied by the estimated outage duration as shown in Table 2 to compute the deferred cost.

Cost for Mitigation is the cost presented in the *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report*, May 28, 2003 and in the *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003. These costs have been escalated 3% per year for two years to convert the costs from 2003 dollars into 2005 dollars to account for construction cost escalation between the time of the original cost estimate and the earliest expected construction dates.

A “High” benefit-cost ratio corresponds to a ratio calculated or expected to be greater than two. A “Moderate” benefit-cost ratio corresponds to a ratio calculated or expected to be greater than one but less than two. A “Low” benefit-cost ratio corresponds to a ratio less than one. All ratios shown in Table 2 are above two, and thus a “High” benefit-cost ratio was assigned for the water treatment plant seismic upgrades. Potential losses from fires following earthquakes have conservatively been excluded from the benefit-cost calculations. Losses exclude “fire-following” losses, which have proven to be <u>significant</u> in historically recent earthquakes such as the 1989 Loma Prieta event and the 1995 Kobe Japan area.

- The implementation deadlines and funding sources to be shown in the last columns of the table will be updated in subsequent revisions.

To be consistent with standardized DMA-2000 grant application processes, a 475-year, 10% probability in 50 years seismic event has been utilized in this grant application. It is extremely noteworthy, however, to point out that the Wasatch front is very susceptible to a 2475-year, 2% probability in 50 years seismic event based on numerous recent geologic studies. (Ref: Masek,

Reaveley, Wong: “Seismic Design Criteria For Water Systems”, 2002). A very important distinction between the Wasatch Front and other seismically active zones (such as California) exist. Specifically, in California the difference between zero period acceleration for a “10% in 50 years event” versus a “2% in 50 years event” is typically on the order of a factor of two. Along the Wasatch range this difference can be a factor of five. This is why the ICBO committees have adopted 2% contours for Utah. In practical layperson’s terms this all simply means the actual risk to the Utah water systems can be very high. Therefore the importance of proactive mitigation efforts must be emphasized.

Table 1: JVWCD Hazard Mitigation Strategy

(1) Hazard Type	(2) Line Number	(3) Overall Perceived Risk[1,2]	(4) Action	(5) Priority[1,3]	(6) Estimated Cost	(7) Benefit-Cost Ratio[1,5]	(8) Implementation Deadline	(9) Funding Sources
Earthquake (Ground Motion, Liquefaction, Surface Faulting)	1	**H**	Seismic Upgrades for the Jordan Valley Water Treatment Plant: High-rise Filter Gallery (Building Structures) Upper Raw Water Pond Screening Building Flocculation Basins Sedimentation Basins Filter Basins Chemical and Control Building 8 Million Gallon Reservoir Washwater Recycle Pump Station #1	H1	$6,470,000[4]; Cost of construction projects currently underway is $294,000	H[6,7]	Phase 1 Construction: completed FY2004 Planning: FY2004 Design: FY2005-2006 Construction: FY2006-2008	To be determined
	2	**H**	Seismic upgrades for the Administration buildings. A principle concern is life-safety of District employees and use of the facilities after an earthquake.	H2	$2,000,000[4]	H[7,8]	Planning: FY2004 Design: FY2005-2006 Construction: FY2006-2007	To be determined
	3	**H**	Seismic Upgrades for the Southeast Regional Water Treatment Plant: Filter Operations Building Filter Basins	H3	$550,000[4], Cost of construction projects currently underway is $55,500	H[6,7]	Phase 1 Construction: completed FY2004 Other Work: To be determined	To be determined
	4	**H**	Seismic upgrades that includes the installation of flexible couplings or relocation of pipe connections at the following reservoirs: 6200 South 3200 West- 2 MG #1 6200 South 3200 West- 2 MG #2 4500 South 4800 West- 1 MG 4500 South 4800 West- 2 MG	H	$76,000[4]	H[7]	To be determined	To be determined

