Wasatch Front Region
Natural Hazard Pre-Disaster Mitigation Plan

Produced by the
Wasatch Front Regional Council in conjunction with
Davis, Morgan, Salt Lake, Tooele and Weber Counties,
Cities and Special Service Districts

Assistance and guidance provided by
the Utah Division of Homeland Security

December, 2008

Executive Summary

Plan Mission

The Wasatch Front Regional Council (WFRC) developed the PDM Plan in partnership with the jurisdictions it serves to substantially and permanently reduce the Region's vulnerability to natural hazards. The Plan is intended to promote sound public policy and protect or reduce the vulnerability of the citizens, critical facilities, infrastructure, private property and the natural environment within the Region. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention and identifying activities to guide the development of a less vulnerable and more sustainable community.

Plan Update

This Plan represents an update of the PDM Plan that was approved by the cities, counties, the State and by FEMA in 2003. All of the demographic data, maps, vulnerability assessments and mitigation strategies have been revised to reflect the constant growth throughout the five county area. Development pressures in hazard areas will continue to increase the risk to residents. The entire plan was reviewed and analyzed by the planning team throughout the planning process and again at the final draft stage before submittal to the state and FEMA.

Plan Organization

The Plan was developed and organized within the rules and regulations established under 44 Code of Federal Regulations (CFR), Section 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 ability of communities within the WFRC planning district to respond to emergencies and disasters. It will also document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Funding

The Plan has been funded and developed under the PDM Program provided by the Federal Emergency Management Agency (FEMA) and the Utah Department of Public Safety, Division of Homeland Security (DHLS).

Plan Participation

Plan participation was completed as a result of a collaborative effort between the WFRC, DHLS, city and county emergency managers, fire departments, sheriff's offices, public works departments, planning commissions, assessor's offices, city and county geographic information systems (GIS) departments, special service districts, school districts, 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 workshops were conducted during the Plan development phase. 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 Identification

It was suggested by the DHLS 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 DHLS that were added to the discussion.

Therefore, the hazard identification study recognized the following natural hazards as being the most prevalent and posing the most potential risk to the WFRC five county planning districts. It is recognized that dam failure is not a natural hazard. However, the impact from a catastrophic dam failure would likely be so severe that it warrants inclusion into the Plan.

- Earthquake
- Flood
- Drought
- Landslide
- Wildfire
- Dam Failure
- Severe Weather
- Insect Infestation

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 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
- Davis, Morgan, Salt Lake, Tooele, Weber Councils of Governments
- Associations of Governments
- Utah Association of Special Districts
- Utah Office of Education
- Davis County and municipalities including: Bountiful, Centerville, Clearfield, Clinton, Farmington, Fruit Heights, Kaysville, Layton, North Salt Lake, South Weber, Sunset, Syracuse, West Bountiful, West Point and Woods Cross
- Davis County elected officials and planning commission members
- Davis County emergency manager Sgt. Brent Peters and DeeEll Fifield, consultant

- Davis County agencies including; public works, GIS office, assessor's office, Local Emergency Planning Committee (LEPC), Sheriff's Office emergency services division, fire departments, school district, special service district
- Morgan County and Morgan City
- Morgan County emergency manager, Terry Turner
- Morgan County elected officials
- Morgan County agencies including; the planning commission, public works, assessor's office, school district, special service districts
- Morgan County residents and other interested members of the public
- Tooele County and municipalities including Grantsville , Ophir , Rush Valley, Stockton, Tooele City, Vernon, and Wendover, school district, special service districts
- Tooele County emergency manager Kari Sagers and PDM Planner Marianne Rutishauser
- Tooele County elected officials
- Tooele County agencies including engineering department, planning commission, assessor's office, the Utah State University Extension Office, and the Natural Resource Conservation Service
- Tooele County public and other interested members
- Salt Lake County and municipalities including Alta, Bluffdale, Draper, Herriman, Holladay, Cottonwood Heights, Midvale, Murray, Riverton, Salt Lake City, Sandy, South Jordan, South Salt Lake, Taylorsville, West Jordan, and West Valley City
- Salt Lake County emergency management to include Kate Smith, Matthew Hurtes and Matt Morrison
- Salt Lake County elected officials
- Salt Lake County agencies including public works, GIS departments, engineering departments, planning commission, assessor's office, Local Emergency Planning Committee (LEPC), emergency services division, fire and sheriff's office, school districts, special service districts
- Salt Lake County public and interested members
- Weber County and municipalities including Farr West, Harrisville, Hooper, Huntsville, Marriott-Slaterville, North Ogden, Ogden, Plain City, Pleasant View, Riverdale, Roy, South Ogden, Uintah, Washington Terrace, and West Haven, school districts, special service districts
- 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
- Weber Basin Water Conservancy District
- Central Utah Water Conversancy District
- Valley Emergency Communications Center (VECC)

Part I. Introduction

The State of Utah is vulnerable to natural and technological (human-caused) hazards that threaten 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 keep the hazard away from people, property and structures; second, those that keep 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 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 facilities. These decisions can influence the degree of hazard vulnerability of a community. Once a capital facility is in place, 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 could restrict development in high vulnerability areas, and building codes, which could ensure that new buildings are built to withstand the damaging forces of hazards, are the most useful mitigation approaches a city can implement.

Often, hazard mitigation is a neglected aspect within emergency management. When local governments place a low priority on mitigation implementation activities relative to the perceived threat, some important mitigation measures may be neglected in favor of higher priority activities. 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 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 (1) identify threats to the community, (2) create mitigation strategies to address those threats, (3) develop long-term mitigation planning goals and objectives, and (4) to fulfill federal, state and local hazard mitigation planning obligations. Mitigation actions in particular would serve to minimize conditions that have an undesirable impact on our citizens, the economy, environment and the well being of the State of Utah. This

Plan is intended to enhance the awareness and to provide mitigation strategies for elected officials, agencies and the public of these hazards and their associated threat to life and property. The Plan also details what actions can be taken to help prevent or reduce hazard vulnerability to each jurisdiction.

B. Scope

The Wasatch Front Natural Hazards Pre-Disaster Mitigation (PDM) Plan was developed in accordance with the requirements of the FEMA Section 322 regulations, the Utah Division of Homeland Security (DHLS) 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 by providing comprehensive hazards identification, risk assessment, vulnerability analysis, mitigation strategy an implementation schedule. Regulations set forth by FEMA were followed during the development of this Plan. Future monitoring, evaluating, updating and implementation will occur following any natural disaster or every five years.

C. Authority

Federal

Public Law (PL) 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 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 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 actions to mitigate risks.

State

Some examples of legislation enhancing the ability of government and persons to mitigate, respond and recover from natural disasters include 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 11, and the Emergency Interim Succession Act, 63-5B.

Local

Local governments play an essential role in implementing effective mitigation. For the purposes of this Plan, local governments include not only cities and counties, but also special service districts with elected boards. 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 cities and counties making up the Wasatch Front Region, the local executives responsible for carrying out plans and policies are the county commissioners and city or town mayors and administrators. Local governments must be prepared to participate in the post-disaster hazard mitigation team process and pre-mitigation planning as outlined in this document in order to effectively protect their citizens.

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 include coordinating with local governments to develop a regional planning process that meets each planning component identified in the FEMA Region VIII Crosswalk document, Utah Division of Homeland Security (DHLS) planning expectation and local input. Another goal is to meet the need of reducing risk from natural and technological hazards in Utah through the implementation of and updating of regional plans.

Short Term Local Goals

The following general goals were used in the development of the PDM Plan. They are shown from highest to lowest priority.

1. Life safety protection.
2. Eliminate and/or reduce property damage.
3. Protect emergency response capabilities (critical infrastructure).
4. Protect/create communication and warning systems.
5. Protect emergency medical services and medical facilities.
6. Ensure mobile resource survivability.
7. Protect critical facilities.
8. Ensure government continuity.
9. Protect developed property, homes, businesses, industry, education opportunities and the cultural fabric of a community. Combine hazard loss reduction efforts with the environmental, social and economic needs of the community.
10. Protect natural resources and the environment.

11. Promote public awareness through education of community hazards and mitigation measures.
12. Preserve and/or restore natural features.

Long Term Local Goals

1. Eliminate or reduce long-term risk to human life and property.
2. Aid private and public sectors in understanding the risks they may be exposed to and identify mitigation strategies to reduce those risks.
3. Avoid risk of exposure to natural and technological hazards.
4. Minimize the impacts of risks that cannot be avoided.
5. Mitigate the impacts of damage as a result of identified hazards.
6. Accomplish mitigation strategies in such a way that negative environmental impacts are minimized.
7. Provide a basis for prioritizing and funding mitigation projects.
8. Establish a regional platform to enable the community to take advantage of shared goals and resources.

Objectives

The following objectives are meant to serve as a measure upon which individual hazard mitigation strategies can be evaluated. These objectives become especially important when two or more projects are competing for limited resources.

1. Identify persons, agencies or organizations responsible for implementation.
2. Project a time frame for implementation.
3. Explain how the project will be financed including the conditions for financing and implementation (as information is available).
4. Identify alternative measures, should financing not be available.
5. Be consistent with, support, and help implement the goals and objectives or hazard mitigation plans already in place.
6. Projects should significantly reduce potential damages to public and/or private property and/or reduce the cost of state and federal recovery for future disasters.
7. Projects should be practical, cost-effective and environmentally sound after consideration of the options.
8. Projects should address a repetitive problem, or one that has the potential to have a major impact on an area or population.
9. Projects should meet applicable permit requirements.
10. Discourage development in hazardous areas.
11. Projects should contribute to short and long term solutions.
12. Project benefits should outweigh the costs.
13. Projects should have manageable maintenance and modification costs.
14. Projects should accomplish multiple objectives when possible.
15. Projects should be implemented using existing resources, agencies and programs when possible.

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 must 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. Tables 2-1, 2-2, 2-3, 2-4 and 2-5 identify the communities that participated in the planning process and have adopted the Plan. A sample of the adoption resolution is given at the end of this section.

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Davis County		
Bountiful		
Centerville	Yes	12/2/08
Clearfield		
Clinton	Yes	12/23/08
Farmington		
Fruit Heights		
Kaysville		
Layton	Yes	12/18/08
North Salt Lake		
South Weber		
Sunset		
Syracuse		
West Bountiful		
West Point		
Woods Cross		

Table 2-1. Participating Communities, Davis County

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Morgan County	Yes	12/2/08
Morgan City	Yes	11/25/08

Table 2-2. Participating Communities, Morgan County

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Salt Lake County		
Alta		
Bluffdale	Yes	12/9/08
Cottonwood Heights		
Draper City	Yes	2/3/09
Herriman	Yes	12/4/08
Holladay	Yes	12/11/08
Midvale	Yes	12/16/08
Murray		
Riverton	Yes	11/18/08
Salt Lake City		
Sandy City	Yes	11/18/08
South Jordan		
South Salt Lake		
Taylorsville		
West Jordan		
West Valley	Yes	12/16/08

Table 2-3. Participating Communities, Salt Lake County

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Tooele County	Yes	12/2/08
Grantsville		
Ophir		
Rush Valley	Yes	1/28/09
Stockton		
Tooele City		
Vernon		
Wendover	Yes	12/17/08

Table 2-4. Participating Communities, Tooele County

Jurisdiction	Participated (Yes/No)	Resolution Adoption Date
Weber County		
Farr West		
Harrisville	Yes	11/25/08
Hooper		
Huntsville		
Marriott-Slaterville	Yes	11/20/08
North Ogden	Yes	11/25/08
Ogden		
Plain City		
Pleasant View		
Riverdale		
Roy		
South Ogden		
Uintah		
Washington Terrace	Yes	12/2/08
West Haven		

Table 2-5. Participating Communities, Weber County

Specialized Local District	Participated (Yes/No)	Resolution Adoption Date
Weber Basin Water Conservancy District		
Pineview Water		
Bona Vista Water		
Weber School District		
Ogden School District		
Northview Fire District		
Central Utah Water Conservancy District		
Granger-Hunter Improvement District	Yes	12/9/08
Salt Lake County Service Area #3	Yes	12/8/08
Davis School District		
Salt Lake School District		
Murray School District		
Jordan School District		
Granite School District		

Specialized Local District	Participated (Yes/No)	Resolution Adoption Date
Tooele School District		
Morgan School District	Yes	12/9/08
South Davis Fire District		
North Davis Fire District		
West Erda Improvement District	Yes	12/2/08
Valley Emergency Communications Center	Yes	12/15/08
Deseret Peak Special Service District	Yes	12/2/08
South Rim Special Service District	Yes	12/1/08
Lake Point Improvement District	Yes	12/4/08
Cottonwood Heights Parks & Rec. Service Area	Yes	12/18/08
Mountain Green Fire Protection District	Yes	12/1/08
Mountain Green Sewer Improvement District	Yes	11/13/08
Stansbury Park Improvement District	Yes	12/2/08
South Davis Recreation Board	Yes	12/15/08
Taylorsville-Bennion Improvement District	Yes	12/30/08
Clinton City Sanitary Sewer SSD	Yes	12/23/08
Midvalley Improvement District	Yes	1/14/09
Stansbury Service Agency	Yes	1/14/09
Unified Fire Authority	Yes	1/20/09

Specialized Local District	Participated (Yes/No)	Resolution Adoption Date

Table 2-6. Participating Specialized Local Districts

Sample Resolution

RESOLUTION NO.______________________

A RESOLUTION ADOPTING THE NATURAL HAZARD PRE-DISASTER MITIGATION PLAN AS REQUIRED BY THE FEDERAL DISASTER MITIGATION AND COST REDUCTION ACT OF 2000.

(Name of Jurisdiction) Johnson City____________________________
(Governing Body) City Council____________________________
(Address) 100 Main Street, Johnson City, UT 84001____________
____

WHEREAS, President William J. Clinton signed H.R. 707, the Disaster Mitigation and Cost Reduction Act of 2000, into law on October 30, 2000; and,

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; and,

WHEREAS, the *Natural Hazard Pre-Disaster Mitigation Plan* has been prepared in accordance with FEMA requirements at 44 C.F.R. 201.6; and,

WHEREAS, Johnson City is within the Wasatch Front Region and participated in the update of the multi-jurisdictional Plan, the *Natural Hazard Pre-Disaster Mitigation Plan*; and,

WHEREAS, Johnson City is a local unit of government that has afforded its citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and,

WHEREAS, Johnson City is concerned about mitigating potential losses and has determined that it would be in the best interest of the community to adopt the *Natural Hazard Pre-Disaster Mitigation Plan*;

NOW THEREFORE, BE IT RESOLVED by Johnson City Council that Johnson City adopts the *Natural Hazard Pre-Disaster Mitigation Plan* as this jurisdiction's Multi-Hazard Mitigation Plan.

ADOPTED this XX day of XX, 2008 at the meeting of the Johnson City Council.

Signed: Chief Elected Official____
City Council____
____
____
____

Part III. Planning Process

This updated Plan was prepared by Wasatch Front Regional Council (WFRC) staff members Desmond Heyliger IV, Suzie Swim, LaNiece Dustman and DeeEll Fifield and was supported by the local working group members 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's departments, planning departments, public works 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 Division of Homeland Security (DHLS).

The planning process included the following steps:

Step 1: Organize Resources

Utah DHLS contracted with Wasatch Front Regional Council (WFRC) to update the 2003 Wasatch Front Region's Pre-Disaster Mitigation Plan 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 committee was created to guide the Plan's overall revision process and content and is identified in Table 3-2. Local working groups were also established to ensure local input and are identified in Tables 3-3, 3-4 (page 25), 3-5 (page 26), 3-6, 3-7 (page 27).

Name	Organization
Desmond Heyliger IV	Wasatch Front Regional Council, Hazard Mitigation Planner
Suzie Swim	Wasatch Front Regional Council, Geographic Information Systems Technician
LaNiece Dustman	Wasatch Front Regional Council, Planner II
DeeEll Fifield	Wasatch Front Regional Council, Hazard Mitigation Planner

Table 3-1. Core Planning Team

Name	Organization
Brad Bartholomew	Utah Division of Homeland Security
Judy Watanabe	Utah Division of Homeland Security
Nancy Barr	Utah Division of Homeland Security
Laura Siebneck	Utah Division of Homeland Security
LaNiece Dustman	Wasatch Front Regional Council
Desmond Heyliger IV	Wasatch Front Regional Council
DeeEll Fifield	Davis County Sheriff's Office (Consultant)
Terry Turner	Morgan County Emergency Services
Kate Smith	Salt Lake County Emergency Management
Marianne Rutishauser	Tooele County Emergency Management
Lance Petersen	Weber County Emergency Services

Table 3-2. Technical Committee

Member Name	Organization Name
DeeEll Fifield	Davis County Sheriffs Office, Emergency Services (Consultant)
Sgt. Sue Campbell	Davis County Sheriffs Office, Emergency Services
Sgt. Brent Peters	Davis County Sheriffs Office, Emergency Services
Lt. Brad Wilcox	Davis County Sheriff's Office
Carol Lloyd	Davis County Sheriff's Office
Brian Wall	Davis County Sheriff's Office
Lt. Kenny Payne	Davis County Sheriff's Office
Kim Boyd	Centerville City
Mike Carlson	Centerville City
Tom Smith	Davis County Public Works
Scott Anderson	Woods Cross Public Works
Paul White	Farmington City
Mike Monson	Hill Air Force Base
Kimberly Giles	Utah Division of Homeland Security
Ty Bailey	Utah Division of Homeland Security
Bruce Perry	Citizen Corps
Jeff Bassett	South Davis Metro Fire
Chief Larry Gregory	Farmington City Fire
Chief Mike Adams	Layton City Fire
Jim Mason	Layton City Emergency Manager
Scott Messel	Kaysville City
Andy Thompson	Kaysville City
Barry Burton	Davis County Community & Economic Development
James Pehrson	Farmington City
Jared Hall	Farmington City Planning Department
Scott Paxman	Weber Basin Water Conservancy District

Table 3-3. Davis County Working Group

Member Name	Organization Name
Terry Turner	Morgan County Emergency Services
Sherrie Christensen	Morgan County Community Development
Dave Manning	Morgan County Community Development
Kent Smith	Morgan County Community Development
Greg McDonald	Utah Geological Survey
Scott Paxman	Weber Basin Water Conservancy District
Jason Allen	Morgan County Engineer

Table 3-4. Morgan County Working Group

Member Name	Organization Name
Kate Smith	Salt Lake County Emergency Management
Matthew Hurtes	Salt Lake County Emergency Management
Leon Berrett	Salt Lake County
Kevin Barjenbruch	National Weather Service
Marty Shaub	University of Utah
John Stillman	Herriman City
Tina Giles	Herriman City
Don Woodruff	Salt Lake County ARES
Anne Von Weller	Murray City Public Services
David Chisholm	Holladay City
Joan Welch	United Fire Authority
Wes Ing	Salt Lake County Public Utilities
Beth Todd	VECC
Dustin Lewis	South Jordan
David Neale	American Red Cross
John Morgan	Taylorsville
Carol Price	Utah State Courts
Gary Christenson	Utah Geological Survey
Lucas Shaw	Utah Geological Survey
Bob Jeppesen	Salt Lake County
BC Randy Willden	Murray City Fire
Mike Stever	Salt Lake City Emergency Management
Dustin Lewis	South Jordan
Kevin Fenn	Taylorsville-Bennion Improvement District
Diane Stillman	Cottonwood Heights
Carrie Hecht	Salt Lake County
Dawn Black	Salt Lake City Emergency Management
Brent Beardull	Salt Lake County
Dennis Pay	South Salt Lake City
Chris Dunn	Salt Lake County
Mike Whimpey	Central Utah Water Conservancy District

Table 3-5. Salt Lake County Working Group

Member Name	Organization Name
Marianne Rutishauser	Tooele County Emergency Management
Tony Crites	Tooele County Emergency Management
Steve Smith	Tooele County Emergency Management
Jim Lawrence	Tooele County Engineering
Kent Page	Tooele County Engineering
Rod Thompson	Tooele County Engineering
Barry Formo	Tooele County Building Department
Barry Solomon	Utah Geological Survey
Joel Kertanius	Grantsville City

Mike Monson	Hill Air Force Base

Table 3-6 Tooele County Working Group

Member Name	**Organization Name**
Lance Peterson	Weber County Sheriff's Office, Emergency Services
Tammy Folkman	Weber County Sheriff's Office
Eli Johnson	Weber County Sheriff's Office
Curtis Christensen	Weber County Engineering
Mike Monson	Hill Air Force Base
Nicholas Reed	Hill Air Force Base
Dan Funk	Harrisville City
Gene Binghan	Harrisville City
Marvin Zaugg	Pineview Water
Terel Grimley	Pineview Water
Mick Holmes	Central Weber Sewer
Paul Hodson	Bona Vista Water
Ger Seegmiller	Jones & Associates
Scott Paxman	Weber Basin Water Conservancy District
Paul Ellsworth	Pleasant View City
Fred Hellstrom	Pleasant View City
Steve Harris	Washington Terrace
Mike Davies	Weber State University
Kimberly Giles	Utah Division of Homeland Security
David Lucas	McKay-Dee Hospital
George Chino	Weber-Morgan Health Department
Bill Reyes	Weber-Morgan Health Department
Karlene Marshall	Ogden Regional Medical Center
Marshall Thompson	Standard Examiner
Chief Chuck Stokes	Weber Fire District

Table 3-7. Weber County Working Group

Step 2: Public Officials Outreach

To ensure the public and their officials were supportive of the Plan, a WFRC representative attended County Councils of Governments meetings. These public meetings have representation from each chief elected official in each county. Additionally, some communities recommended meeting with their city council to better inform the community.