Table 1: JVWCD Hazard Mitigation Strategy								
(1) Hazard Type	(2) Line Number	(3) Overall Perceived Risk[1,2]	(4) Action	(5) Priority[1,3]	(6) Estimated Cost	(7) Benefit-Cost Ratio[1,5]	(8) Implementation Deadline	(9) Funding Sources
	5	**H**	Acquire backup sources of power – portable diesel generator sets for pump stations in the following output capacities:[11] 800 kW 4160 Volt (3600 West, 10200 South Pump Station) 600 kW 480 Volt (3145 West, 11400 South and 5700 West, 10200 South Pump Stations) 600 kW 2400 Volt (Terminal Reservoir Pump Station) 500 kW 480 Volt (Draper No. 1 and 1300 East, 10700 South Pump Station)	M	To be determined	M	To be determined	To be determined
	6	**M**	Perform structural seismic upgrades for the following reservoirs. There is a concern for localized flooding and damage to property in the vicinity if reservoir contents were released. 2300 East 9800 South- 6 MG 6000 West 4700 South- 6 MG 3600 West 10200 South- 3 MG 5700 West 10200 South- 3 MG	M	$800,000[4]	M[7,12]	To be determined	To be determined
	7	**M**	A raw water or treated water aqueduct may catastrophically fail. Acquire repair segments to reduce the delay in repairing.	H	Small	H[9]	To be determined	To be determined
	8	**M**	Install a parallel pipeline (potentially a 33" line) to either the 4500 South or 6600 South crossing of the Jordan River / liquefaction zone with a seismic-resistant pipeline design.	M	Project-dependent	L	To be determined	To be determined
	9	**M**	Perform seismic upgrades for well house structures.	M	$330,000[4]	H[7]	To be determined	To be determined
	10	**L-M**	Booster pump station seismic upgrades – There are no pump stations that would be expected to be non-functional in a 475-yr earthquake (10% in 50 years) for which no redundant flow path exists, with the potential exception of the finished water pumps at Jordan Valley Water Treatment Plant that pumps water from the 8 MG reservoir to Bluffdale City's 6 MG reservoir (mainly rural/agricultural area with limited number of industrial customers).	M	$200,000[4]	H[7]	To be determined	To be determined

Table 1: JVWCD Hazard Mitigation Strategy								
(1) Hazard Type	(2) Line Number	(3) Overall Perceived Risk[1,2]	(4) Action	(5) Priority[1,3]	(6) Estimated Cost	(7) Benefit-Cost Ratio[1,5]	(8) Implementation Deadline	(9) Funding Sources
	11	**L**	Develop the capability to provide temporary disinfection of groundwater from the wells. Some wells already have this capability and thus more research is necessary to more concretely define this mitigation action. 9 of 27 equipped, 2 portable stations.	M	Small	H[9]	To be determined	District Operations
Building/ Facility Fire/ Explosion or Facility Flood due to burst pipe (includes computer failure)	12	**H**	Ensure adequate procedures and training are in place for minimizing the risks for fire and flooding.	H	Small	H[9]	To be determined	District Operations
Landslide/ Rock Slide (earthquake-related)	13	**H**	There is a concern that a landslide could damage the Salt Lake Aqueduct or the Olmsted Aqueduct. Such damage could result in loss of the District's raw water supply but would be the responsibility of others to repair.[10] No recommended mitigation actions were therefore identified in the *JVWCD Emergency Repairs and Funding Study, Revision 1*, June 2000.	n/a	n/a	n/a	n/a	n/a
Loss of Raw Water Supply (includes dam failure, turbid raw water, contaminated raw water and transportation accident)	14	**H**	Such damage could result in loss of the District's raw water supply but would be the responsibility of others to repair.[10] No recommended mitigation actions were identified in the *JVWCD Emergency Repairs and Funding Study, Revision 1*, June 2000.	n/a	n/a	n/a	n/a	n/a
Power Outage (includes wind/ snow/ ice storm impacts)	15	**H**	Consider obtaining emergency electrical generators as noted above.	See Line 5 above	See Line 5 above	See Line 5 above	See Line 5 above	See Line 5 above

Table 1: JVWCD Hazard Mitigation Strategy								
(1) Hazard Type	(2) Line Number	(3) Overall Perceived Risk[1,2]	(4) Action	(5) Priority[1,3]	(6) Estimated Cost	(7) Benefit-Cost Ratio[1,5]	(8) Implementation Deadline	(9) Funding Sources
Flood in the Jordan River	16	**H**	The operations and maintenance complex may be flooded during a 100-year or 500-year event, resulting in potential loss of SCADA, as well as access to maintenance shops, repair equipment and the emergency operations center. Consider making provisions to have a temporary SCADA system for use at an alternate location. Practice yearly SCADA-free operation for a day. Make provisions to move equipment and vehicles temporarily if flooding threatens. Make provisions for a temporary location for the emergency operations center.	H	Small	H[9]	To be determined	District Operations
	17	**M**	Loss of more than one river-crossing pipeline is unlikely in any flood event. Recommended actions noted above for installing a parallel pipeline to either the 4500 South or 6400 South crossing would further enhance redundancy.	See Line 8 above	See Line 8 above	See Line 8 above	See Line 8 above	See Line 8 above
	18	**M**	Reduce flooding vulnerability of bridge/road to allow access to complex and passage of District vehicles.	L	Project-dependent	L	To be determined	To be determined
	19	**L**	Flooding of the Jordan Narrows Pump Station may require replacement of the electrical control equipment on the floor of the station. This pump station is not used for pumping raw or potable water. No recommended mitigation actions were identified in the *JVWCD Emergency Repairs and Funding Study, Revision 1*, June 2000.	n/a	n/a	JVWCD to investigate potential regional impact	n/a	n/a

Table 1 Notes:

1. L = Low, M = Moderate, H = High

2. Overall perceived risks were developed based on a consensus of the Planning Committee. The factors considered in assessing risk were: estimated frequency of occurrence, vulnerability/fragility, and consequences. Information was utilized from the Emergency Repairs and Funding Study 2000 findings and other reports.

3. A qualitative approach was used to assign action priorities. Generally, priorities were selected that corresponded to benefit-cost ratios; for example, a high benefit-cost action was assigned a high priority. The judgment of the Planning Committee, in some cases determined the assignment of priority.

4. Costs were developed in *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report*, May 28, 2003 and the in *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003 for 475-yr earthquake event (10% probability in 50 years). These costs have been escalated 3% per year for two years to convert the costs from 2003 dollars into 2005 dollars to account for construction cost escalation between the time of the original cost estimate and the earliest expected construction dates.

5. A "High" benefit-cost ratio corresponds to a ratio calculated or expected to be greater than two. A "Moderate" benefit-cost ratio corresponds to a ratio calculated or expected to be greater than one but less than two. A "Low" benefit-cost ratio corresponds to a ratio less than one.

6. Benefit-cost ratios for the two water treatment plants were estimated using the following relationship (see Table 2 for documentation of the actual calculations):

Benefit-Cost Ratio = (Probability for Significant Earthquake Event * Deferred Cost) / Cost for Mitigation

Where:

Probability for Significant Earthquake Event is assumed to be 10%, the probability for a 475-year earthquake over a 50-year time span, which was used in the *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report,* May 28, 2003.

Deferred Cost (avoided loss) is the estimated loss of business commerce revenue in the JVWCD service area following given earthquake event. The loss of business revenue is based on an examination of the annual Utah State Domestic Product (SDP). Of the total $70.4 billion annual Utah SDP, the JVWCD service area was estimated to contribute approximately $15.2 billion, or $41.8 million on a daily basis. (See Table 3 for calculations of the estimated SDP produced in the JVWCD service area.) Based on the percent of total system capacity, the JVWTP provides approximately 70% of the total system capacity and the SERWTP provides approximately 10%, with the system wells providing the remaining 20%. Therefore, the JVWCD total water supply would be reduced by 70% if a critical structure at the JVWTP is rendered inoperable following the event. Similarly, the total water supply capacity would be reduced by 10% if a critical structure at the SERWTP were rendered inoperable. Based on an evaluation of outage impact factors (*Applied Technology Council, (1991), Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States, ATC-25, Redwood City, California: Applied Technology Council*), the estimated daily loss of commerce revenue within the JVWCD service area would be $9.9 million and $0.8 million for the loss of the capacity provided by the JVWTP or SERWTP, respectively. (See Table 4 for calculations of the daily loss of commerce revenue.) The daily loss of revenue due to the reduced water supply is multiplied by the estimated outage duration as shown in Table 2 to compute the deferred cost.

Cost for Mitigation is the cost presented in the *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report*, May 28, 2003 and in the *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003. These costs have been escalated 3% per year for two years to convert the costs from 2003 dollars into 2005 dollars to account for construction cost escalation between the time of the original cost estimate and the earliest expected construction dates.

All ratios shown in Table 2 are above two, and thus a "High" benefit-cost ratio was assigned for the water treatment plant seismic upgrades. Potential losses from fires following earthquakes have been excluded from the benefit-cost calculations.