Step 3: Establish Continuity in the Planning Process

To meet the requirements set forth by DMA 2000, the WFRC was contracted by DHLS to assist the cities, counties, and special service districts within the Wasatch Front Region in updating the multi-jurisdictional PDM Plan.

Step 4: Data Acquisition

Contact was made with the GIS technician and/or planning commission staff in cities and counties to assess available data at the local level. Agreements were made to allow for the exchange of data between the local jurisdictions and WFRC. Mapping 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 threaten the planning region. This information was gathered from local, state and federal agencies, organizations, newspapers 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. County-level mitigation planning meetings were held during this process and are explained in further detail in Table 3-8 (page 29). During these meetings, attendees had the opportunity to review hazard information and provide comment. 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 and natural resources of the planning region.

Step 6: County Vulnerability Assessment

This step was conducted through a review of local base maps, topographical maps, floodplain maps, United States Geological Survey (USGS) and Utah Geological Survey (UGS) maps, Automated Geographic Reference Center (AGRC) maps, FEMA hazard maps and climate maps from the National Climatic Data Center (NCDC). A detailed vulnerability assessment was completed with the use of GIS software for each county within the WFRC planning region. The FEMA modeling program Hazards United States – Multi-Hazards (HAZUS-MH) was used to determine vulnerability to earthquakes and floods. Loss estimation methodology was developed by the core planning team, with assistance from the technical team, to determine vulnerability from each identified hazard. Transportation Analysis Zone (TAZ) and Census 2000 data were used to estimate the number of residents and households that could be affected by the hazard. Utah State sales tax and Equifax Business data were used to find the total number of businesses and annual sales vulnerable to hazards. HAZUS-MH infrastructure data was used to analyze the amount of infrastructure vulnerable to hazards.

Step 7: Review Existing 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 leaders and members. This step identified what goals are already established and adopted for the planning area.

Step 8: Form Local Working Groups

Davis, Morgan, Tooele, Weber, and Salt Lake Counties each organized a working group. These working groups were comprised of individuals with an interest in hazards mitigation, as well as, technical experts from the government sector having mitigation expertise. These committees included city planners, city engineers, county and city GIS staff, floodplain managers, sheriff and fire staff, and city and county emergency managers. Each completed section of the updated Plan was reviewed and analyzed for accuracy by the working groups, individual county emergency mangers and WFRC staff. Every section of the Plan was updated and revised as part of the planning process.

Step 9: Risk Assessment Review

The working groups were tasked with reviewing county risk assessments for accuracy and completeness and with developing mitigation strategies for all natural hazards threatening their respective county. Changes or additions were conveyed to the Core Planning Team for revision.

Step 10: Mitigation Strategy Development

Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each participating county evaluated, identified and profiled the hazards, and vulnerability assessment completed by WFRC. Each Mitigation Strategy developed underwent a cost/benefit analysis to determine the best action to take given limited budgets allocated to hazard mitigation efforts at the local level.

Step 11: Prioritization of Identified Mitigation Strategies

DMA 2000 requires state, tribal, and local governments to show how mitigation actions were evaluated and prioritized. The prioritization process was completed by the core planning team, the technical team and the local planning teams over a series of planning meetings. Prioritization was accomplished using the STAPLEE method as explained in the FEMA How to Guide, Document 386-3. This process resulted in each Mitigation Strategy given a High, Medium or Low priority by the local planning teams.

Step 12: State Review

DHLS created a formal PDM Plan review committee to insure local plans met the requirements of DMA 2000. This committee reviewed the Plans from March 17 through May 1, 2008, and again from August 1 to August 31, 2008, subsequent to submission to FEMA for final review and acceptance.

Step 13: Adoption

The Plan went through a public adoption process from November to December 31, 2008, and was adopted by the cities and counties listed in Table 2-1 of Part II, Adoption Process and Documentation.

Year	Date	Activity	Purpose
2006	**January 1**	Scope of Work designates WFRC, Davis, Morgan, Salt Lake, Tooele and Weber Counties as sub-grantees of the state to revise the Wasatch Front PDM Plan	Continued the relationship with local council members and municipalities.
2007	**January-May**	Gather information	Data collection
	September 10	Meeting with DHLS to discuss the planning process	Identified planning team and available resources.
	February	HAZUS-MH training.	Taught basic functions of HAZUS-MH model.
	February 27	Kick-off meeting with emergency managers in the WFRC Region	Identified levels of involvement.
	March-April	Revision of Morgan County risk assessment	For review.
	March-April	HAZUS-MH modeling runs.	Modeled earthquake and flood hazards.
	April	Revision of Tooele County risk assessment	For review.
	April	Public meetings - handed out pamphlets and briefed council	Public involvement

Year	Date	Activity	Purpose
		members about PDM Plan at county councils of governments	
	April 10	Meeting with technical committee	Discussed timeline and planning process
	April 11	Working group meeting. Morgan County Risk Assessment Review	Reviewed risk assessment
	April 30	Working group meeting. Tooele County risk assessment review	Reviewed risk assessment
	May	Revision of Weber County risk assessment	For review
	May 8	Meeting with DHLS	Progress report
	May 24	Working group meeting. Weber County risk assessment review	Reviewed risk assessment
	May-June	Revision of Davis County risk assessment	For review
	June 12	Meeting with Technical Committee	Progress report
	June 28	Working group meeting. Davis County risk assessment review	Reviewed risk assessment
	July	Revision of Salt Lake County risk assessment	For review
	July 10	Meeting with DHLS	Progress report
	July 30	Working group meeting. Salt Lake County risk assessment review	Reviewed risk assessment
	August	Organized mitigation strategies review workshop	Organized event
	August 16	Meeting. with Regional Growth Committee	Briefed on Plan progress
	August 21	Meeting. mitigation strategies development workshop	Educated working group members on current hazards mitigation at the federal and state levels. Suggestions provided for mitigation efforts viable at the local level
	September 5	Working group meeting Morgan County mitigation strategies review	Reviewed mitigation strategies
	September 11	Meeting with DHLS.	Progress report
	September 18	Working group meeting. Weber County mitigation strategies review	Reviewed mitigation strategies
	October 1-3	Western States Seismic Policy Council Conference	Learned about current mitigation strategies for seismic hazards
	October 9	Meeting with DHLS.	Progress report
	October 11	Working group meeting. Tooele County mitigation strategies review	Reviewed mitigation strategies
	October 22	Meeting with Utah DHLS for review.	Track progress
	October 25	Working group meeting. Davis County mitigation strategies review	Reviewed mitigation strategies
	November 13	Meeting with DHLS	Progress report

Year	Date	Activity	Purpose
	November 20	Working group meeting. Salt Lake County mitigation strategies review	Reviewed mitigation strategies
	December 11	Meeting with DHLS	Progress report
	December	Revised mitigation strategies	For review
2008	**January**	HAZUS-MH modeling runs	Re-ran models to accommodate county requests and new data
	January-March	Revision of remaining Plan sections	For review
	March 17-April 4	Public comment period	Public involvement
	April 7	Submitted Plan to Utah DHLS for initial State review and FEMA conditional review	State and federal review
	April 7-August 31	Continued Plan revision	Final Plan proofreading, mitigation strategy updates. Addition of Special Service District data
	November-December	Local jurisdiction Plan adoption	
	December1	Submit Plan to Utah DHLS for final State review.	State review
	December15	Plan forwarded to FEMA for final approval	Federal review may take up to 45 days, begin work on Technical

Table 3-8 Planning Process Timeline

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.

The first draft of this Natural Hazard Mitigation Plan was placed on the Wasatch Front Regional Council (WFRC) website for a 30-day public comment and review period. There were no public comments received on that draft of the Plan. Members of the public and elected officials from each jurisdiction were notified of the public comments at county Council of Government meetings. Beginning in December, 2008, the final draft of the Plan was placed on the WFRC website for public comment and review. The final Plan draft was also presented to each of the Council of Governments public meetings which resulted in a number of newspaper articles on the PDM planning process. Each jurisdiction and special service district that approved the plan did so in a public meeting.

Information Sources

- Federal Emergency Management Agency (How-to Guides)

- National Weather Service (hazard profile)
- National Climate Data Center (drought, severe weather)
- 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, Annual Report 2006-2007 Forest Service
- Utah Department of Transportation (traffic data)
- Utah Automated Geographic Resource Center (GIS data)
- University of Utah Seismic Station (earthquake data)
- Utah State University (climate data)
- Councils or Government
- Association of Governments
- Utah Association of Special Districts
- State Office of Education
    - Davis County and municipalities (Emergency Operations Plan, histories, mitigation actions, public input, data: GIS, assessor, transportation, property and infrastructure)
    - Morgan County and municipalities (Emergency Operations Plans, histories, mitigation
- actions, public input, data: GIS, transportation, property and infrastructure)
- Tooele County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, data: GIS, transportation, property and infrastructure)
- Salt Lake County and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, data: GIS, assessor, transportation, property and infrastructure)
- Weber County and municipalities (Emergency Operations Plan, histories, mitigation actions, public input, data: GIS, assessor, transportation, property and infrastructure, parcel, 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
    - State of Utah Wildfire Plan 2007
    - State of Utah Drought Plan 2007

Part IV. 2003 Mitigation Goals and Objectives Review

The 2003 Wasatch Front Pre-Disaster Mitigation Plan required each county to develop a prioritized set of mitigation goals, objectives and actions for each identified hazard. Below is a review of each of the goals and actions and a status update.

Davis County

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. Five 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 hundreds of billions of dollars in damage to residential structures, industry, and of critical infrastructure, and likely 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: Provide earthquake public education
Status: Accomplished. The county distributes printed materials at preparedness fairs, civic and church group meetings

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.
Status: Not Accomplished. This action can only be accomplished should the Utah Geological Survey update the maps & data and there is no evidence that has occurred since 2003.

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 fire department buildings exist in Clinton, South Weber and Layton. Identify other at risk critical infrastructure facilities, including water distribution systems.

Goal #2: Protect emergency response capabilities and critical facilities.

Objective 2.1: Priority HIGH Provide fire department with buildings that meet current construction codes, ensuring response capability of fire apparatus and personnel after an earthquake. Identify and prioritize other critical lifeline infrastructure which are at risk, such as water collection, storage, treatment and distribution facilities.

Status: Ongoing. The Layton Fire Department received a PDM Grant in 2007 to seismically upgrade station #53. The South Davis Metro Fire Department has constructed a new fire station, #85, and currently constructing another station, #82, designed to current seismic standards. The former stations were not compliant. Budget limitations have delayed Clinton, and South Weber fire station updates. The Weber Basin Water Conservancy District (WBWCD) received a FEMA grant to prepare a District wide multi-hazard mitigation Plan which will address earthquake and other hazards.

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.
Status: Ongoing: The county Emergency Management Coordinator is also the County Fire Marshal and issues a yearly wildland fire safety media release. The LEPC works closely with all Public Safety throughout the county involving Wildland Fire Safety, preparedness and prevention regarding wildland fire responses that may occur.

Objective 1.2: Priority MEDIUM Provide wildfire training to city and county planning and zoning officials and staff.
Status: Ongoing. The local chapter of American Planning Association has provided this training.

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 Widen and stabilize the firebreak between Farmington Canyon and Bountiful. Widen and stabilize the firebreak north of Farmington Canyon to the Weber River.
Status: Ongoing. A new firebreak road was completed from Farmington Canyon to Centerville. Centerville plans to continue the firebreak southward through the city. Continuation south through Bountiful isn't planned at this time. Continuation of the firebreak north from Farmington Canyon is planned as funding becomes available. The WBWCD mitigation Plan will address water delivery reliability for fire fighting following a major regional earthquake.

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 WBWCD 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 public education and awareness programs.
Status: Ongoing.: Printed materials are distributed at community preparedness fairs, civic and church organization functions

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. Encourage city planners to update building codes. Update county flood maps to include contour lines.
Status: Ongoing. Building codes are updated regularly as mandated by the state. No known flooding mandates exist at the community level except for Layton City which has an Ordinances that prohibits construction in 100-year floodplains. FEMA flood maps and data were updated for all Davis County in 2006-2007. All of the maps have a 2 foot contour.

Objective 2.2: Priority MEDIUM Lessen the impacts of flood damage caused by water canal and pipeline failure through regular inspections.
Status: Ongoing. Continually occurring

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 Provide city-planning commissions with information concerning landslides and debris flows. Encourage cities to adopt a standard of requiring geo-technical studies in identified landslide and debris flow areas.
Status: Ongoing. This information is provided upon request. The Utah Geologic Survey (UGS)no longer reviews geology reports submitted to counties and cities when requested and must be privately contracted. The UGS also assists communities in writing geologic hazard ordinances.

Problem Identification: There are a number of canyons that do not currently have debris basins 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, WBWCD maintains the Davis Aqueduct which runs from the mouth of Weber Canyon south to Bountiful. Any event that caused a break in the line would result in significant flooding. This hazard will be quantified in the WBWCD multihazard mitigation Plan which will be developed in 2009-2010. The WBWCD has also identified landslide hazards along the Gateway Canal near the mouth of Weber Canyon. The canal supplies water to the Davis Aqueduct to the south as well as the Weber Aqueduct to the north.

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 through the construction of new debris basins and the retrofit of others.
Status: Ongoing. Davis County Public Works has installed closed circuit TV monitors on several debris basins. Centerville is planning to construct a debris basin on Centerville Creek as the budget allows.

Objective 2.2: Priority HIGH Mitigate the impact of flood damage caused by a catastrophic failure of the Weber Basin Aqueducts.
Status: Ongoing. The WBWCD has received a mitigation planning grant. Identification of methods to mitigate hazards posed by landsliding will be one aspect of this Plan. The District will identify feasible mitigation strategies for possible flooding due to aqueduct failures. The District is also developing a feasibility plan for mitigating landslide hazards along the Gateway Canal

Hazard: Severe Weather

Problem Identification: Most presidential disaster declarations are the result to severe weather. Davis County is prone to the effects of severe weather. These are usually thunderstorms and snowstorms. However, the county is also prone to extremely severe wind events referred to as “East Winds.” Historically, Davis County has experienced wind gusts of over 110 mph and sustained winds of 80+ mph. These can result in millions of dollars in damage. On average Davis County experiences at least one severe wind event each 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 to protect themselves from the effects of severe weather.

Objective 1.1: Priority HIGH Coordinate with all cities in the county to gain participation in the National Weather Service Storm Ready program.
Status: Accomplished. Davis County will be presented the Storm Ready Certification in 2008.

Objective 1.2: Priority MEDIUM Encourage avalanche safety preparedness for county backcountry users.
Status: Ongoing. The County has worked closely with the US Forest Service to improve avalanche preparedness efforts for those that use Davis County's backcountry in the winter. County search and rescue is frequently called out to search for the lost individual. The county hopes to develop an introductory-level avalanche awareness training program.

Problem Identification: 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. Establish alert and notification procedures/system to notify emergency responders, flood control, and emergency managers.
Status: Ongoing. Davis County has acquired the CityWatch program, a reverse 911 system used emergency public notification. The county is planning to purchase NOAA weather radios for all Public Safety agencies. There has been no progress on hardening county communications capabilities.

Morgan County

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
Status: Ongoing, Morgan County Each Year cleans out debris and dead trees that have fallen into the stream channels as citizens make them aware of the problems.
Action #2: Work with Weber Basin to increase flood storage area
Status: Not accomplished
Action #3: Advise residents and develop outreach materials on the availability of flood insurance
Status: Ongoing: The County encourages at-risk residents to obtain flood insurance.

Goal #2: Reduce threat of unstable canals throughout the county.

Objective#2: Priority MEDIUM Identify countywide canal systems
Action: Map and assess for structural integrity canal systems in the County
Status: Ongoing: The Weber Basin Water Conservancy District owns the largest canal system in the county and it is constantly monitored by them. The County does not assess privately owned canals.

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: Reduce loss of life and damage to property

Objective: 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
Status: Not accomplished
Action #2: Facilitate a Pre-Earthquake damage assessment. To evaluate retro fix critical facilities
Status: Not accomplished
Action #3: Work with the county's businesses to ensure proper earthquake preparedness training
Status: Not accomplished

Hazard: Dam Failure

Problem Identification: Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.
Goal: Reduce loss of life and limit damage to property.

Objective: 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
Status: Not accomplished
Action #2: Improve emergency notification systems/public awareness dam information
Status: Ongoing. The County has been working to obtain funding to develop a Reverse 911 system that could be used in time of emergency.
Action #3: Improve Inundation Maps
Status: Accomplished. The County has obtained flood inundation maps in digital format.

Hazard: Drought

Problem Identification: The residents' of Morgan County are unaware of the water conservation options that are available to them.

Goal: Decrease the impact of drought on the community.

Objective: Priority LOW Develop and promote water conservation measures.
Action #1: Promote water conservation utilizing Drought Contingency Plan
Status: Not accomplished.
Action #2: Promote the use of the secondary water system
Status: Not accomplished.

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: Assist residents protect themselves from the affects of severe weather.

Objective: Priority MEDIUM Lessen the impact of severe storms to resident's and businesses in Morgan County
Action #1: Increase residents' awareness of the need for food storage for use during severe storms.
Status: Ongoing. The County actively promotes Individual and Family Preparedness.
Action #2: Increase residents' awareness of where emergency shelters are located
Status: Not accomplished.
Action #3: Have all cities in the County participate in the FEMA Storm Ready program.
Status: Ongoing. The County has conducted a Storm Ready program evaluation to determine actions that need to be undertaken in order to obtain certification.
Action #4: Encourage avalanche preparedness for county backcountry users.
Status: Not accomplished

Hazard: Wildfire

Problem Identification: Continuing non-compliance with existing building codes and fire codes.

Goal #1: Building and Fire Code Compliance

Objective: Priority HIGH Increase compliance with existing building and fire codes.
Action #1: Develop and enforce current local, state and national codes.
Status: Ongoing. The County Building Code now requires sprinklers in all new construction including private dwellings.

Goal #2: Wildfire Community Education

Objective: 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.
Status: Ongoing. The County promotes the Fire Wise program.
Action #2: Provide wildfire training to city and county planning and zoning officials and staff.
Status: Accomplished. The County Fire Department worked with the Community Development Department to define the Wildland Interface Zones.

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: Avoid risk or exposure to landslides through informed planning and zoning decisions.

Objective #1: Priority LOW Educate planning commissions
Action: Provide City and County Planning Commissions with information concerning landslides.
Status: The County has identified landslide zones and requires geotechnical studies on identified threat areas prior to the issuance of building permits.

Objective #2: Priority MEDIUM Monitor historical landslide areas.
Action: Evaluate current landslide maps to verify accuracy.
Status: Accomplished. The maps have been revised and updated in most areas.

Salt Lake County

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 and Special Service District EOPs.
Status: Accomplished for the County EOP, ongoing for City EOP's, and partially accomplished for Special Service District EOP's. The Central Utah Water Conservancy District's Red Butte Dam failure EOP has and flood inundation map.

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.
Status: Not Accomplished

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).
Status: Not Accomplished

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
Status: Not Accomplished
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: 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.
Status: Not Accomplished

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.
Status: Ongoing. Valley Emergency Communications Center (VECC) has been working with cities in the county to update communications, focusing on specific systems, which has included some or all of the following capabilities:

- ***Radio system updated for 800 MHz, Ultra-High Frequency (UHF), Very High Frequency (VHF) and Amateur frequencies***
- ***Agency listing with gateway devices which enable disparate communications systems to link***
- ***VECC paging server capability to text message multiple units/personnel***
- ***Listing of Public Safety Satellite telephones in the County***
- ***VECC Dialogic Emergency Notification System, a reverse 911 system used to notify public or for notification of response agencies.***
- ***Promoting narrow banding compliance prior to 2013 deadline***
- ***Salt Lake City is seeking grant funding to build and deploy communications trailer***

Objective 1.2: Priority HIGH Ensure adequate coordination of disaster response and recovery activities.
Action: Assess EOC's (countywide)
Status: Ongoing. The County completed FEMA's Capability Gap Assessment in 2007.