7. Benefit-cost ratios were also developed for JVWCD in the *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003. The benefit-cost ratios in this report conservatively do not include any potential loss of business commerce revenue or losses from fires following earthquakes.

8. The benefit-cost ratio for the administration complex was determined from the ratio provided in the *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003 and a factor to account for the potential loss of life at the facility since the facility houses on average of at least 50 employees or visitors at any time.

9. Mitigations that have small estimated costs were assigned high benefit-cost ratios.

10. Agencies with responsibility to repair damage: Central Utah Water Conservancy District (CUWCD) and Bureau of Reclamation (BOR)

11. Reference: *JVWCD Evaluation for Standby Power*, April 2000.

12. The benefit-cost for these reservoirs could also include applicable possible fire following and liabilities caused by local flooding.

Table 2: Benefit-Cost Estimates for JVWCD Water Treatment Plant Seismic Upgrades

Facility	Asset	Outage Duration (days)[1]	Deferred Cost[2]	Cost for Mitigation[3]	Benefit-Cost[4]
Jordan Valley WTP	High-rise	180	$1,785,300,000	$2,632,000	68
	Filter Gallery (Building Structures)	30	$297,600,000	$1,030,000	29
	Upper Raw Water Pond	2	$19,800,000	$501,000	4
	Screening Building	2	$19,800,000	$105,100	19
	Flocculation Basins	3	$29,800,000	$83,800	36
	Sedimentation Basins	3	$29,800,000	$584,100	5
	Filter Basins	30	$297,600,000	$243,600	122
	Chemical and Control Building	30	$297,600,000	$704,200	42
	8 Million Gallon Reservoir	5	$49,600,000	$267,000	19
	Washwater Recycle Pump Station #1	1	$9,900,000	$29,000	34
Southeast Regional WTP	Filter Operations Building	30	$22,900,000	$427,200	5
	Filter Basins	30	$22,900,000	$66,100	35

Table 2 Notes:

1. The outage duration are engineering estimates on the expected time duration before normal or sufficient water treatment capacity can be restored. The time estimates include consideration of the existing un-retrofitted condition of the facilities, the expected damage that may be caused by the seismic event at each facility, and the potential time it would take to repair the structures for reoccupation and water treatment use. These durations are based heavily on engineering judgment and may vary under actual conditions.

2. Deferred cost represents the estimated impact to business commerce in the JVWCD service area due to the reduced water supply over the assumed outage duration. See Table 3 for the estimate of the Utah State Domestic Product (SDP) produced in the JVWCD service area. The deferred cost calculations assume that the available JVWCD water supply capacity is reduced by 70% if a structure at the JVWTP is rendered inoperable following the event and 10% if a structure at the SERWTP is rendered inoperable. See Table 4 for estimated daily commerce revenue losses as a percentage of the interruption in supply.

3. Costs were developed in *JVWCD Seismic Hazard Mitigation Project, Phase 1: Predesign Report*, May 28, 2003 and the in *JVWCD Seismic Hazard Mitigation Benefit-Cost Analysis Report*, October 6, 2003 for 475-yr earthquake event (10% probability in 50 years). These costs have been escalated 3% per year for two years to convert the costs from 2003 dollars into 2005 dollars to account for construction cost escalation between the time of the original cost estimate and the earliest expected construction dates.

4. These values are all greater than 2, and therefore seismic upgrades for the water treatment plants have been assigned to be “High” in Table 1.

Table 3: Estimated State Domestic Product (SDP) Produced within the JVWCD Service Area

Market Sector	(A) Utah Annual SDP (millions)[1]	(B) % of Total SDP produced in JVWCD Service Area[2]	(C) JVWCD Service Area Annual Domestic Product (millions)[3]	(D) JVWCD Service Area Daily Domestic Product (thousands)[4]
Agriculture, Forestry, and Fishing	$874	15%	$131	$359
Mining	$1,323	30%	$397	$1,087
Construction	$4,357	25%	$1,089	$2,984
Manufacturing	$8,079	20%	$1,616	$4,427
Transportation and Public Utilities	$5,595	25%	$1,399	$3,832
Wholesale Trade	$4,243	25%	$1,061	$2,906
Retail Trade	$6,989	25%	$1,747	$4,787
Finance, Insurance, and Real Estate	$14,135	15%	$2,120	$5,809
Services	$14,498	25%	$3,625	$9,930
Government	$10,315	20%	$2,063	$5,652
TOTAL:	**$70,408**		**$15,248**	**$41,774**