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.
Status: Accomplished. The information was updated by the Utah Geological Survey and provided to the County by request. Portions are available in the Statewide Geographic Database rather than on County GIS. The Central Utah Water Conservancy District has developed GIS based maps of the Red Butte Dam area in northeastern Salt Lake County that identifies earthquake hazards from ground shaking (peak ground acceleration), fault rupture, liquefaction, and landslides for both the 500 year and 2,500 year seismic events.

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.
Status: Ongoing. County ordinances are available online and can be downloaded. However, the County website is not easily searchable to locate relevant ordinances and there needs to be a link established from the Emergency Management website to the County Clerk website.

Hazard: Flooding

Problem Identification: Although located in a semi-arid region, Salt Lake City is subject to cloudburst and snowmelt floods.

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).
Status: Ongoing. Holladay now participates in the NFIP, but Alta has not yet joined.

Objective 1.2: Priority MEDIUM Provide current FIRMs for emergency planners.
Action: Update & digitize floodplain maps
Status: Ongoing. Floodplain maps have been digitized but have not been completely updated.

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
Status: Not Accomplished

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
Status: Ongoing. Dams are mapped and assessed by State Division of Water Rights and this information is reported to the County Emergency Management.

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.

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.
Status: Not Accomplished.

Objective 1.2: Priority MEDIUM Monitor historical landslide areas.
Action: Evaluate current landslide maps to verify accuracy.
Status: Accomplished. The Utah Geologic Survey has completed this task and provided an update to the County.

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
Status: Accomplished. Countywide landslide susceptibility map may be found at: map annex www.unifiedfire.org/emplans.html

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.

Goal 1: Reduce the threat of life loss due to severe weather.

Objective 1.1: Priority LOW Become National Weather Service (NWS) "Storm Ready Community"
Action: Contact NWS/SLC Office and begin process of becoming a Storm Ready Community.
Status: Accomplished. County, Salt Lake City, and Sandy participate in the program. Other cities qualify as participating under the County.

Objective 1.2: Priority LOW Improve response times to severe weather alerts.
Action: Incorporate NWS on light boards on freeway system.
Status: Accomplished. The NWS and the Utah Department of Transportation cooperate to provide this information.

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.
Status: Not Accomplished
Action: Encourage avalanche preparedness for county backcountry users.
Status: Accomplished. The County participates with the Utah Avalanche Forecast Center to provide this information.

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.
Status: Ongoing. The County Emergency Operations Center (EOC) and VECC have been surge protected. County is unsure of the status of other critical facilities.

Hazard: Wildfire

Problem Identification: Utah's typical fire season is the dry period from May through October. Lightning causes the largest numbers of wildfires. 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.

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.

Status: Ongoing. This objective has been partially accomplished by the development and implementation of the Regional Wildfire Protection Plan which the County participated in.

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: Create defensible space
Status: Ongoing. The Regional Wildfire Protection Plan has been a catalyst for fuel clearing projects in Emigration Canyon, Rose Canyon and High Country Estates.

Tooele County

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.
Status: Not Accomplished. However the County encourages water conservation.
Action: Establish economic incentives for water conservation.
Status: Not Accomplished.

Objective 2: Priority MEDIUM Protect water aquifers
Action: Create and enforce zoning (land use) to protect primary recharge areas.
Status: Ongoing. The County has been conducting a groundwater study as part of a Tooele Valley Drought Management Plan.
Action: Watch countywide inventory data from public, private, and monitoring wells.
Status: Ongoing. Data is collected by the County Health Department and efforts are underway to provide for the sharing of the data.

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
Status: Ongoing. The Tooele County Fire Warden conducts fire hazard inspections.

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.
Status: Ongoing. County produces a yearly calendar with natural and technological hazard and risk information. Fire Wise workshops have not been conducted.
Action: Inform people seeking building permits and realtors showing homes in these areas of the risk.

Status: Not Accomplished.
Action: Determine the specific areas where the Wildfire Protection Standards are in effect and make it available to the public in a graphic form.
Status: Not Accomplished.

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
Status: Accomplished. The County had conducted annual Weather Spotter training since 2003.
Action: Increase Amateur Radio Operator Involvement in weather observations.
Status: Accomplished. County has worked with the NWS to provide precipitation gauges to amateur radio operators and weather spotters.
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.
Status: Ongoing. The County works with federal and state agencies as part of an insect and pest control program.

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
Status: Not Accomplished.

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.
Status: Not Accomplished.

Objective 2: Priority HIGH Take advantage of continuing education opportunities for planners and policy officials
Action: Attend ACT-21 classes
Status: Not Accomplished.
Action: Collect building data for input into computer earthquake models.
Status: Ongoing. The County has a GIS staff position to share earthquake and other hazard data received from the state with county agencies.

Weber County

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: Priority HIGH Reduce the impact of non-structural events following an earthquake.
Action 1: Develop and implement an emergency operations plan similar to Salt Lake City school districts.
Status: In Progress.
Action 2: Develop a training document for schoolteachers showing non-structural mitigation activities for classrooms.
Status: Not Accomplished.

Problem Identification: Critical facilities (to include, but not limited to public safety, utilities, wastewater, water/sewer, schools, hospitals, public works and other critical facilities), need to be made less vulnerable from the impacts of earthquakes to allow to a more timely and efficient response and recovery.

Objective: Priority HIGH Reduce the impact of non-structural events following an earthquake.
Action: Develop an earthquake vulnerability study for identified critical facilities.
Status: Ongoing. The Ogden School District has completed a structural and non-structural vulnerability survey. The school district is seismic retrofitting several school buildings and plans to retrofit Ogden High School to mitigate earthquake impacts. The Weber School District is planning to conduct a study in the future. There are no other known vulnerability studies completed in the county.

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: Priority HIGH Increased awareness of high liquefaction areas
Action: Include current liquefaction maps on the County website.
Status: Ongoing. The FEMA floodplain maps have been placed on the county website. The county is still planning to include the liquefaction data on the website.

Problem Identification: Development on identified fault traces increases the risk to life and property.

Objective: Priority HIGH Promote natural hazards ordinance limiting development in high-risk areas.
Action: Make available copy of county natural hazards ordinance for cities within the county.
Status: Not Accomplished.

Hazard: Flood

Problem Identification: Communities not involved in the NFIP.

Objective: Priority MEDIUM Make 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.
Status: Ongoing. The County has encouraged Washington Terrace, Huntsville and Marriott-Slaterville to participate in the NFIP. Washington Terrace has not been mapped and has no flood hazards. Marriott-Slaterville needs to be mapped. Huntsville has not joined either and may be out of the flood zone. The county will continue to work with the State DHLS.

Problem Identification: Stormwater issues continue to be a critical flood issue in the county.

Objective: Priority MEDIUM 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.
Status: Ongoing. The County "Regional Stormwater Management Plan" was completed and submitted to the state in 2003.

Problem Identification: Weber County has an extensive canal system and canal breach or overtopping has and will continue to create a significant flood threat. A portion of this canal system is owned by the United States Bureau of Reclamation and operated by the Weber Basin Water Conservancy District (WBWCD).

Objective: Priority LOW 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. As a part of the WBWCD hazard mitigation planning process, the seismic vulnerability of these canals, and the resulting possible flooding will be evaluated. The District is considering possible canal lining projects, primarily for water conservation purposes. However, these lining projects could also mitigate flood hazards due to canal failures as well. If these projects prove feasible, the District will seek PDM funds to augment District costs for implementation.
Status: Ongoing. Listed in Mitigation Plan.

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.

Objective: Priority MEDIUM Reduce impact to life and property from severe weather related incidents
Action: Establish and support countywide National Weather Service Storm Ready program.
Status: Accomplished. Weber County is completing Storm Ready certification in 2008. Funding was received to purchase 50 National Oceanographic and Atmospheric Administration (NOAA) weather radios that were installed in City Offices, police and fire stations.
Action 2: Identify areas of avalanche risk and develop and post signs for avalanche danger.
Status: Not Accomplished.

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.

Objective: Priority HIGH 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.
Status: Accomplished. The County has passed a Wildland Fire Ordinance in conjunction with the Weber Fire District.
Action 2: Have communities participate in the Fire Wise Community programs.
Status: Ongoing. Uintah and Nordic Valley Communities participate in this program. County continues to encourage other communities to participate.

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.

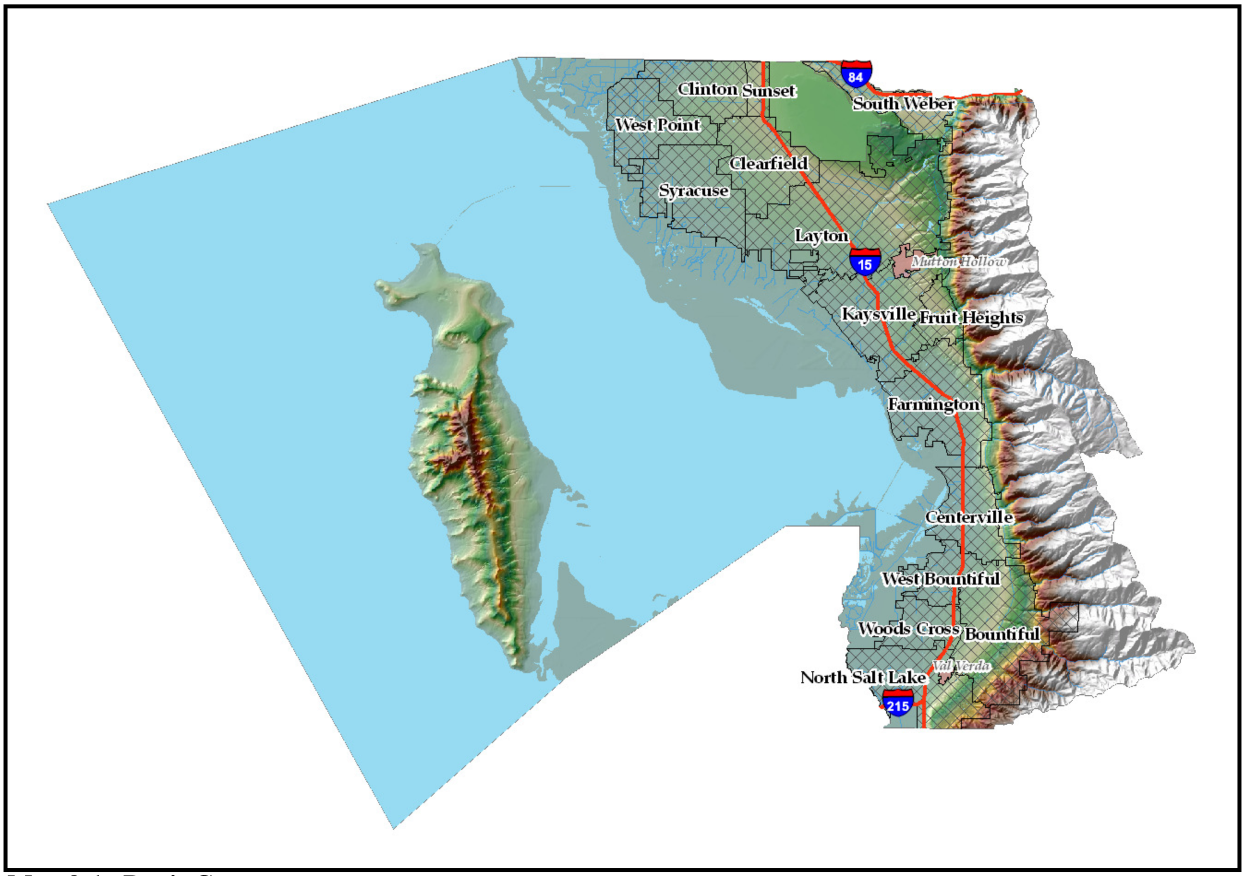
Objective: Priority MEDIUM Reduce the impact of catastrophic flooding due to dam failure
Action: Re-evaluate current high hazard dams and evaluate use of early warning sirens to warn public.
Status: Ongoing. The County is working with the Bureau of Reclamation to obtain accurate dam failure flood inundation maps.
Action 2: Identify and then fund dams needing armored concrete chutes.
Status: Not Accomplished.

Hazard: Landslide

Problem Identification: Weber County has significant areas of landslides.

Objective: Priority MEDIUM Re-evaluate current landslide map
Action: Update current landslide map and supporting data.
Status: Ongoing. Weber County Emergency Manger and state geologists toured the Ogden Valley (Huntsville and Eden). The county has a severe problem with the Norwood Tuff layer of soil on the south and west sides of the upper valley. Maps need to be updated with the state , posted on the county website and strict adherence to building codes in those hazard areas enforced.

Objective 2: Priority LOW Monitor landslide movement in areas that impact infrastructure and population.
Action: Evaluate landslide areas where parameters can be used.
Status: Accomplished. The County currently uses the state monitoring system.



Map 9-1. Davis County

Part IX. Davis County

With a total area of 630 square miles and only 223 square miles of usable land, Davis County is the second smallest county in Utah. Antelope Island in the Great Salt Lake 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 populous county in the state with a population density of roughly 933 people per square mile. Morgan County bounds the county to the east, Salt Lake County to the south, Tooele County to the west, and to the north, Weber County. The western half of Davis County consists of the Great Salt Lake, while the eastern edge of the County is the front of the Wasatch Mountains, much of that in the Wasatch National Forest.

Davis County includes 15 municipalities: ***Bountiful***, ***Centerville***, ***Clearfield***, ***Clinton***, ***Farmington***, ***Fruit Heights***, ***Kaysville***, ***Layton***, ***North Salt Lake***, ***South Weber***, ***Sunset***, ***Syracuse***, ***West Bountiful***, ***West Point***, and ***Woods Cross***. Unincorporated areas with significant populations are limited to ***Hill Air Force Base,*** the ***Val Verda*** area between the communities of North Salt Lake and Bountiful and the ***Mutton Hollow*** area between Kaysville and Layton. 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 the Great Salt Lake (also owned by the State).

Most of the early settlers in Davis County were ranchers and farmers. The fertile ground produced sugar beets, tomatoes, alfalfa, grain, corn, potatoes, onions and extensive fruit orchards were developed on the bench areas. Cattle ranching and dairy farming were also leading agricultural activities.

As the county population continued to grew, Davis County developed a commercial and industrial base. The military became an important part of the County economy with the development of the Naval Supply Depot and Hill Air Force Base. The Naval Supply Depot was sold to private developers in the 1960's and it became the Freeport Center, which is the largest distribution center in the United States. 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 current economy has many components including manufacturing, trade, services and government. Some of the largest employers include Hill Air Force Base, Davis County School District, Lifetime Products Inc., Smith's Marketplace, Utility Trailer Manufacturing and Wal-Mart (UDWS 2007b). Davis County's population is large and growing and the housing and community demands are high. 2005 total personal income was $7.7 billion up from $7.2 billion in 2004 (BEA 2007). 2005 per capita income was $28,776 (BEA 2007) and the average monthly nonfarm wage was $2,713 (UDWS 2006).

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 provide a starting point for predicting where future events could occur. The following historical hazard event statistics were consolidated from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) of the Hazards and Vulnerability Research Institute. This database records reported natural hazard events which cause greater than $50,000 in damages. Monetary figures are in 2005 dollars.

Risk Assessment

The risk assessment process revealed the following for Drought, Earthquake, Flood, Infestation, Landslide/Slope Failure, Severe Weather, and Wildland Fire. Drought, Infestation and Severe Weather are regional hazards and can be found in Part VII. Refer to Part VI for an explanation of the risk assessment methodology. According to this data, there are a total of 130 identified critical facilities within Davis County. For the complete list, refer to Appendix D.

Number of Structures with Moderate or Greater Vulnerability (% of Total)									
Critical Facilities	**Total**	***Dam Failure***	***Flood***	***Ground Shaking***	***Lique-faction***	***Problem Soils***	***Slope Failure***	***Wildfire***
Amateur Radio Repeaters	**12**	1 (8%)	2 (17%)	12 (100%)	5 (42%)	0 (0%)	1 (8%)	12 (100%)
Public Safety Repeaters	**9**	0 (0%)	0 (0%)	9 (100%)	1 (11%)	0 (0%)	1 (11%)	6 (67%)
Electric Generation Facilities	**1**	1 (100%)	0 (0%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Emergency Operations Centers	**1**	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Fire Stations	**16**	2 (13%)	1 (7%)	15 (100%)	9 (60%)	0 (0%)	0 (0%)	1 (6%)
Hospitals	**3**	0 (0%)	0 (0%)	2 (100%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)

Number of Structures with Moderate or Greater Vulnerability (% of Total)									
Critical Facilities	**Total**	***Dam Failure***	***Flood***	***Ground Shaking***	***Lique-faction***	***Problem Soils***	***Slope Failure***	***Wildfire***
Oil Facilities	**7**	1 (14%)	0 (0%)	7 (100%)	7 (100%)	0 (0%)	0 (0%)	0 (0%)
Police Stations	**14**	3 (21%)	2 (14%)	14 (100%)	12 (86%)	0 (0%)	0 (0%)	0 (0%)
Schools	**88**	14 (17%)	3 (3%)	88 (100%)	69 (78%)	0 (0%)	1 (1%)	0 (%)
Water Treatment Facilities	**3**	0 (0%)	1 (33%)	3 (100%)	3 (100%)	0 (0%)	0 (0%)	0 (0%)

Table 9-1. Davis County Critical Facility Hazard Risk Assessment

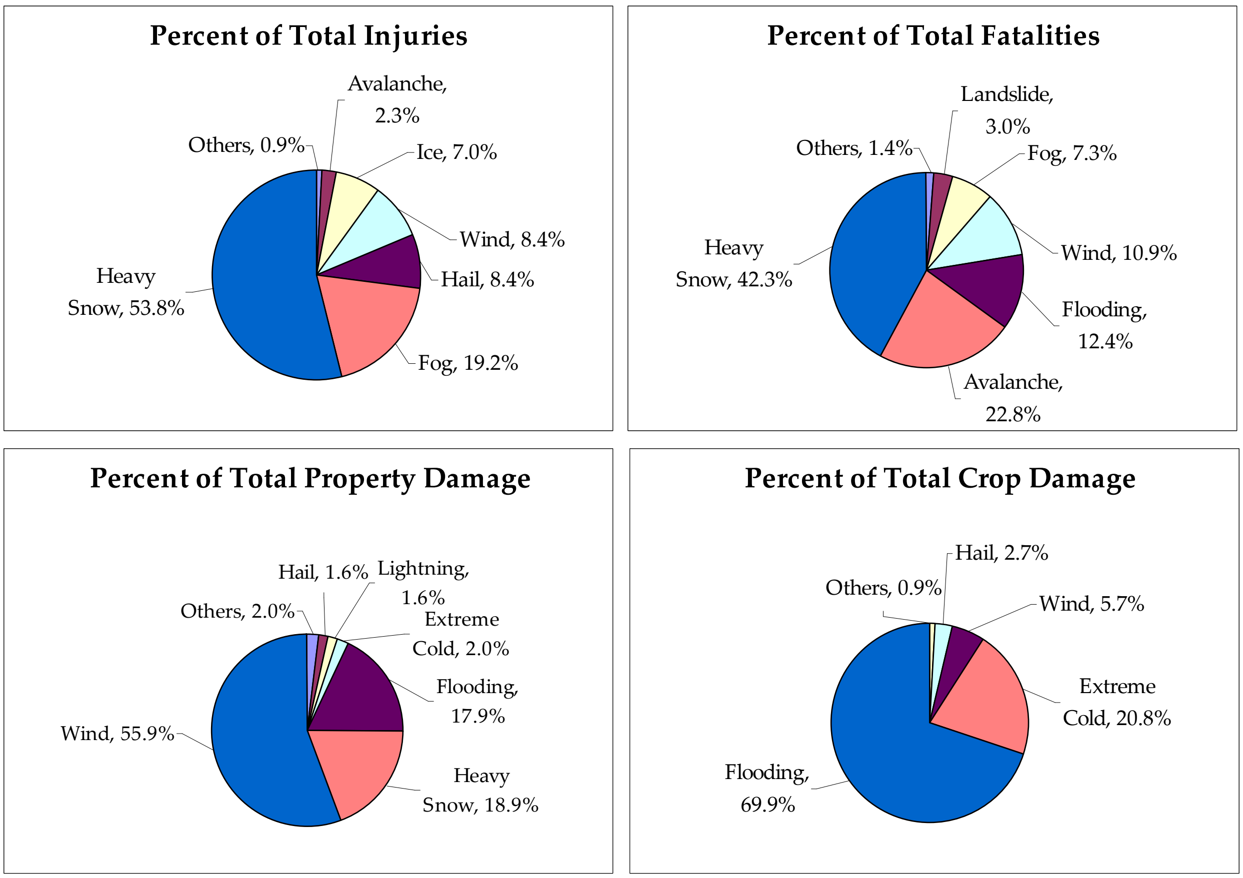


Figure 9-1. Major Disaster Event Averages 1962-2005, Davis County, Percentages (HVRI 2007)

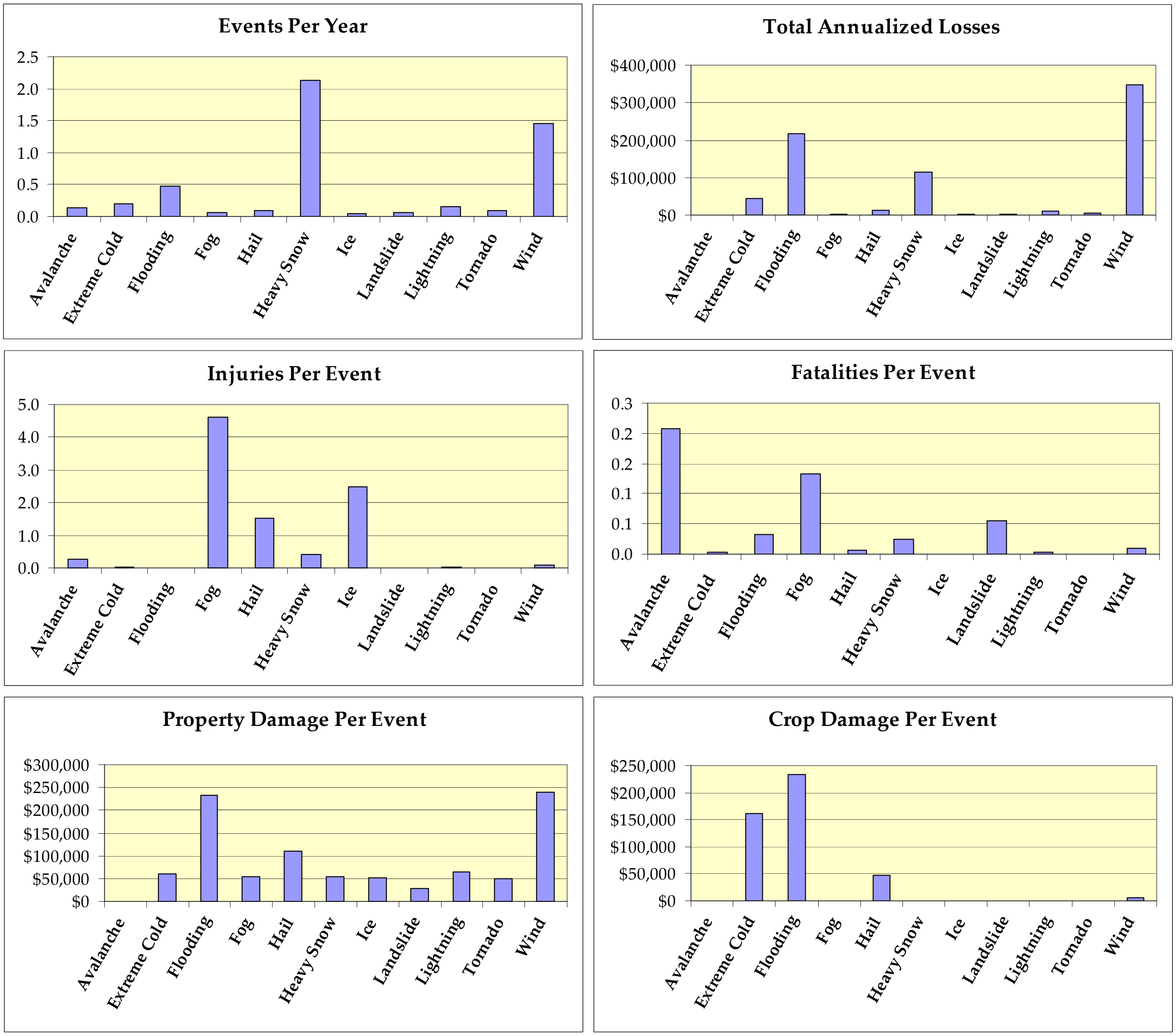


Figure 9-2. Major Disaster Annual and Per Event Averages 1962-2005, Davis County, Counts (HVRI 2007) **Does not include losses from wildfire*

1. Earthquake

Hazard Profile

Potential Magnitude			Probability		
	X	*Catastrophic (>50%)*			*Highly Likely*
		Critical (25-50%)		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*

Location	Eastern areas of Bountiful, Centerville, Farmington, Kaysville, Fruit Heights, and Layton along the western portion of the Intermountain Seismic Belt. Ground shaking will be felt throughout the entire County. Surface fault ruptures will be found along and near the current fault trace. Liquefaction can be expected in areas of deep sediment and shallow groundwater, from the foothills to the western portion of the county near the Great Salt Lake.
Seasonal Pattern	There is no seasonal pattern for earthquakes, they can occur at any time of the year or day during 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, and the Wasatch Fault Zone.
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.
Secondary Hazards	Fire, landslide, rock falls, avalanche, flooding
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DHLS, AGRC.

Description of Location and Extent

According to the Davis County Emergency Operations Plan, Davis County contains the highest density of faults in the entire state of Utah. These faults are primarily normal faults, meaning the two sides of the fault are moving away from one another. Davis County has experienced earthquakes in the past, but few damaging earthquakes have had their epicenters within the county boundary in recent history (Map 9-2, page 121).

In northern Utah, the Wasatch Fault Zone (WFZ) is an active fault zone that is capable of producing a large 7.0+ Richter magnitude earthquake on average every 300-400 years. There is a 25% probability of a damaging earthquake occurring along one of the WFZ segments in the next 100 years (McCalpin and Nishenko 1996 in UGS 2002). The average repeat time on any single segment ranges from about 1,200-2,600 years. The last major earthquake for each of the five central segments ranges from 250 to 2,900 years ago (Lund 2005). Davis County is situated between two segments of the Wasatch Fault, the Weber Segment and the Salt Lake Segment. The Weber Segment, running from North Salt Lake along the eastern edge of the valley to Willard Bay, represents the fault segment of greatest concern within the County. 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 and Salt Lake segments of the Wasatch Fault both have the potential for a magnitude 7.0 or greater earthquake which would cause much damage to the entire county.

The East Great Salt Lake fault is another active fault with two segments (Fremont Island and Antelope Island) in Davis County. Less is known about this fault due to its proximity to populated areas. Dinter and Pechmann (2005) conducted Carbon-14 dating of the two segments in 2004 and found the fault to be very active. For general information on all Quaternary faults in Davis County, see Table 9-2.

Name	Fault Type	Length (km)	Time of Most Recent Deformation	Recurrence Interval
Fremont Island section, EGSLFZ	Normal	30	3150 +235/-211 cal yr B.P.	4200 years
Antelope Island section, EGSLFZ	Normal	35	586 +201/-241 cal yr B.P.	4200 years
Salt Lake segment, WFZ	Normal	43	1300 ±650 cal yr B.P.	1300 years
Weber segment, WFZ	Normal	56	950 ±450 cal yr B.P.	1400 years

Table 9-2. Davis County Quaternary Faults (UGS 2002, Lund 2005) (EGSLFZ=East Great Salt Lake Fault Zone, WFZ=Wasatch Fault Zone, cal yr B.P.=calendar years before present)

Maps 9-3 and 9-4 (pages 122-123) represent groundshaking potential within Davis County for a 2500-year earthquake event. This represents an event with an approximate magnitude of 7.5 on the Richter scale. Spectral acceleration of 0.2 seconds represents the frequency of shaking which affects primarily one- to two-story buildings. Spectral acceleration of 1.0 seconds represents the frequency most likely to affect buildings three stories or higher. Values are represented as a percent of the force of gravity. Ten percent of gravity (0.1G) is the threshold at which poorly-built structures begin to suffer significant damage (FEMA 1995).

Liquefaction is one of the secondary hazards associated with an earthquake and affects almost the entire County. Davis County is located atop the ancient Lake Bonneville lakebed, which is made up of unconsolidated sandy soils. The area is also subject to shallow ground water and a high earthquake threat. For a further explanation of the liquefaction threat, see Map 9-5 (page 124). Refer to the "regional hazards identification" section for a narrative explanation.

Vulnerability Analysis

Vulnerability to earthquake in Davis County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH) **. The following numbers were based on a probabilistic 2500-year event with a Richter magnitude of 7.1 as well as an arbitrary 5.9 event located in close proximity to the county's most populated areas. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the <u>HAZUS-MH Technical Manual (Earthquake Model)</u> at www.fema.gov/hazus).*

Building Damage

HAZUS-MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 9-3 lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage during either an arbitrary Richter magnitude 5.9 (M5.9) or a probabilistic Richter magnitude 7.1 (M7.1) earthquake. Also listed are the estimated monetary losses to structures, contents/inventory and income.

Category	Number of Structures with >50% Damage		Category	Estimated Losses	
	Davis M5.9	2500-yr M7.1		Davis M5.9	2500-yr M7.1
Residential	7,618	41,310	Structural Losses	$96,362,000	$751,502,550
Commercial	282	954	Non-Structural Losses	$345,379,000	$2,646,616,900
Industrial	91	294	Content Losses	$131,812,000	$844,568,670
Government	15	49	Inventory Losses	$4,504,000	$38,314,060
Education	11	38	Income and Relocation Losses	$90,090,000	$3,983,479,080
Totals	**8,017**	**42,645**	Totals	**$668,147,000**	**$8,264,481,260**

Table 9-3. Building Damage Counts and Estimated Losses

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in Table 9-4. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage (>50%)		Estimated Losses	
		Davis M5.9	2500-yr M7.1	Davis M5.9	2500-yr M7.1
Waste Water Facilities	3	1	3	$21,559,000	$77,769,000
Waste Water Pipelines	1,242 km	203 leaks/breaks	4,455 leaks/breaks	$730,000	$16,039,000
Potable Water Pipelines	2,069 miles	256 leaks/breaks	5,633 leaks/breaks	$923,000	$20,279,000
Natural Gas Pipelines	828 km	216 leaks/breaks	4,775 leaks/breaks	$780,000	$17,145,000
Electrical Power Facilities	1	0	1	$11,375,000	$51,503,000
Communication Facilities	5	0	4	$46,000	$220,000
Highway Bridges	130	0	81	$3,359,000	$61,530,000
Railway Facilities	2	0	2	$712,000	$2,169,000
Airport Facilities	4	0	4	$2,569,000	$9,719,000
Total Losses				**$42,053,000**	**$256,373,000**

Table 9-4. Damage to Transportation and Utilities

Debris Removal

Table 9-5 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 at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres with a depth of three feet.

Category	Davis M5.9	2500-yr M7.1
Brick, Wood & Others	111,000 tons / 4,440 loads	758,000 tons / 30,320 loads
Concrete & Steel	197,000 tons / 7,880 loads	1,603,000 tons / 64,120 loads

Table 9-5. Debris Generated/Number of Loads

Fire Following

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 9-6 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Davis M5.9	2500-yr M7.1
Ignitions	11	12
Persons Exposed	261	447
Value Exposed	$13,663,000	$28,594,000

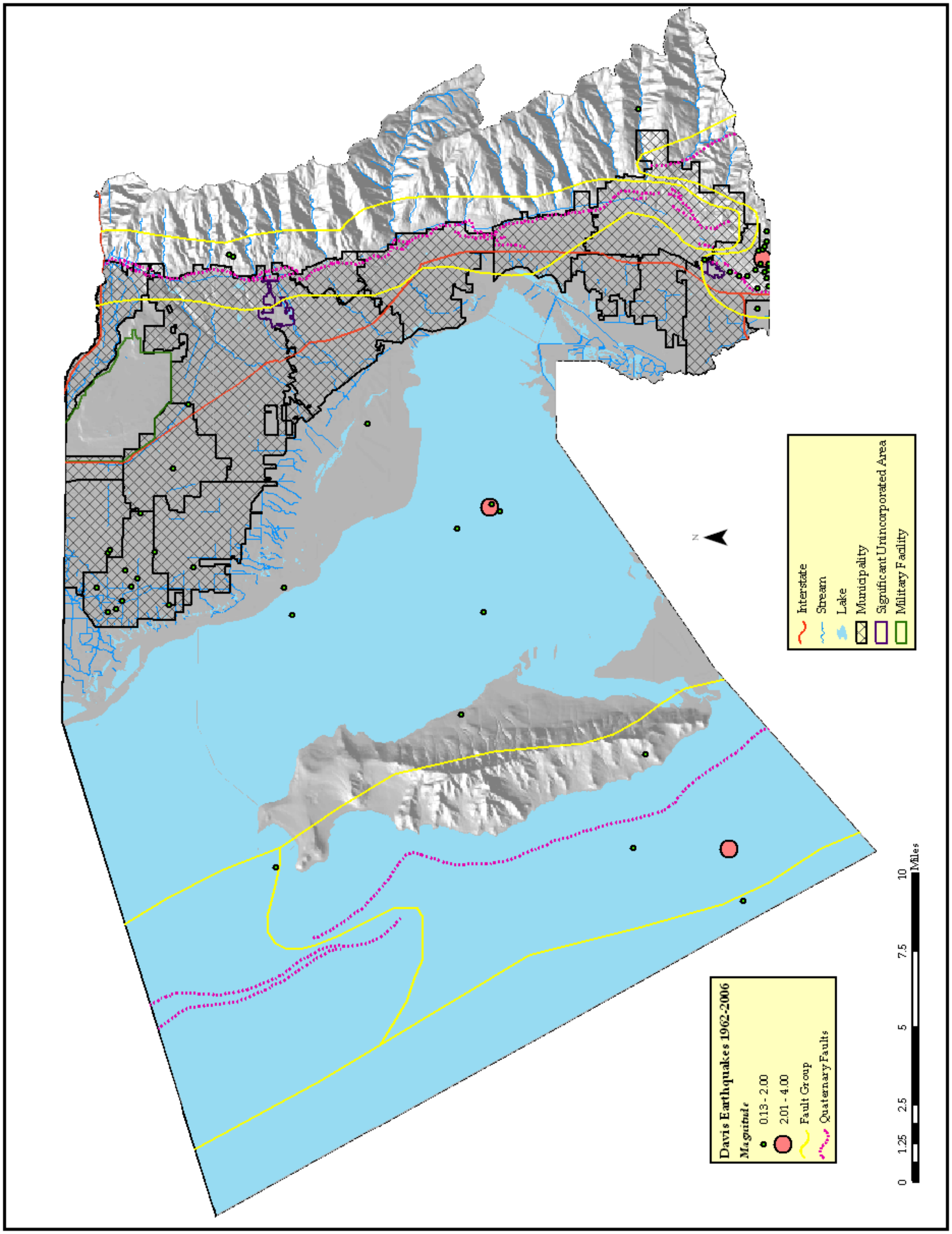
Table 9-6. Fire Following Event, Population Exposed, and Building Stock Exposed

Casualties

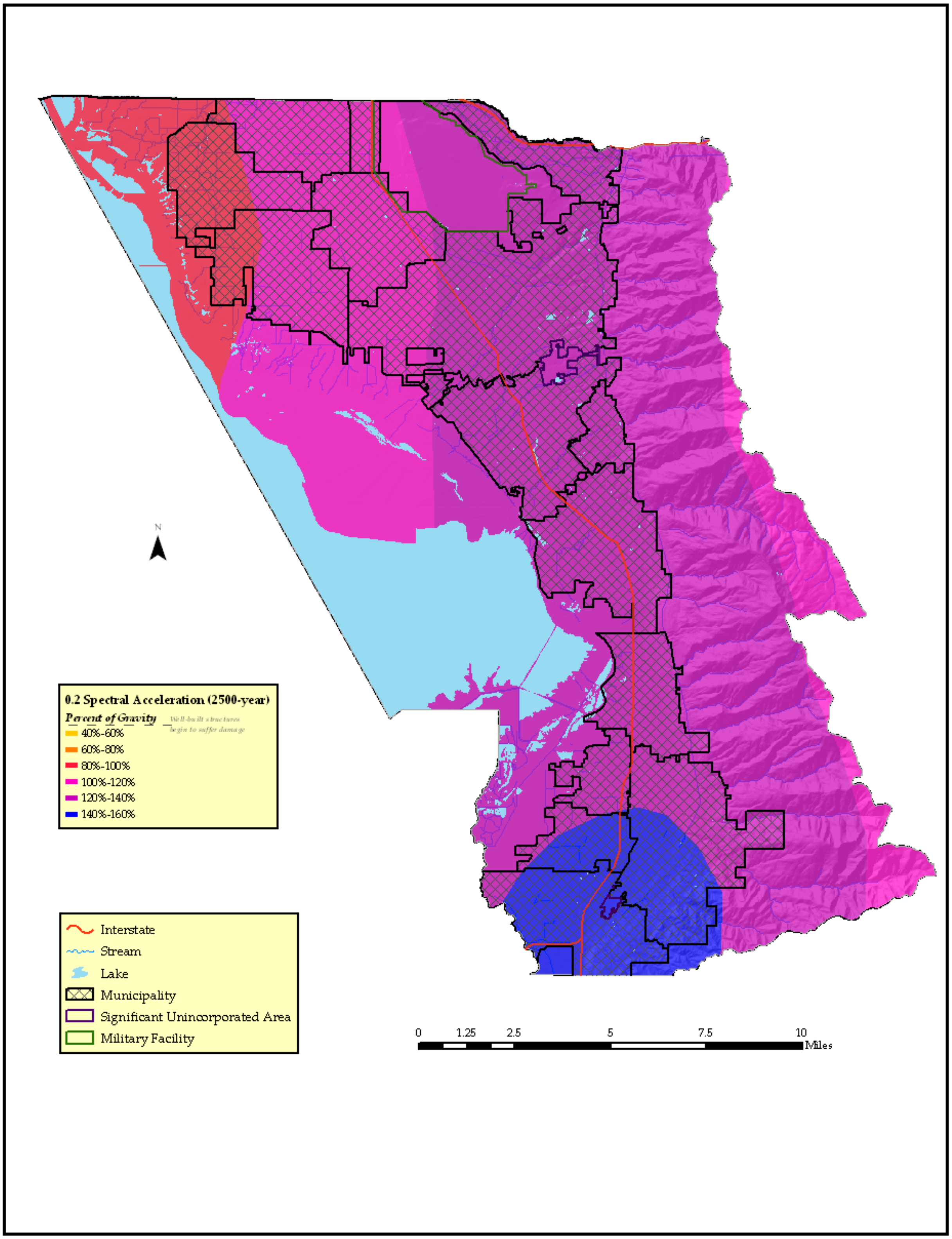
Table 9-7 estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons, the daytime scenario (2 p.m. local time) a commercial concentration, and the commute scenario (5 pm. local time) a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major), and fatalities.