Table 3 Notes:

1. The Utah State Domestic Product is for year 2001 and is referenced from the Buraeu of Economic Analysis, an agency of the U.S. Department of Commerce. See the following website for backup data: http://www.bea.gov/bea/regional/gsp

2. The percentages of each market sector that JVWCD serves are only approximate. Actual percentages may be within plus or minus 10%. Through wholesale and interconnections with other water districts, JVWCD provides water, in one way or another, to approximately 80-90% of the Salt Lake County population and industries. Salt Lake County comprises approximately 40% of the total population of the State of Utah and hence approximately 40% of the Utah SDP. See the following website for additional backup data: http://www.bea.gov/bea/regional/reis

3. The JVWCD service area contribution to the annual SDP in each market sector is determined by multiplying column (A) by column (B).

4. The average daily portion of the SDP that the JVWCD service area contributes to each market sector is determined by dividing the annual contribution (column (C)) by 365 days.

Table 4: Estimated Daily Business Commerce Loss in JVWCD Service Area
(Based on an assumed Interruption of Supply)

Market Sector	Impact Factor for **10%** Interruption of Supply[1, 3]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]	Impact Factor for **30%** Interruption of Supply[1]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]	Impact Factor for **50%** Interruption of Supply[1]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]
Agriculture, Forestry, and Fishing	2.81%	$10	14.03%	$50	25.27%	$91
Mining	0.79%	$9	3.95%	$43	7.11%	$77
Construction	2.63%	$78	13.16%	$393	23.68%	$707
Manufacturing	3.35%	$148	16.76%	$742	30.16%	$1,335
Transportation and Public Utilities	1.58%	$61	7.90%	$303	14.21%	$545
Wholesale Trade	1.05%	$31	5.26%	$153	9.47%	$275
Retail Trade	1.05%	$50	5.26%	$252	9.47%	$453
Finance, Insurance, and Real Estate	1.05%	$61	5.26%	$306	9.47%	$550
Services	2.42%	$241	12.10%	$1,202	21.79%	$2,164
Government	1.32%	$75	6.58%	$372	11.48%	$669
TOTAL:		**$763**		**$3,815**		**$6,866**

Market Sector	Impact Factor for **70%** Interruption of Supply[1, 3]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]	Impact Factor for **90%** Interruption of Supply[1]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]	Impact Factor for **100%** Interruption of Supply[1]	JVWCD Service Area Daily Domestic Product Loss (thousands)[2]
Agriculture, Forestry, and Fishing	36.49%	$131	47.72%	$171	53.33%	$192
Mining	10.26%	$112	13.42%	$146	15.00%	$163
Construction	34.21%	$1,021	44.74%	$1,335	50.00%	$1,492
Manufacturing	43.57%	$1,929	56.98%	$2,522	63.68%	$2,819
Transportation and Public Utilities	20.53%	$787	26.84%	$1,029	30.00%	$1,150
Wholesale Trade	13.68%	$398	17.89%	$520	20.00%	$581
Retail Trade	13.68%	$655	17.89%	$856	20.00%	$957
Finance, Insurance, and Real Estate	13.68%	$795	17.89%	$1,039	20.00%	$1,162
Services	31.47%	$3,125	41.16%	$4,087	46.00%	$4,568
Government	17.11%	$967	22.37%	$1,264	25.00%	$1,413
TOTAL:		**$9,919**		**$12,970**		**$14,497**

Table 4 Notes:

1. Percentage impact factor to JVWCD service area domestic product, by market sector, for given losses of water supply *(Applied Technology Council, (1991), Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States, ATC-25, Redwood City, California: Applied Technology Council).* Impact factors estimates are specific to the State of Utah.

2. Daily loss of commerce revenue in the JVWCD service area is determined by multiplying the percentage impact factor by the estimated average daily portion of the SDP that the JVWCD service area contributes (column (D) in Table 3). For example, if JVWCD is able to supply only 90% of the service area water requirements (a 10% interruption), output from the agriculture, forestry, and fishing market sector is estimated to be reduced by 2.81%.

3. Based on total system capacity, 10% and 70% interruption in supply were selected as a reasonable estimate of the potential effects due to a critical structure at the SERWTP or a critical structure at the JVWTP being rendered inoperable after a large earthquake event affecting the JVWCD service area.