Night Event	Davis M5.9	2500-yr M7.1	Day Event	Davis M5.9	2500-yr M7.1	Commute Event	Davis M5.9	2500-yr M7.1
Minor	223	2,589	*Minor*	250	3,039	*Minor*	227	2,700
Major	46	792	*Major*	62	1,086	*Major*	59	924
Fatalities	9	186	*Fatalities*	14	302	*Fatalities*	13	243

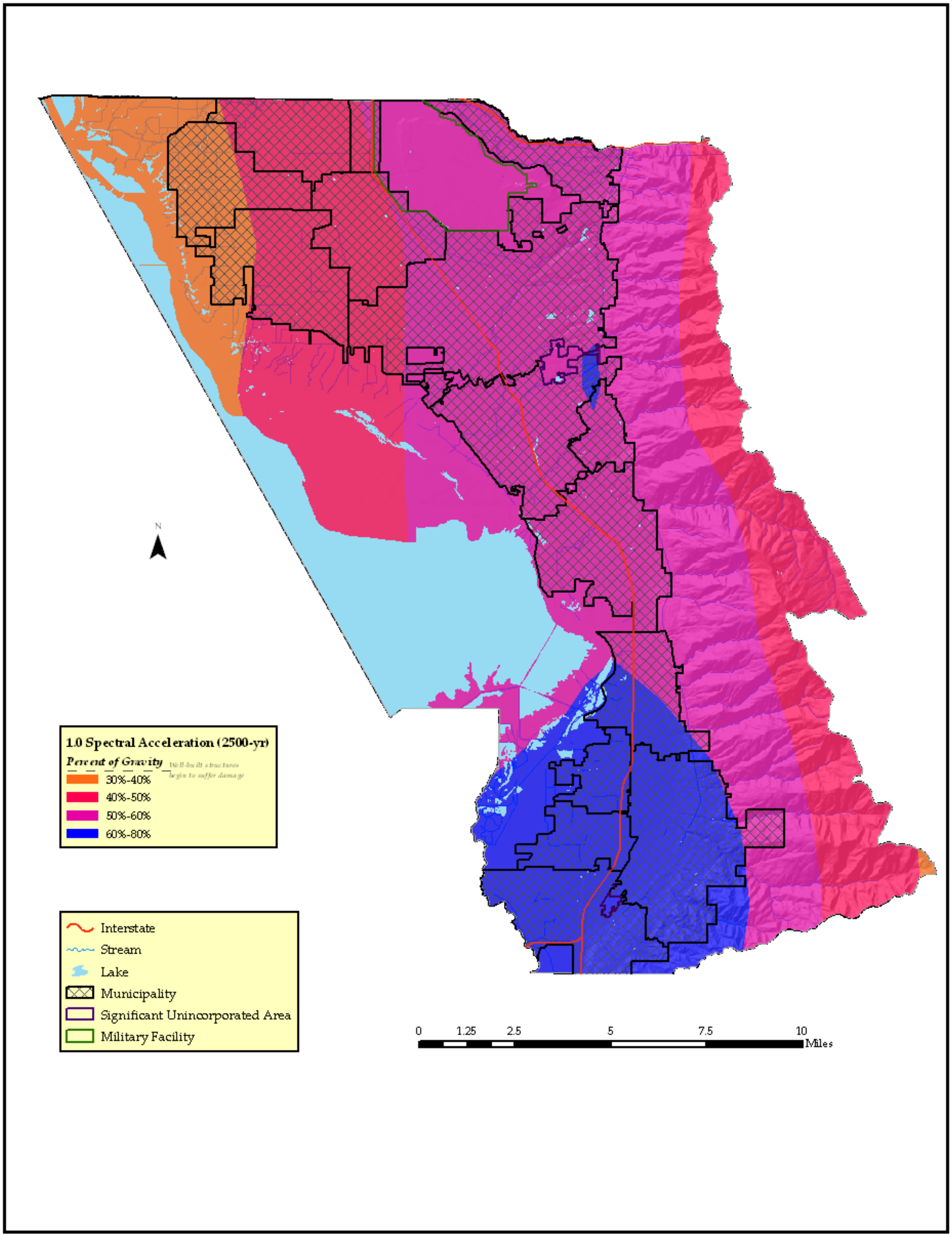
Table 9-7. Casualties



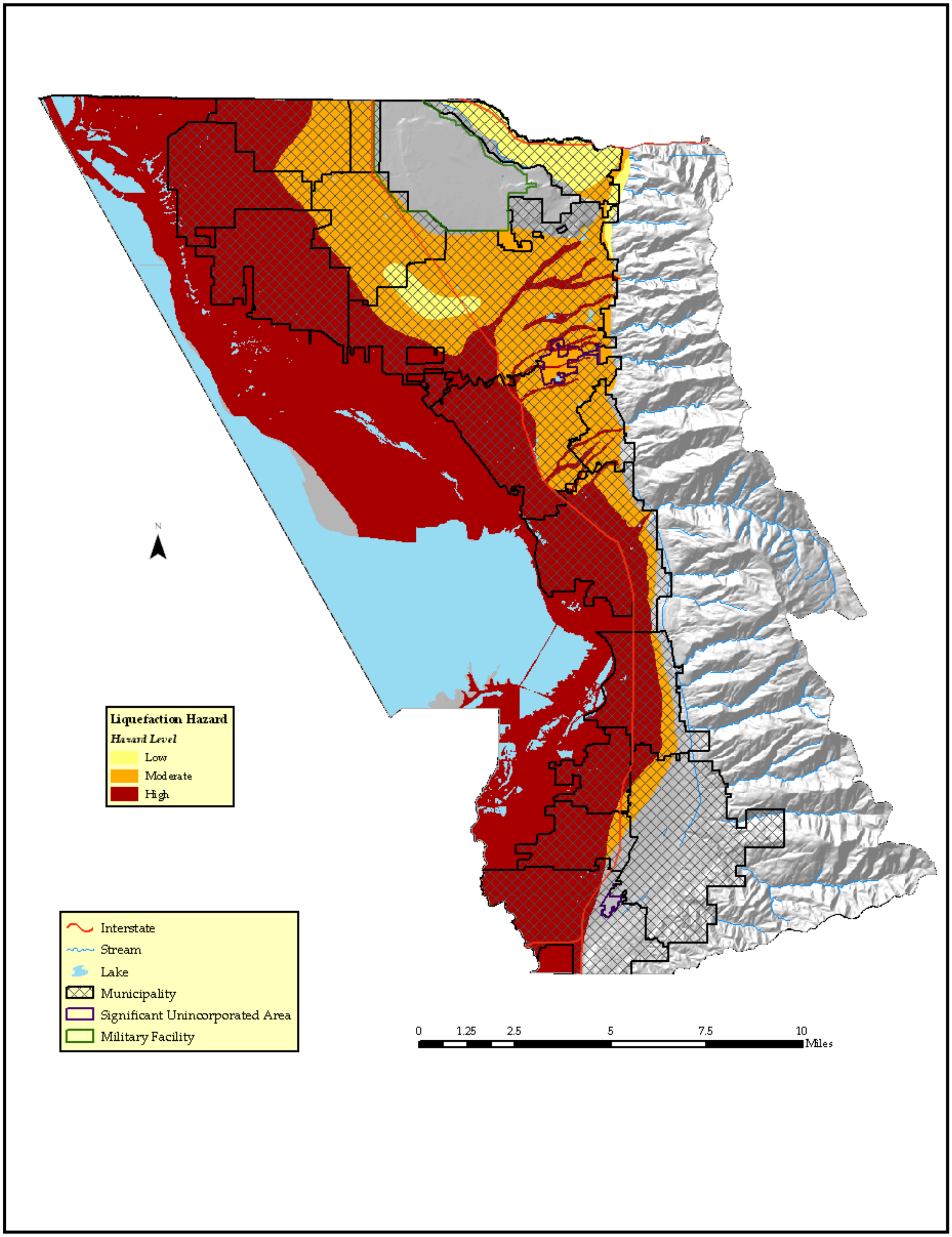
Map 9-2. Historical Davis County Earthquake Epicenters, 1962-2006 (Source: UUSS)



Map 9-3. 0.2-Second Spectral Acceleration, Davis County (NSHMP 2002)



Map 9-4. 1.0-Second Spectral Acceleration, Davis County (NSHMP 2002)



Map 9-5. Liquefaction Potential, Davis County (Christenson and Shaw 2008)

2. Flood

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*			*Likely*
		Limited (10-25%)		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Weber River; many creeks along Wasatch Front				
Frequency	Spring, late summer				
Conditions	Cloudburst storms and heavy snowfall runoff				
Duration	Flooding can last anywhere from hours to days and even months				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of FIS, FIRM, HAZUS-MH				

Description of Location and Extent

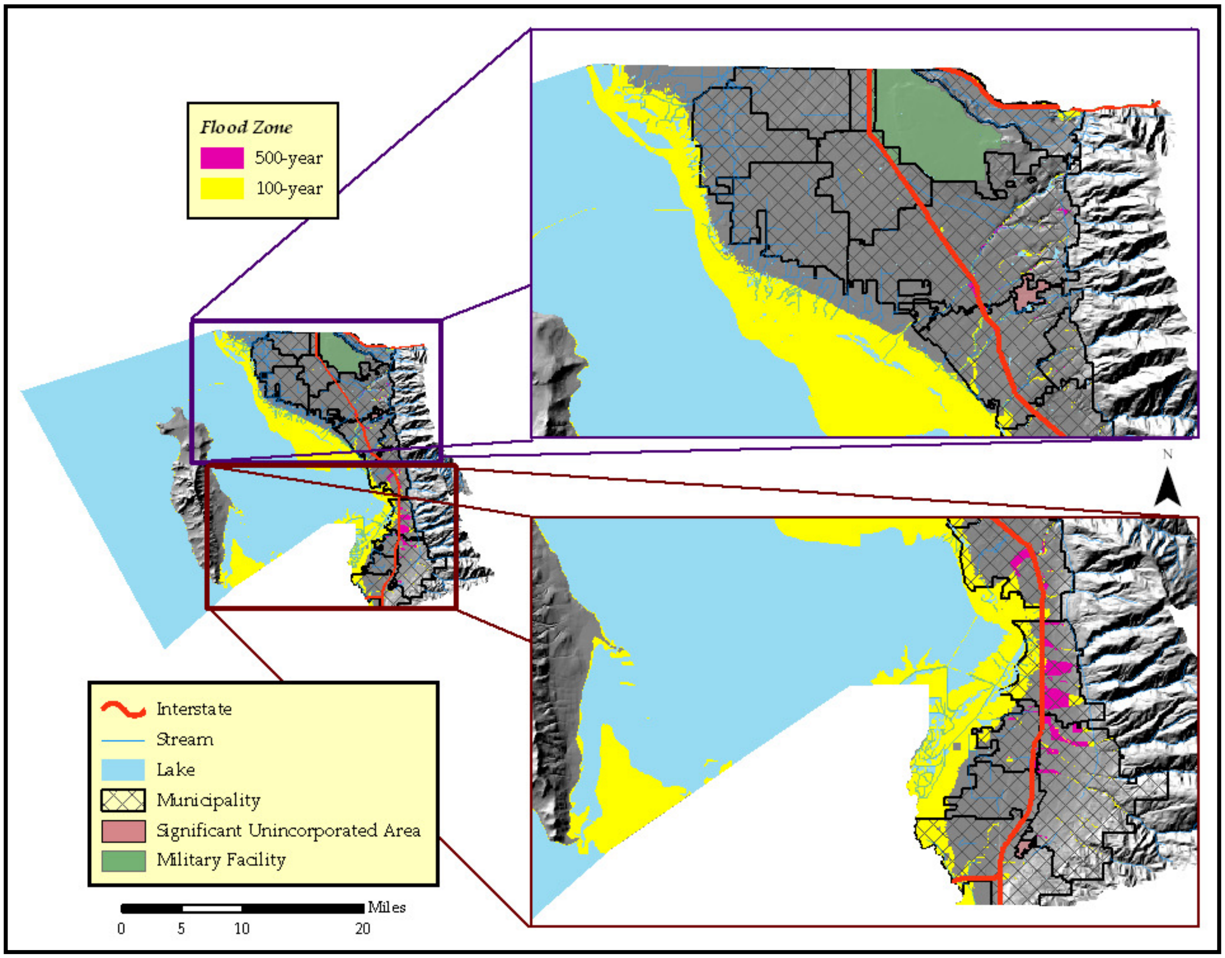
The greatest flood risk within Davis County has been associated with cloudburst storms that generally result in flash flooding in localized areas. Heavy rain and rapid snowpack melt can also result in unusually heavy water, and/or mud and debris flows. Davis County's precipitation is associated with 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 are the Weber River and Jordan River. The Weber River flowing through South Weber, acts as a partial northern county boundary. The Jordan River flows through uninhabited areas and into the Great Salt Lake on southern end of the county. Many smaller tributaries have flooded in the past and also pose a future flood threat. Many are 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 developed or are being developed, and therefore, residential and commercial flooding is probable. Flood can also pose a threat to the agricultural lands that are in 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, threatening shorelines and, in some cases, 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. Primary threatened utilities are power substations and water treatment plants located on Stone Creek, Farmington Creek, Holmes Creek and Millcreek.

In 1983, Rudd Creek experienced a debris flow that damaged several homes, roads and other infrastructure. Farmington Creek also flooded that year, damaging homes and also contaminating the city's water supply.



Map 9-6. 100-year and 500-year Flood Plains, Davis County (FIMA 2007)

Davis County Public Works has projected to spend over $50 million in flood control mitigation projects over the next few years. Much of that work will concentrate in existing creek beds throughout the County. The County spends over $1 million in yearly maintenance and new project costs.

Vulnerability Assessment

Assessing flood in Davis County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH), for both 100-year (NFIP Zone A) and 500-year (NFIP Zone B or Zone X (shaded)) flood events. Analysis was completed using Flood Insurance Rate Maps (FIRM) or Digital Flood Insurance Rate Maps (DFIRM). Only streams which contained detailed flood cross-section data could be evaluated. Flooding from the Great Salt Lake was not included. Consequently, the results should be considered conservative. Total monetary losses include structures, contents and business interruption. (*For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the <u>HAZUS-MH Technical Manual (Flood Model)</u> at www.fema.gov/hazus).*

Number of Structures in Flood Plains				
	Acres Flooded	Population Displaced	*Residential Units* Total Losses	*Commercial/Industrial Units* Total Losses
100-year Flood	683	2,311	*245* **$37,810,000**	*3* **$18,370,000**
500-year Flood	1155	2,492	*266* **$43,430,000**	*3* **$23,210,000**

Table 9-8. Davis County Flood Hazard

Agricultural Losses

Agricultural losses are listed in Table 9-9. Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15th.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$14,749	$19,665	$15,899	$21,198
Corn Silage	$151,723	$202,297	$163,549	$218,066

Table 9-9. Agricultural Losses, June 15th Scenario

Vehicle Losses

Table 9-10 contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$1,535,794	$1,603,936
Nighttime Scenario	$2,533,427	$2,751,553

Table 9-10. Vehicle Losses

Debris Removal

Table 9-11 shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	3,563 tons/143 loads	4,145 tons/166 loads
Structures	3,637 tons/146 loads	4,289 tons/ 172 loads
Foundations	3,771 tons/151 loads	4,461 tons/179 loads
Totals	**10,970 tons/440 loads**	**12,895 tons/517 loads**

Table 9-11. Debris Generation and Removal

3. Wildland Fire

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*	X	*Highly Likely*
	X	*Critical (25-50%)*			*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Wildland-Urban Interface (WUI) areas near the foothills and in forested areas				
Frequency	Summer months				
Conditions	Areas affected by drought and/or heavily overgrown dry brush and debris Common triggers: lightning and humans				
Duration	Days to months; depends on climate and fuel load as well as resources (financial, manpower) to extinguish the fire				
Secondary Hazards	Landslides, debris flows, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by US Forest Service, National Climatic Data Center, FEMA, AGRC, County Hazard Analysis Plans, and DHLS				

Description of Location and Extent

Potential wildfire hazard within Davis County is growing as population growth is spreading into wildland areas known as the Wildland-Urban Interface (WUI) where the threat is most severe. Over the past 30 years, urban sprawl has encroached upon forested foothill areas and wildland areas.

The wildfire threat in Davis County has had a significant affect on watersheds, including landslide, debris flow, and other forms of erosion. Federal, state and local agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect watersheds.

Wildland fire risk is found on Map 9-7, page 130. The map layers were provided by the Utah Division of Forestry, Fire and State Lands and show four categories of wildfire risk (Extreme, High, Medium and Low). These ratings cover all of Davis County and are based on the type and density of vegetation in each area as well as vulnerable populations. Additional factors that influence wildfires (weather conditions, wind speed and direction) are not considered in this risk assessment.

The entire County has a moderate or greater risk for wildfires. Municipalities primarily affected include the foothill communities of Bountiful, Centerville, Kaysville, Farmington, Fruit Heights, Layton, North Salt Lake, and South Weber. Antelope Island also has a considerable risk for experiencing a wildfire. Development has been advancing further and further into the WUI, with many of the most vulnerable homes some of the most costly to replace. Without effective fuel reduction measures and sufficient defensible space, these areas are likely to see considerable losses.

Vulnerability Assessment

Table 9-12 (below) estimates infrastructure vulnerable to wildland fire in Davis County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 9-13 (page 129) estimates the total area, population, and buildings vulnerable to wildland fire for individual cities and unincorporated areas.

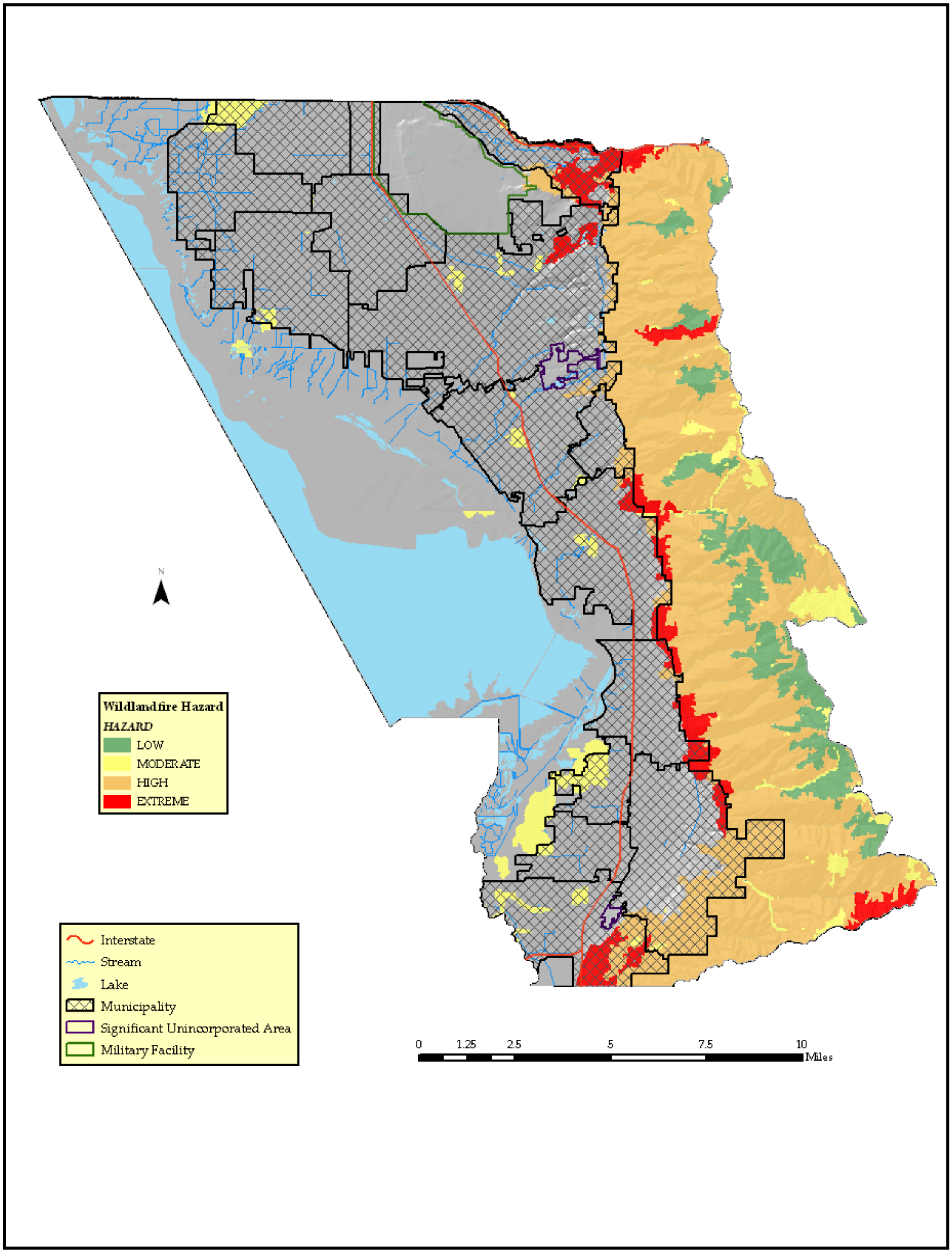
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	4.9 miles	$24,200,027
Highway Bridges	10 bridges	$15,469,072
Railway Segments	3.4 miles	$1,682,730
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$41,351,829**

Table 9-12. Infrastructure Vulnerable to Wildland Fire, Davis County

Incorporated Areas	City Area (Acres)	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Bountiful	8,450	3,146	*1,538* **$341,889,000**	*163* **$136,290,000**
Centerville	3,808	277	*87* **$18,206,298**	*8* **$4,400,000**
Clearfield	4,897	0	0	0
Clinton	3,809	0	0	0
Farmington	6,356	680	*297* **$45,245,145**	*3* **$250,000**
Fruit Heights	1,465	126	*34* **$9,055,820**	*4* **$18,000,000**
Kaysville	6,615	215	*72* **$11,938,498**	*1* **$150,000**
Layton	14,036	1,726	*366* **$64,019,439**	*60* **$86,680,000**
North Salt Lake	5,474	3,750	*1,364* **$273,551,328**	*44* **$23,160,000**
South Weber	3,091	80	*25* **$2,343,726**	*7* **$60,000,000**
Sunset	930	0	*0*	0
Syracuse	5,833	0	0	0
West Bountiful	1,908	0	0	0
West Point	4,455	0	0	0
Woods Cross	2,432	0	0	0

Unincorporated Areas	Area (Acres)	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Hill AFB	6,919	0	0	0
Mutton Hollow	911	345	*108* **$19,249,600**	*0* **0**
Val Verda	259	459	*136* **$18,640,300**	*0* **0**

Table 9-13. Vulnerability Assessment for Wildland Fire, Davis County *(2006 socioeconomic values)*



Map 9-7. Wildland Fire Risk, Davis County (UDFFSL 2007)

4. Slope Failure

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	See Map 9-8. Generally occur in canyon mouths and foothill areas.				
Frequency	Spring and Summer; after heavy or long-duration precipitation				
Conditions	Usually caused by the stress release of over-weighted soils, shallow groundwater in certain soils, or loosening of rock and debris.				
Duration	Hours to years				
Secondary Hazards	Flooding (natural dams), traffic accidents				
Analysis Used	Information and maps provided by UGS, DHLS				

Description of Location and Extent

Future landslide areas are usually located in the areas of historical landslides, which are well defined and localized. Landslides have been one of the most reoccurring hazards within Davis County along the canyon benches. The homes in these areas have the greatest vulnerability to rockfalls, debris flows, landslides and other types of slope failure. Map 9-8 (page 134) delineates areas of potential landslides for Davis County.

Recent landslides in Davis County include the Heather Drive landslide (2001) and the South Weber Drive landslides (2005 and 2006). Damages from the Heather Drive landslide have been estimated at over $1 million affecting homes and utilities (Elliot 2007). The South Weber Drive landslides each caused less than $50,000 in damages (HVRI 2007).

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 Barnard Creek, Barton Creek, Stone Creek, Parish Creek, Ricks Creek, Steed Creek, Farmington Creek, Shepherd Creek, Baer Canyon, and the South Fork of Holmes Creek with one debris basin each and Mill Creek which contains two debris basins. Unprotected canyons include Deuel Creek, Davis Creek, Snow Canyon, North, South, and Middle Forks of Kays Creeks.

Heather Drive Landslide, Layton (*Source: American*

Many homes are built on alluvial fans and additional detention basins and/or an upgrade of existing basins is needed.

Davis County and local jurisdictions recognize 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 landslides through projects in the Centerville Canyon alluvial fan and Barnard Creek alluvial fan.

Vulnerability Assessment

Table 9-14 estimates infrastructure vulnerable to landslides in Davis County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 8-15 estimates the total area, population, and buildings vulnerable to landslides for individual cities and unincorporated areas. Repair and/or replacement of the Davis Aqueduct and associated distribution network would increase the numbers below by an additional $100-200 million.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	1.39 miles	$9,581,012
Highway Bridges	11 bridges	$17,140,206
Railway Segments	.26 miles	$295,634
Railway Bridges	0 bridges	$0
Water Distribution Lines	235.50 miles	$7,579,602
Gas Lines	94.14 miles	$3,031,846
Sewer Lines	141.42 miles	$4,547,764
Total Estimated Infrastructure Replacement Cost		$42,176,064

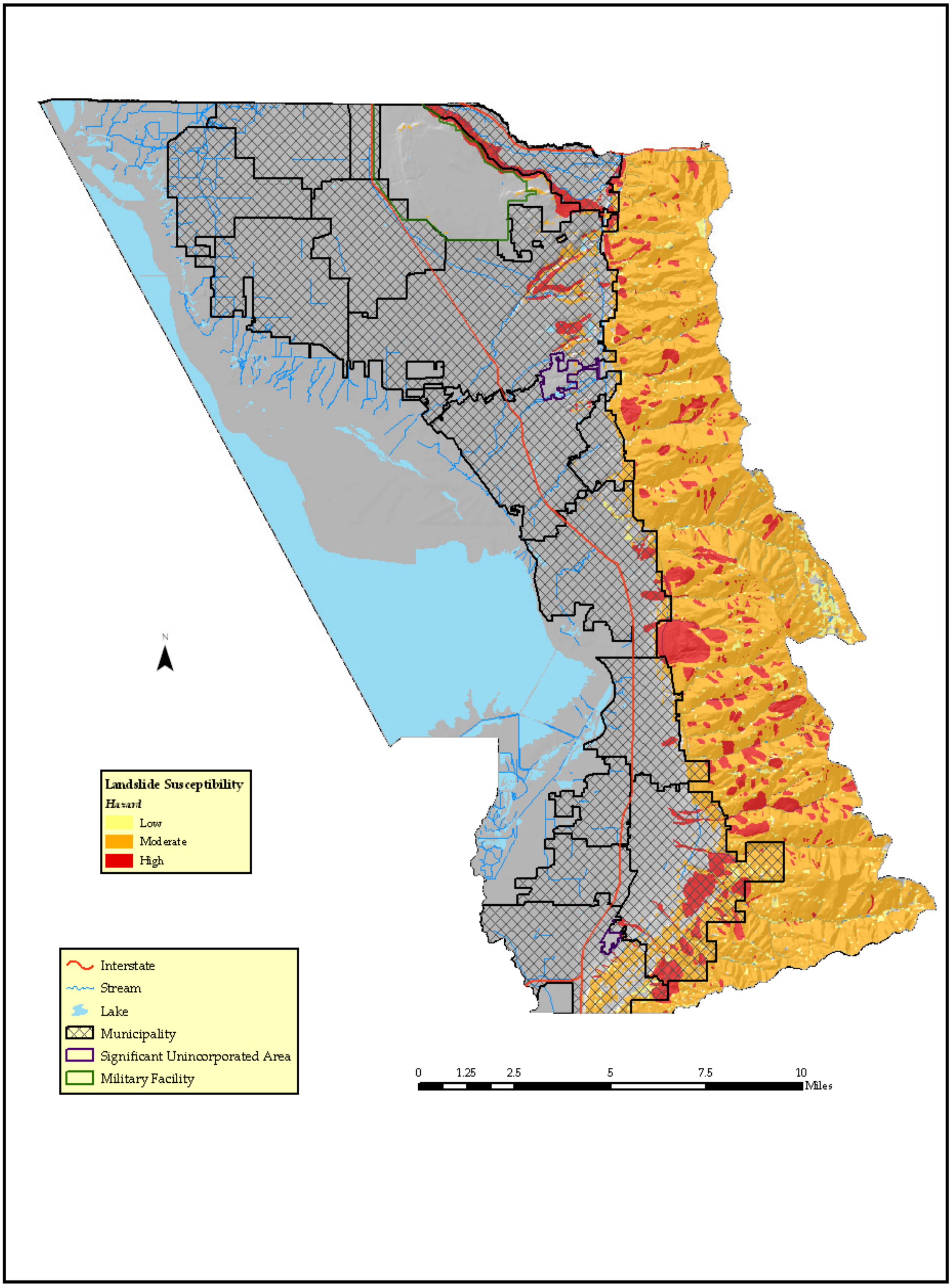
Table 9-14. Infrastructure Vulnerable to Landslides, Davis County

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Bountiful	2,477	15,575	4,678 **$906,128,600**	248 **$7,963,830**
Centerville	327	3,600	738 **$152,509,600**	18 **$2,641,732**
Clearfield	0	0	0	0
Clinton	0	0	0	0
Farmington	723	4,752	1,011 **$195,830,700**	16 **$2,104,783**
Fruit Heights	247	1,669	422 **$81,741,400**	1 **$12,489**
Kaysville	131	1,282	340 **$65,858,000**	2 **$124,523**
Layton	1,518	7,792	2,199 **$425,946,300**	38 **$26,739,586**
North Salt Lake	1,018	4,287	1,362 **$263,819,400**	31 **$5,163,445**
South Weber	808	2,418	674 **$130,553,800**	9 **$1,786,389**
Sunset	0	0	0	0
Syracuse	0	0	0	0

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
West Bountiful	0	0	0	0
West Point	0	0	0	0
Woods Cross	0	0	0	0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Hill AFB	115	0	0	0
Mutton Hollow	23	135	40 **$7,748,000**	0
Val Verda	2	34	12 **$2,324,400**	0

Table 9-15. Vulnerability Assessment for Landslides, Davis County *(2006 socioeconomic values)*



Map 9-8. Landslide Susceptibility, Davis County (Giraud and Shaw 2007)

5. Dam Failure

Hazard Profile

Potential Magnitude	X	*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)			*Likely*
		Limited (10-25%)		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	See Map 9-9 (page 137)				
Frequency	*Rainy Day Failure:* Spring, late summer *Sunny Day Failure:* Anytime				
Conditions	*Rainy-day failure* happens mainly during heavy precipitation events, can have some warning time. *Sunny day failure* happens with no warning at all usually from sudden structural failure.				
Duration	Hours to days				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of BOR inundation maps and plans, FIS, Utah Division of Water Rights				

Description of Location and Extent

Ninety dams and irrigation impoundments are located in Davis County. Twenty-six of these are listed as high hazard; meaning if they fail, they have a high probability of causing loss of life and extensive economic loss. Twenty-three dams have a moderate hazard threat; if they fail, they have a low probability of causing loss of life. Both threats would cause appreciable property damage. Mitigation efforts should be developed and pursued. Thirty-two 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. Damage would be limited to the owner of the dam. However, they should still be monitored. No hazard rating is provided for nine dams. These dams have yet to be inspected. Table 9-16 is a list of all high and moderate hazard dams in Davis County.

The dam safety hazard is classified by the State Engineer. This classification is based upon the damage caused if the dam were to fail. The classification of a high hazard dam does not mean that the dam has a high probability of failure.

Vulnerability Assessment

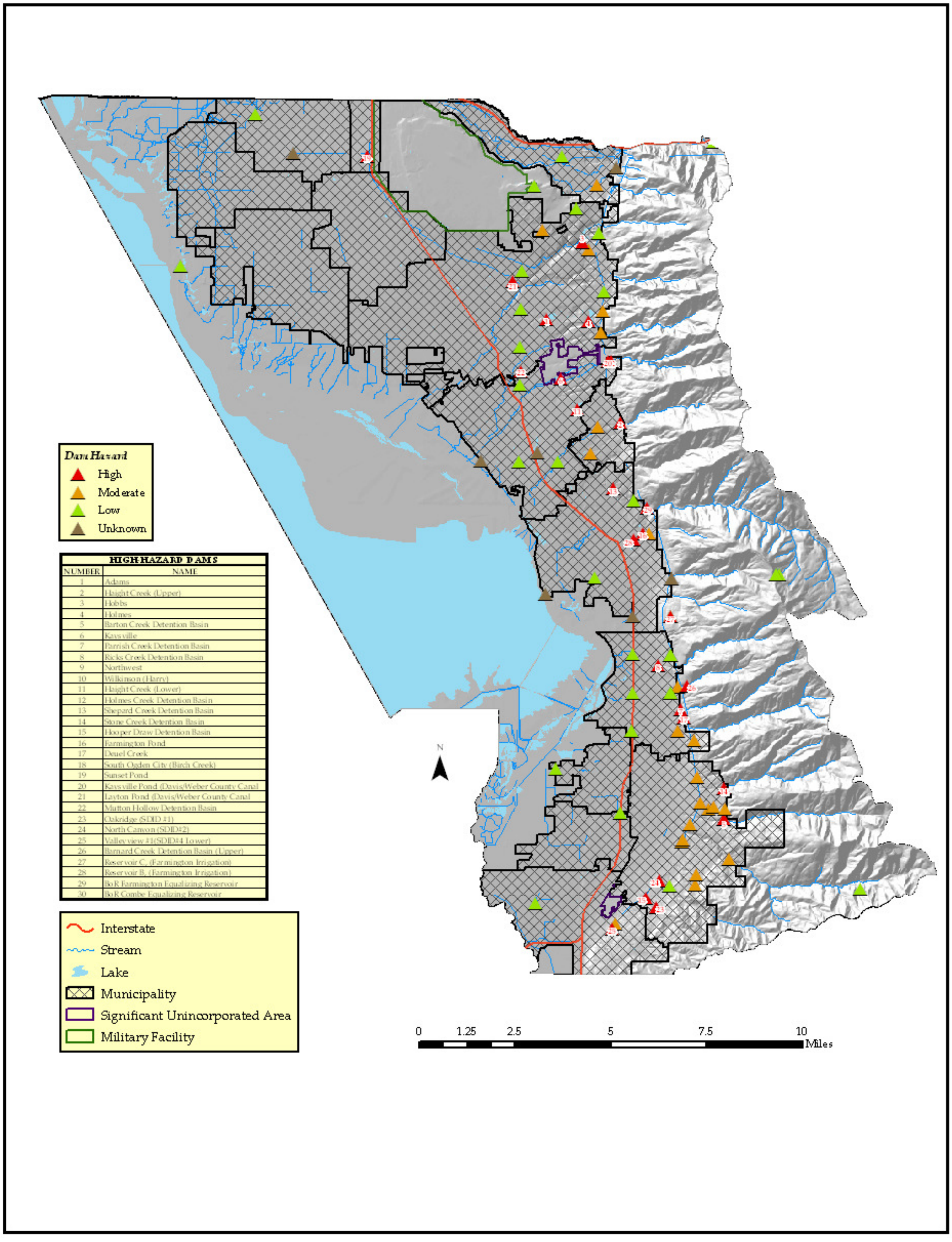
Table 9-17 estimates infrastructure vulnerable to dam failure in Davis County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 9-18 estimates the total area, population, and buildings vulnerable to dam failure for individual cities and unincorporated areas.

Name	Rating	Name	Rating
Adams	High	Valleyview #1(SDID#4 Lower)	High
BOR Farmington Equalizing Reservoir	High	BOR 1.9 Equalizing Reservoir	Moderate
Bountiful – North Canyon (SDID#2)	High	BOR 17.2 Equalizing Reservoir	Moderate
Bountiful – Oakridge (SDID #1)	High	BOR 17.8 Equalizing Reservoir	Moderate
Centerville – Barnard Creek (Lower) DB	High	BOR 18.0 Equalizing Reservoir	Moderate
Davis County – Barton Creek DB	High	BOR 18.0 Upper Equalizing Reservoir	Moderate
Davis County – Farmington Pond	High	BOR 18.5 Equalizing Reservoir	Moderate
Davis County – Holmes Creek DB	High	BOR 18.8 Equalizing Reservoir	Moderate
Davis County – Hooper Draw DB	High	BOR 18.9 Equalizing Reservoir	Moderate
Davis County – Mutton Hollow DB	High	BOR 19.5 Lower Equalizing Reservoir	Moderate
Davis County – Parrish Creek DB	High	BOR 19.5 Upper Equalizing Reservoir	Moderate
Davis County – Ricks Creek DB	High	BOR 2.6 Equalizing Reservoir	Moderate
Davis County – Shepherd Creek DB	High	BOR 4.3 Equalizing Reservoir	Moderate
Davis County – Stone Creek DB	High	BOR 5.0 Equalizing Reservoir	Moderate
Davis/Weber County Canal Co. – Kaysville	High	Bountiful City – Eagle Ridge	Moderate
Davis/Weber County Canal Co. – Layton Pond	High	Bountiful City – Millcreek DB #3	Moderate
Davis/Weber County Canal Co. – Sunset Pond	High	Centerville City Erosion Dike	Moderate
Deuel Creek (Former BOR Regulating)	High	Centerville City – Deuel Creek DB	Moderate
Benchland Irrigation – Reservoir B	High	Davis County – Barnard Creek (Lower) DB	Moderate
Benchland Irrigation – Reservoir C	High	Farmington City – Rudd Creek DB	Moderate
Haights Creek (Lower)	High	Fruit Heights – Dry Hollow DB	Moderate
Haights Creek (Upper)	High	Haights Creek (Middle)	Moderate
Hobbs	High	Lower (Dennis)	Moderate
Holmes	High	Valleyview #2(SDID#3 Upper)	Moderate
Kaysville	High		

Table 9-16 High and Moderate Hazard Dams, Davis County (Utah Division of Water Rights 2007)

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	12.85 miles	$105,801,968
Highway Bridges	38 bridges	$71,093,046
Railway Segments	14.57 miles	$16,733,995
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		$193,629,009

TabTable 9-17. Infrastructure Vulnerable to Dam Failure, Davis County



Map 9-9. Dam Failure Hazard, Davis County (Utah Division of Water Rights 2007)

6. Problem Soils

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
		Limited (10-25%)		***X***	***Possible***
	X	***Negligible (< 10%)***			***Unlikely***
Location	See Map 9-10 (page 139)				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to Years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Problem soils are soils that present problems for buildings and other engineered structures. Three types of problems soils are present in Davis County – oolitic sands, limestone and peat bogs. Oolitic sands are found on the northwest shore of Antelope Island. Limestone karst structures are found in the Mueller Park area in the far southeastern portion of the county. Finally, peat bogs are found along the shores of the Great Salt Lake in Farmington Bay. All of these areas are thinly populated and pose little danger. See Map 9-10 for more information on the locations of problem soils in Davis County.

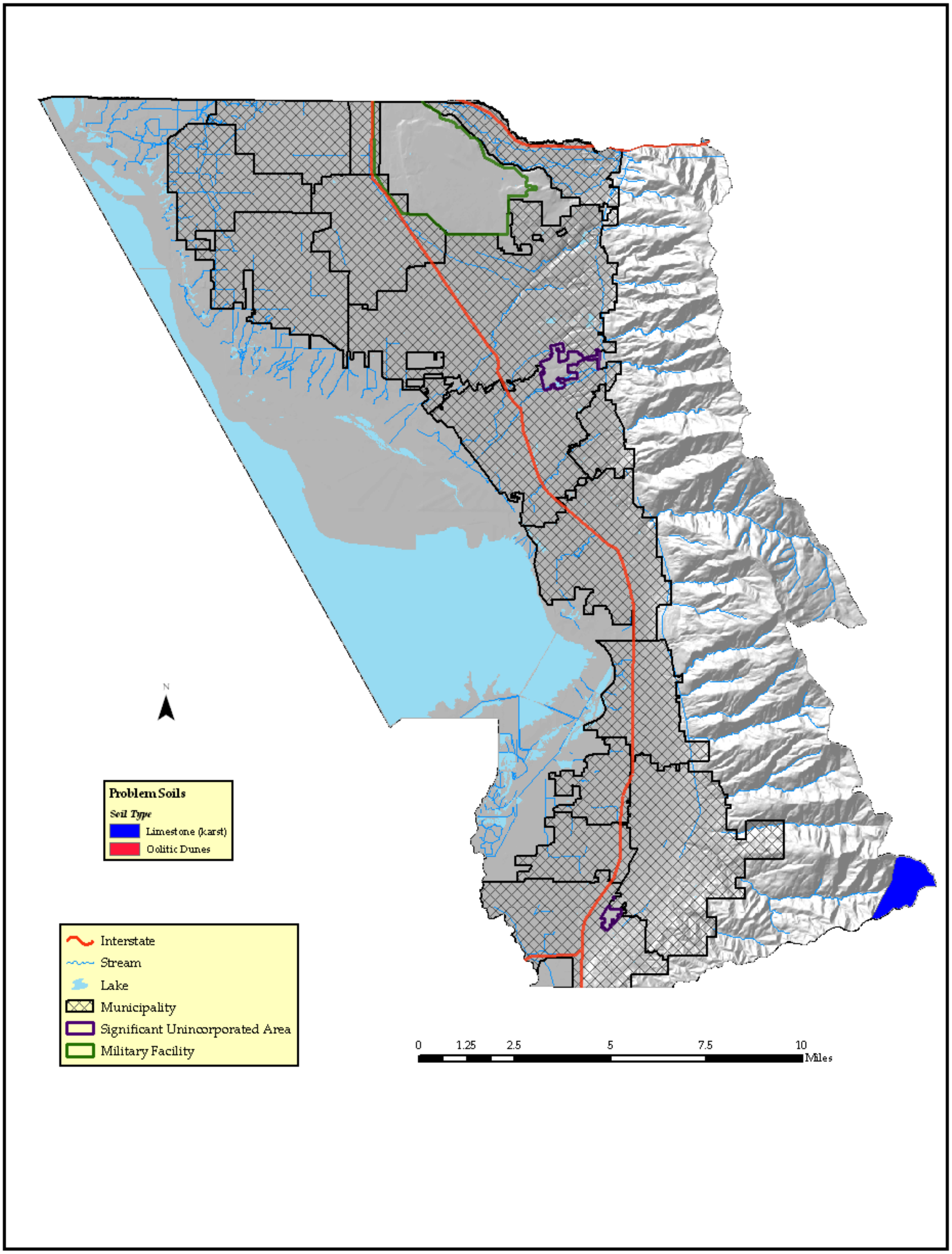
The oolitic sands on Antelope Island are on a public beach. Periods of flooding on the Great Salt Lake have eroded away much of the sands. The sands pose little threat to buildings, but can cover nearby roads at times.

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way casing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Fortunately, the karst structures in Davis County are located in remote areas.

Peat bogs are collections of dead and dying plants. Areas of this problem soil can experience subsidence and can be compressed easily (Mulvey 1992). Furthermore, these bogs can produce methane which is highly flammable.

Vulnerability Assessment

Problem soils were found not to affect any population or infrastructure in Davis County. Therefore, no significant vulnerability exists.



Map 9-10. Problem Soils Susceptibility, Davis County (Mulvey 1992)

Hazards and Future Development

Population Estimates									
County	**2000 Pop (July 1)**	**2006 Pop (est.)**	**Absolute Change 2000-2006**	**% Change 2000-2006**	**AARC 2000-2006**	**Rank by 2000 Pop**	**Rank by Absolute Change**	**Rank by % Change**	**Rank by AARC**
Davis County	240,204	282,217	16,634	23.2%	3.5%	3	3	8	8
Population by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	941,172	1,104,356	1,389,252	1,665,238	1,966,372	2,207,282	2,429,057	2,654,682	1.3%
Davis County	146,540	187,941	240,204	304,502	352,320	382,219	404,170	424,177	1.2%
Households by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	298,700	357,257	446,844	565,333	679,589	780,369	870,671	960,756	1.5%
Davis County	39,994	53,643	71,201	97.801	117,172	130,248	139,178	146,811	1.5%

Table 9-18. Demographic and Economic Projections (UPEC 2007, 2008) All statistics are based on July 1 snapshot. AARC = Average Annual Rate of Change

Davis County's population will continue to grow in the eastern and southern portions of the county where new development is occurring because housing and land values are slightly lower than nearby Salt Lake County (refer to Table 9-18). 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.

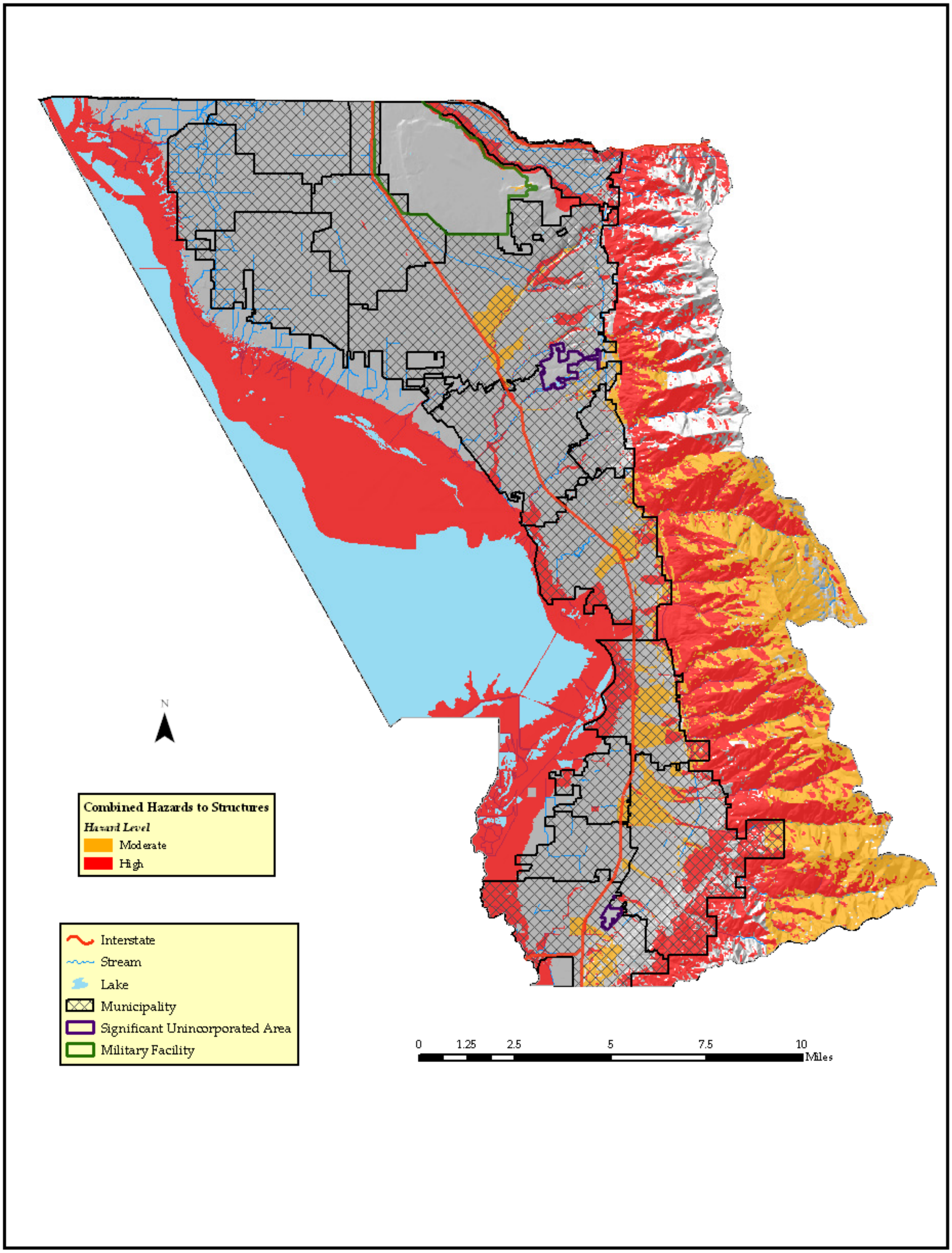
Those portions of the county that are near the Great Salt Lake are subject to high liquefaction in the event of an earthquake which poses a risk to incoming residents and new structures. One way for the county to mitigate the earthquake threat and its secondary risks is to continue to establish zoning ordinances and building codes that will recognize the threat and reduce it. Examples of more appropriate forms of land use along fault lines include "farms, golf courses, parks, and undeveloped open space" (UGS 1996).

Wildfire risk is most severe in the foothills of northern Davis County. These areas, known as WUI zones, are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. Some ways to mitigate this threat are 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. Much new development can be found near areas of current landslides. More detailed landslide studies and zoning appropriate for high hazard areas will decrease the likelihood of landslides damaging persons and property.

Flooding is of considerable concern along the Great Salt Lake and within alluvial fans along the foothills of the Wasatch Mountains. Much of the new development in Davis County is moving westward toward the lake and the 100-year floodplain. Zoning restrictions on building location and building codes that prevent basements would be well-suited in these areas.

Map 9-11 (page 142) shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, tornado, wildland fire and wind) in Davis County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Map 9-11. Combined Hazards to Structures, Davis County

Mitigation Strategies

The Davis County Mitigation Strategies Working Group developed the following Mitigation Strategies. The Working Group revised and expanded on strategies implemented in the 2003 PDM Plan. Information on Working Group members can be found in Part III.

Dam Failure

Problem Identification: Many high hazard dams and irrigation impoundments are located above inhabited areas in Davis County. "High hazard" does not mean that these dams have a high likelihood of failing, but that if they did fail, the magnitude of damage would be considerable. Additionally the Weber Basin water aqueduct traverses the county on the high bench along the Wasatch mountain front between the mouth of Weber Canyon and Bountiful. The aqueduct transports several thousands of gallons of water daily. Any event that caused a break in that water line would result in massive flooding, threatening many residents due to the fact that there are only manual valves in the system. Irrigation canals and associated secondary water distribution systems require regular inspection and maintenance.

Goal #1 – *Increase awareness of potential hazard from dams and water distribution systems in the county.*

Objective 1.1 (Priority MEDIUM): Educate public on water system/dam failure hazard.

Action 1: Compile inundation data/maps for high risk dams/irrigation impoundments

Time Frame: 5 years
Funding: County/City Emergency Management, County/City Planners
Estimated Cost: $50,000
Staff: Contracted
Jurisdictions: Countywide

Action 2: Provide information to residents on the hazard.

Time Frame: 3 years
Funding: County/City Emergency Management
Estimated Cost: Unknown
Staff: County/City Emergency Management
Jurisdictions: Countywide

Objective 1.2 (Priority MEDIUM): Lessen the impacts of flood damage caused by irrigation system infrastructure failure.

Action: Inspect irrigation canals/debris basins

Time frame: 3 Years
Funding: Weber Basin Water District, Federal Grants
Estimated Cost: Unknown
Staff: Weber Basin Water District, Weber-Davis Canal Co., Hooper Canal Co., Irrigation Districts
Jurisdictions: Communities within Davis County down slope from Weber Basin Irrigation pipeline

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 runs north and south, and numerous water and petroleum pipelines either cross over or run within ½ mile of the fault. Five moderately sized petroleum refineries located in the southern end of the county are subject to severe damage from ground movement and liquefaction. A major earthquake in the area would result in hundreds of millions of dollars in damage to residential structures, industry, and of critical infrastructure, and likely 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: Ongoing
Funding: County/City Emergency Management
Estimated Cost: Minimal
Staff: County/City Emergency Management
Jurisdictions: Countywide

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: Ongoing
Funding: Undetermined, potentially USGS or UGS
Estimated Cost: Minimal
Staff: UGS Staff
Jurisdictions: Countywide

Problem Identification: A number of critical structures within the county do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. This could delay life-saving rescue operations and hamper efforts to restore order in the event of a disaster.

Goal #2 – *Protect emergency response capabilities and critical facilities.*

Objective 2.1 (Priority HIGH): Ensure critical emergency service and water distribution facilities meet current construction codes, to allow for prompt response operations after an earthquake.

Action: Retrofit or construct new fire department facilities for earthquake resistant standards.

Time Frame: 3-5 Years
Funding: Grants and city budgets
Estimated Cost: Unknown

Staff: Contract
Jurisdictions: Countywide, targeting Clinton City, South Weber, and Layton City

Action: Retrofit high risk Weber Basin Water facilities including the Davis South water treatment plant filter building, well houses and nonstructural components District wide.
Time Frame: 2-5 Years
Funding: FEMA PDM grants and WBWCD funds
Estimated Cost: $3,000,000
Staff: WBWCD
Jurisdiction: WBWCD

Flooding

Problem Identification: Many citizens are not fully aware of the flood hazard in Davis County. Because of this, development has been allowed to occur in areas of previous flooding.

Goal #1 – Educate citizens of Davis County about flood hazard.

Objective 1.1 (Priority HIGH): Increase the level of understanding in homeowners, city officials, permit authorities and title companies/realtors.

Action: Create a brochure about flood hazard and disseminate
Time Frame: Immediate
Funding: County Budget
Estimated Cost: Minimal
Staff: County/City Emergency Management, Storm Water Coalition
Jurisdictions: Countywide

Objective 1.2 (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: County Planning Staff
Jurisdictions: Countywide

Problem Identification: Debris basins and other flood control infrastructure require regular inspection and maintenance. Stream channels may also change with heavy flow events. Proper flood control measures should be an ongoing priority.

Goal #2 – *Reduce flood hazard*

Objective 2.1 (Priority HIGH): Increase the capacity of streams to better handle runoff.

Action: Clean/maintain stream channels

Time frame: 5-20 Years
Funding: General fund, bond measure
Estimated Cost: $50,000,000
Staff: Davis County Public Works
Jurisdictions: Countywide

Problem Identification: Flooding in Davis County often occurs rapidly. For citizens to adequately protect themselves against the threat, sufficient warning needs to be given.

Goal #3 – *Increase warning lead times to reduce the vulnerability of persons and property to flood hazards.*

Objective 3.1 (Priority MEDIUM): Quickly notify persons of flood event.

Action: Implement a flood notification system.

Time frame: 5 Years
Funding: General Funds, Federal Grants
Estimated Cost: $50,000
Staff: Public Works
Jurisdictions: Countywide

Objective 3.2 (Priority MEDIUM): Establish a county-wide warning/notification system.

Action: Improve on the existing "reverse 911" warning system.

Time Frame: 2 Years
Funding: City/County Budget
Estimated Cost: Unknown
Staff: Emergency Management
Jurisdictions: Countywide

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. 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): Support programs to prepare residents for adverse weather conditions.

Action 1: Encourage all cities to participate in the Storm Ready program.

Time Frame: 1 Year
Funding: City and county budgets
Estimated Cost: Minimal
Staff: City/County Emergency Managers

Jurisdictions: Countywide

Action 2: Encourage avalanche preparedness for county backcountry users.

Time Frame: 1 Year
Funding: Minimal
Estimated Cost: Minimal
Staff: City/County Emergency Managers, State Hazard Mitigation Team, Utah Avalanche Forecast Center
Jurisdictions: Countywide

Action 3: Install avalanche warning signs in Farmington Canyon.

Time Frame: 1 Year
Funding: Unknown
Estimated Cost: $100
Staff: County Emergency Managers
Jurisdictions: County

Problem Identification: Davis County cities near the mountain front are subject to strong easterly canyon winds. These high winds can result in serious disruption of essential public services and communications for emergency responders have been severely hampered in the past by high wind damage to communication infrastructure.

Goal 2 – Ensure communication during severe weather events.

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: Unknown
Staff: UCAN, city and county personnel
Jurisdictions: Countywide

Slope Failure

Problem Identification: Numerous canyons, large and small exist along the east bench of Davis County. They were formed over thousands of years by debris flows and mudslides. Now, many hundreds of homes and other structures, pipelines, power lines and roadways have been constructed on top of or through the alluvial fans produced by these events. Nature continues to construct 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): Educate planning commissions.

Action 1: Provide city-planning commissions with information concerning landslides and debris flows.

Time Frame: Ongoing
Funding: None
Estimated Cost: 0

Staff: County/community staff
Jurisdictions: Countywide

Action 2: Encourage cities to adopt a standard of requiring geo-technical studies in identified landslide and debris flow areas.
Time frame: 5 years
Funding: None
Estimated Cost: 0
Staff: LEPC members
Jurisdictions: Countywide

Problem Identification: There are a number of canyons that do not currently have debris basins constructed to contain debris flows. Others are insufficient in size. These need to be built or reconstructed in order to provide protection to residents.

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 1: 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 jurisdictions, Centerville City and future developments on alluvial fans in Davis County.

Action 2: Rehabilitate watershed areas affected by wildfire.
Time Frame: Ongoing/as needed
Funding: Federal grants (NRCS, USFS)
Estimated Cost: Unknown
Staff: County public works, USFS
Jurisdictions: County

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

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. High voltage power lines in the Farmington bench area prevent firefighting helicopters from the ability to draw fire suppression water from irrigation reservoirs

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 1: Public awareness and education
- *Time Frame:* Immediate
- *Funding:* LEPC
- *Estimated Cost:* $0
- *Staff:* LEPC membership, UFFSL, National Forest Service
- *Jurisdictions:* Wildland/Urban Interface (WUI) communities

Action 2: 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, DHLS, National Forest Service
- *Jurisdictions:* WUI communities

Objective 1.2 (Priority HIGH): Maintain fire breaks

Action: Routinely maintain fire breaks in preparation for wildfire season
- *Time Frame:* Ongoing
- *Funding:* WUI Cities, County
- *Estimated Cost:* Unknown
- *Staff:* Public Works of respective county/cities
- *Jurisdictions:* WUI Cities, County

Objective 1.3 (Priority HIGH): Provide firefighting helicopter access to irrigation reservoirs in the Farmington bench area

Action: Relocate high voltage power lines in the Farmington bench area
- *Time Frame:* Immediate
- *Funding:* Federal, State, Private Sector
- *Estimated Cost:* $600,000
- *Staff:* Fire Department
- *Jurisdictions:* Farmington City

Problem Identification: Given that wildfire is a hazard that can be managed through effective fuel control and the lack of defensible space in one home could threaten other homes nearby in subdivisions, ordinances requiring residents to maintain defensible space around their respective homes would greatly reduce the fire hazard in these areas. Programs could be established to assist residents in performing this requirement or to encourage rebates for property insurance.

Goal #2 – Require homeowners to maintain defensible space around homes and businesses to more effectively mitigate the wildfire hazard.

Objective 2.1 (Priority HIGH): Establish ordinances requiring the maintenance of defensible space by homeowners, businesses, and government

Action 1: Draft ordinance requiring defensible space

Time Frame: 1 year
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Service, County/City Attorney, County City Councils
Jurisdictions: WUI Communities

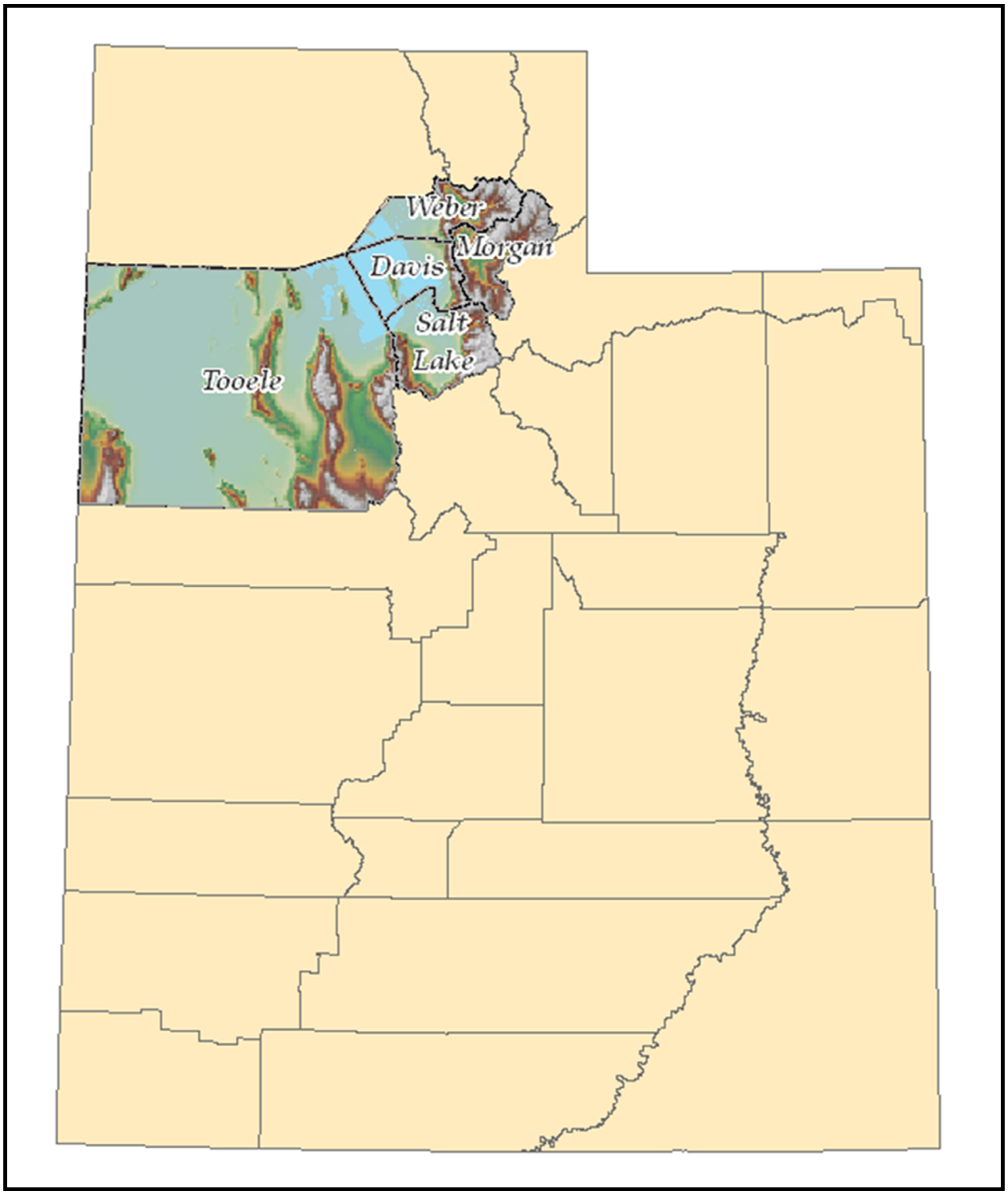
Action 2: Educate citizens about new defensible space requirement

Time Frame: 1 year
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Service, City/County Fire
Jurisdictions: WUI Communities

Objective 2.2 (Priority HIGH): Establish program to assist/encourage homeowners in creating/maintaining defensible space.

Action: Start a bi-yearly effort to help homeowners create defensible space through yard waste removal and trimming assistance.

Time Frame: 1-2 years
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Service, City/County Fire, Public Works
Jurisdictions: WUI Communities



Map 4-1. Wasatch Front Counties

Part V. Regional Data

The Wasatch Front Region comprises 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 (next page) identifies the population for each city using WFRC and U.S. Census Bureau population estimates.

Davis County		**Morgan County**		**Salt Lake County**		**Tooele County**		**Weber County**	
Bountiful	43,295	**Morgan**	3,636	**Town of Alta**	365	**Grantsville**	7,499	**Farr West**	5,093
Centerville	15,831			**Bluffdale**	7,088	**Ophir Town**	23	**Harrisville**	4,934
Clearfield	29,192			**Cottonwood Heights**	34,954	**Rush Valley Town**	466	**Hooper**	4,476
Clinton	19,572			**Draper**	36,873	**Stockton Town**	451	**Huntsville**	716
Farmington	15,916			**Herriman**	14,643	**Tooele**	27,415	**Marriott-Slaterville**	1,546
Fruit Heights	5,269			**Holladay**	25,308	**Vernon Town**	241	**North Ogden**	17,619
Kaysville	25,590			**Midvale**	27,249	**Wendover**	1,537	**Ogden**	80,773
Layton	65,269			**Murray**	44,844			**Plain City**	3,496
North Salt Lake	12,846			**Riverton**	35,543			**Pleasant View**	6,934
South Weber	5,822			**Salt Lake**	178,858			**Riverdale**	8,168
Sunset	5,225			**Sandy**	94,203			**Roy**	36,223
Syracuse	20,788			**South Jordan**	44,009			**South Ogden**	15,228
West Bountiful	5,343			**South Salt Lake**	21,354			**Town of Uintah**	1,139
West Point	8,740			**Taylorsville**	58,048			**Washington Terrace**	8,726
Woods Cross	8,824			**West Jordan**	100,280			**West Haven**	5,939
				West Valley	120,235				
Unincorporated	4,533	**Unincorporated**	5,191	**Unincorporated**	165,704	**Unincorporated**	13,053	**Unincorporated**	15,280

Table 4-1. Local Population Data, 2006, Salt Lake County, 2007 Estimates *(Sources: WFRC)*

A. Geographic and Physiographic Background

Davis County is located in northern Utah with an area of approximately 633 square miles. Two thirds of the county is covered by the Great Salt Lake, allowing for only 233 square miles of usable land, much of which is National Forest. The Great Salt Lake is the largest water body within the state and was named due to its' high salt content. The elevation ranges from 4,200 feet at the Great Salt Lake to 9,547 feet at Francis Peak. Davis County is bordered by Morgan County to the east, Weber County and the Weber River to the northeast, Tooele County to the west, and Salt Lake County to the south (Davis County 2003).

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, and the Weber River, which is a major river valley in northern Utah. Two smaller tributaries also run through the county East Canyon Creek and Lost Creek. Morgan County also has farming and grazing lands. The county is bordered to the east by Rich and Summit Counties, the north by Weber County, the west by Davis County and the southwest by Salt Lake County. The county's elevation ranges from 4,895 feet at Mountain Green to 9,547 feet at Francis Peak. Morgan City is the most populated city within the county (Morgan County 2003).

Salt Lake County is the most populous county in Utah and is the State Capital. Salt Lake County is situated between two mountain ranges, the Oquirrh Mountains to the west and the Wasatch Range to the east. The valley floor is approximately 35 miles long from the border with Davis County on the north to the 10-mile long Traverse Mountain Range on the south end of the county's southern border with Utah County. From the west border with Tooele County, it is 33 miles wide east to the borders of Summit, Wasatch and Morgan Counties. The County comprises 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, to the highest point of the planning region in the Wasatch Range which is 11,330 feet at Twin Peaks.

The Jordan River is the major river drainage in the county, flowing north through the middle of the valley from Utah Lake in Utah County into 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. This being the Great Basin, all the surface flows drain into the Great Salt Lake, which also receives inflow from the Weber and Bear Rivers (Salt Lake County 2003).

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. Most of the County's population lives in the eastern valleys where most of the irrigated and dry farmland is also located. Several hundred square miles in the western part of the county are arid desert, are largely owned by the federal government, and are sparsely populated. The County includes a portion of the Great Salt Lake desert, salt flats and is generally uncultivated. Altitudes range from 4200 at the Great Salt Lake to 11,031 feet above sea level at the top of Deseret Peak in the Stansbury Mountains (Tooele County 2001).

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 most populous. Weber County has a total of 662 square miles. The Great Salt Lake covers approximately 112 square miles of the county's area. Elevation ranges from 4200 feet at the Great Salt Lake to over 9,700 feet 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. The county is bordered by Box Elder County on the west, Cache and Rich Counties on the north, Morgan County on the east and Davis County on the south (Weber County 2000).

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, running north-south, forms the border between Salt Lake and Tooele County. The Stansbury Mountains form the western side of the Tooele valley.

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 geologic process of this area.

The Uintah and Wasatch Ranges 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 rockfalls occur.

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 worlds' largest open pit mine, the Bingham Copper Mine. The Salt Flats in the western portion of Tooele County are a remnant of Lake Bonneville's fine compressed sediment, comprised of salt that includes gypsum, potash, and calcium carbonate.

C. Climate

Northern Utah has a cold desert climate. Utah has hot dry summers and cold winters. However, Utah's climate is variable, wet in some areas of the state and dry in others. This variability 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).

Northern 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 through June and can cause flooding along the lower streams. Flash flooding from summer thunderstorms 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 averages less than 5 inches annually. The average annual precipitation at the Salt Lake International Airport is 15.3 inches, with an average of 58.9 inches of snowfall. Utah is the second driest state in the nation.

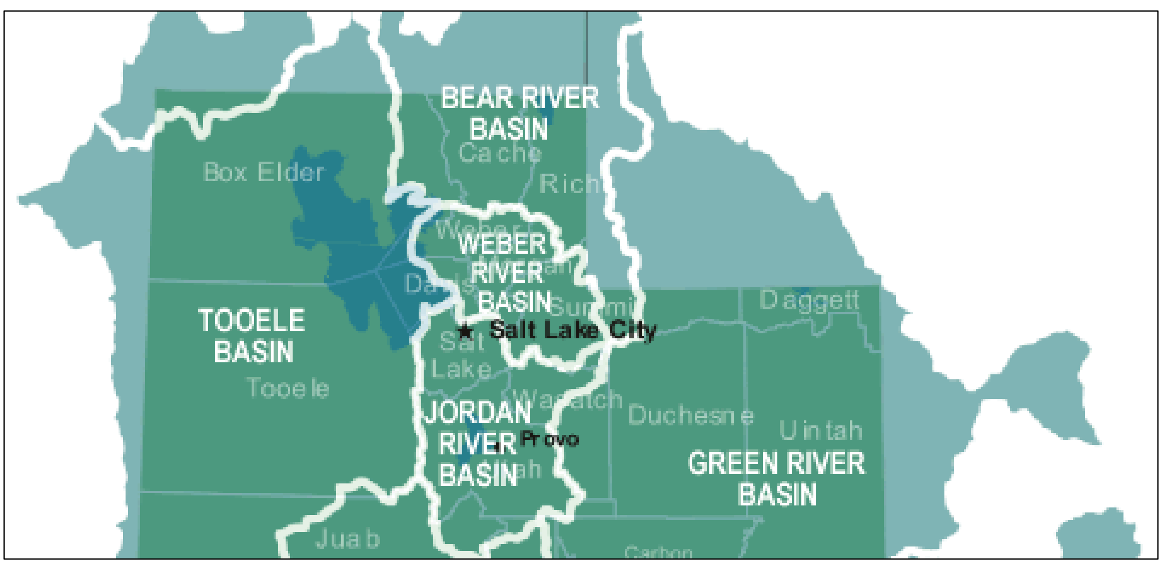
The surrounding mountain ranges act as a barrier to the cold continental arctic masses. This also insulates the area during the day and cools the area rapidly at night. On clear nights, the colder air accumulates on the valley floor, while the foothills and benches remain relatively warm.

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 caused by areas of sinking air or high-pressure anticyclones settling over the Great Basin.

Average wind speeds are usually light to moderate, 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. Dust storms can occur in the western portions of the region. Tornadoes have occurred in this region but are uncommon. Severe 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. Larger drainages 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, Tooele and Bear River Basins.



Map 4-2. Area Drainage Basins *(Source: USGS 2006)*

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 decreased, with residential and commercial development on the rise. According to the Utah Water Plan, the Jordan River, Bear River 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 state in the nation and ranks second in per capita water use of public supplies. According to the Utah Division of Water Resources, Utah last experienced drought conditions from 1999 to 2004 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 latest drought is unusual because of the severity. The 2002 water year was one of the driest ever recorded (Utah Division of Water Resources 2007).

E. Development Trends

All counties along the Wasatch Front Region of Northern Utah (Davis, Morgan, Salt Lake, Tooele, and Weber) will continue to grow. Despite nationwide trends, Utah continues to develop. 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. See Table 4-3 (next page) for projected population and household growth in Davis, Morgan, Salt Lake, Tooele and Weber counties.

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 as 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 previously 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 is one of Utah's fastest growing counties. 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.

Salt Lake County is continuing to infill with residential growth in the south valley area between the Kennecott Copper Daybreak development 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. The opening of the Legacy Parkway in 2008 provided a much needed alternate north/south transportation expressway through the county. The planned Legacy Highway north extension will further facilitate transportation into Weber County.

Weber County's residential growth has been moving west into agricultural lands near the Great Salt Lake. Growth pressures and the demand for a rural atmosphere continue to inflate property values in the Ogden Valley. Development pressure in west Weber County has placed a premium on the availability of drinking and secondary water. The ground is so flat near the lake that sewage must be pumped to treatment plants. Septic systems are no longer permitted due to the negative impact to groundwater supplies. 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 due to the area's strong job market. Nationally, growth is occurring in the west and in the south.

Area	2000 Population	2010 Population	2020 Population	2030 Population	% Growth 2000-2030
Davis County	240,204	323,087	369,467	390,159	62.4%
Morgan County	7,181	10,589	16,756	24,478	240.9%
Salt Lake County	902,777	1,079,679	1,273,929	1,468,615	62.7%
Tooele County	41,549	63,777	91,849	119,871	188.5%
Weber County	197,541	232,696	278,256	320,634	62.3%
Region	**1,389,252**	**1,709,828**	**2,030,257**	**2,323,757**	**67.3%**
Area	**2000 Households**	**2010 Households**	**2020 Households**	**2030 Households**	**% Growth 2000-2030**
Davis County	71,698	102,444	122,029	135,759	89.3%
Morgan County	2,069	3,348	5,517	8,198	296.2%
Salt Lake County	297,064	369,665	453,993	544,378	83.3%
Tooele County	12,931	20,772	32,056	44,391	243.3%
Weber County	66,082	80,279	99,428	119,489	80.8%
Region	**449,844**	**576,508**	**713.023**	**852,215**	**89.5%**
Area	**2000 Household Size**	**2010 Household Size**	**2020 Household Size**	**2030 Household Size**	**Change 2000-2030**
Davis County	3.30	3.11	2.98	2.82	-0.48
Morgan County	3.47	3.16	3.04	2.99	-0.48
Salt Lake County	2.99	2.88	2.76	2.65	-0.34
Tooele County	3.11	2.98	2.78	2.62	-0.49
Weber County	2.94	2.92	2.88	2.64	-0.30
Region	**3.04**	**2.92**	**2.80**	**2.68**	**-0.36**

Area	2001 Employment	2010 Employment	2020 Employment	2030 Employment	% Growth 2000-2030
Davis County	125,330	169,750	200,044	209,651	67.3%
Morgan County	3,135	4,212	7,676	11,497	266.7%
Salt Lake County	663,866	790,393	781,221	994,647	49.8%
Tooele County	16,172	24,998	37,469	50,980	215.2%
Weber County	108,233	129,971	156,377	181,205	67.4%
Region	**916,736**	**1,119,324**	**1,298,823**	**1,447,980**	**57.9%**

Table 4-3 Population and Household Projected Trends (UPEC 2008)

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 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 both 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 Pleasant View on the north and south to Bluffdale. At its widest, the valley 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 receives water from its significant tributaries; Hardscrabble Creek, Deep Creek, Lost Creek, East Canyon Creek and Cottonwood Creek. In Davis County, several small creeks, such as Kays, Farmington, Davis, Deuel, North Canyon and others 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 are also an internationally significant habitat. As many as one million migratory shorebirds and waterfowl utilize the Great Salt Lake wetlands during 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 development pressures are occurring.

Numerous rivers and streams flow into the lake, supplying 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 U.S. Army Corps of Engineers (USACE) 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, including marsh, wet meadow, riparian scrub, playa/mudflat and open water.

Farmlands

Over the past several years, many acres of farmland in the area have been developed. Morgan and Tooele counties still maintain a good percentage of their land in 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 infrastructure. As development continues to creep higher on the foothills of the Wasatch Mountains, slope stability, erosion and drainage problems will present engineering challenges in development design.

Development is usually attracted more to the views of slopes and faults than repelled 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 large 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 U.S. Forest Service. The Bureau of Land Management primarily administers the open space in the west desert area of Tooele County. Some notable peaks in Wasatch Range just east of the Weber/Davis area are Ben Lomond Peak, Mount Ogden, Thurston Peak and Francis Peak. In the Salt Lake area, Lone Peak, Broadfork Twin Peak and Mt. Olympus are significant. 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 and vacant land. 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, citizens as well as 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 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 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 (TRI) 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 (LUST) 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 interfluvial 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. 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 annually receive 60 to 100 inches of precipitation. 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 substances found in landfills and mine tailings can be leached by rain and snow and find its 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 some of the ground water supply of southwestern Salt Lake County. There is also a plume of contaminated groundwater slowly moving westward near Sunset, caused by the inappropriate disposal of solvents and other chemicals for decades 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.

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 County portion of the Wasatch Front Urbanized Area (WFUA). 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. Other major north-south arteries in Davis County include U.S. Highway 89 and the Legacy Parkway. The historic development has followed the geographic constraints particularly in transportation.

Transportation

Large employment centers, such as Hill Air Force Base, University of Utah, Salt Lake City International Airport and the downtown Salt Lake City Central Business District will need to be served with an improved transportation system.

The growth and distribution of population and employment in the WFUA 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 determining 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 for major transportation requirements.

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 WFUA. Anticipated growth will increase the need for north-south travel in the Region, which is being addressed in part by the recently reconstructed I-15, the Legacy Parkway, and the completion of the Utah Transit Authority's Transit Express (TRAX) light rail transit system between Sandy and downtown Salt Lake City with its additional line to the University of Utah area. Plans for a TRAX line between Sandy and the southwest part of Salt Lake County are well underway with planned completion by 2011. A TRAX line between downtown Salt Lake City and the airport is also planned. The UTA Commuter Rail between Pleasant View and Salt Lake City was completed in 2008. By 2011, the UTA plans to extend the commuter rail north to Brigham City and south into Utah County. In addition, the Salt Lake portion of the WFUA'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 WFUA will increasingly be affected by the population and employment growth in the Ogden/Layton urban area to the north, the Provo/Orem urban 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 WFUA 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. Davis County's transportation system will need to improve east/west capacity 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 significant. This report will only very briefly mention a few. Technology advances in communications have made it possible for telecommuting, reduced the requirement of a daily commute to a workplace; increased availability of reliable public transportation has changed where people live and work; advances in agriculture have allowed more food to be produced on less land; and technological advances allow developments on marginal sites.

Reclamation of Industrial Land

Much public and private land will remain undeveloped because of specific environmental constraints, such as steep slopes, prime wetlands, or hazardous substances. However, other environmentally challenging properties are now developable due to advances in technology. Some areas historically used for industrial or mining activity are planned to be reclaimed for other uses. For example, Kennecott's Daybreak community is a 12,000 unit, mixed use development on 4,500 acres in South Jordan.

Employment Trends

In the past 30 years, the Region's economy has diversified, resulting in more widespread 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, State of Utah).

No longer dependent on a limited number of sectors, the Region's economy is now based on the service sector and other industries, such as health care, education, and local government. Agriculture continues 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 changes, up or down, during the past decade. Overall, large employment gains are occurring in 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: 2007-2030 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 about 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 urban 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 Falcon Hill development on 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). 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 county as well as 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 Plans (sometimes referred to as General Plans, Land Use Management Codes, and other planning documents). Master Plans and Land Use Management Codes are formally adopted by city or county councils 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 guidelines 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 VI. Capabilities Assessment

This assessment analyzes current capacity to mitigate the effects of natural hazards and emphasizes the positive capabilities that should be continued. 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 the capabilities assessment could be completed by all five counties. General capabilities of the region and for each jurisdiction are addressed followed by any specific city and county capabilities.

The following areas were assessed to determine mitigation capabilities:

1. *Staff and Organization*
2. *Technical*
3. *Fiscal*
4. *Policies and Programs*
5. *Legal Authority*
6. *Political Willpower*

Staff and Organization

The assessment found that each county and 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 governmental structure.

<u>City and County Elected Officials</u>
An elected council or a commission consisting of between three to seven members governs each county. Either a town or city council, consisting of between five to seven members, governs each municipality. The elected officials have the responsibility of adopting mitigation policies. All cities and counties receive their legal authority to govern from the State of Utah.

<u>County General Capabilities</u>
Listed below is a general organizational list of county/city governmental administrative areas involved in 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 Departments
- County Health Departments
- Police and Fire Departments
- County Emergency Management Agencies
- Special Improvement Districts

Emergency Management
All Utah counties, most of the larger cities and the universities have designated emergency management directors. The emergency management office is responsible for natural and man-made hazard mitigation, preparedness, and response and recovery operations.

Local Emergency Planning Committee (LEPC)
The mission of LEPC is to coordinate emergency preparedness for hazardous materials between all public and private emergency task disciplines. Many LEPC's have expanded their mandated hazardous materials function to include all hazards. In the Region, LEPC's are comprised of elected officials; law enforcement, emergency management, firefighting, emergency medical services, health, local environmental, hospital and transportation personnel; broadcast and print media; community groups; and owners and operators of hazardous chemical facilities that are required by federal law to have hazardous chemical emergency planning. Each county in the region has an active LEPC.

Fire/Emergency Medical Services
Most cities staff fire service organizations and all five counties have fire service. Following a national trend, several multi-jurisdiction fire districts have been formed with the goal to better provide fire and emergency medical services.

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. County health departments organize, coordinate and direct emergency medical and health services. The health department assesses 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. Short of a pandemic disease outbreak, health departments within the five counties will likely continue to adequately staff, train and fund their missions.

School Districts
School Districts are located in all the counties. District administrators work closely with local public safety officials including law enforcement, fire emergency medical services, and public health to help to ensure that schools are well prepared for any kind of emergency.

Special Service Districts
For the purposes of this Plan, Special Service Districts (SSD) are defined as quasi-governmental agencies having taxing authority, providing a specific public service that may include; public transportation, fire, water, wastewater and sewer. These SSD's work closely with local public safety officials to ensure that these Districts are well prepared for any kind of emergency. In many cases, the districts participate in the county or city emergency preparedness committee for emergency coordination, planning and response.

Technical Capability

Throughout the plan update process, WFRC staff consulted with and utilized the technical expertise from a wide variety of resources listed below:

Jurisdiction 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 coordinate data processing and computer capabilities for GIS. GIS is a 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 networks assure emergency communications through radio, microwave, telephone, satellite, internet, e-mail, fax and amateur radio. One of the most beneficial capabilities of PSC is providing cross communication between equipment and frequencies. PSC coordinates dissemination of emergency information to the media, the public and emergency personnel; activates internal information systems; acts as a liaison to elected officials; assists in the provision of emergency information and document the impact.

Public Works
Public works departments generally provide engineering, transportation, GIS, water, wastewater, sanitation (in some cases electric power) expertise and capability. As a team, public works personnel identify critical infrastructure and plan and prepare for emergency mitigation.

Other Technical Capabilities

Utah Division of Homeland Security (Utah DHLS)
Utah DHLS assisted WFRC in providing information on 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(USU) Cooperative Extension
The USU Extension Service assisted with family and community data 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 was utilized as a technical resource for academic mitigation research and demographic data.

Wasatch Front Regional Council (WFRC)
WFRC is a valuable cooperative planning organization between Davis, Morgan, Salt Lake, Tooele and Weber Counties. WFRC is a resource for coordination, communication and planning expertise.

Fiscal Capability

All counties have limited fiscal capabilities to implement mitigation actions. Davis, Salt Lake, Tooele and Weber counties have larger tax bases and greater man-made hazard threats 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 funds for federal grants in the past.

Utah State Code; Section 17-50-501 classifies counties into six categories based on population. The State of Utah grants graduated autonomy to counties according to class size (Table 5-1 next page). The lower numbered class counties receive more authority from the State to regulate their own affairs.

Class 1	More than 700,000	▪ Salt Lake County population 1,002,690
Class 2	125,000 – 700,000	▪ Davis County population 292,054 ▪ Weber County population 216,289
Class 3	18,000 – 125,000	▪ Tooele County population 50,686
Class 4	10,000 – 18,000	
Class 5	3,500 – 10,000	▪ Morgan County population 8,827
Class 6	Less than 3,500	2

Table 5-1. County Classifications

Policies and Programs

Connecting local land use management with natural hazard planning is an effective way to mitigate a community's risk. Many communities have plans, ordinances, agreements, maps, training, warning systems, etc. in place that help them to become more disaster resistant. One of the goals of this Plan is for communities to coordinate existing activities so that individual objectives become part of an overall plan of action.

Land Management Tools

Ordinances

- **Zoning ordinances** designate the use of land and structures for the purpose of protecting the health, safety and welfare of 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 maps. 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 uses that are permitted to exist in each of the zones.

- **Subdivision ordinances** regulate all divisions and improvements of property including the division of land involving the dedications of new or changes of existing streets/roads.

- **Design controls** regulate building and landscaping. Such controls can be tailored to require that new developments meet the specific needs of the area. For example, requiring flame resistant roofs in urban-rural wildland fire interface zones or requiring that trees and vegetation are planted on steep slopes to help mitigate landslide hazards.

- **Floodplain 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 homes and businesses through the National Flood Insurance Program (NFIP). The NFIP's Community Rating System was implemented to encourage cities to manage floodplain activities that exceed the minimum NFIP standards. A community participating in the system will receive reductions in insurance premiums.

- **Building codes** require certain standards of practice.

<u>Easements</u>

Easements can be a cost effective way to control development in hazard prone areas. Various land trusts can help secure easements that can then be conserved or preserved.

<u>Planning</u>

- **General 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 while land use management codes implement that vision. General plans and land use management codes are being consulted, reviewed, and changed as necessary.

- **Emergency Operations Plans (EOPs)** identify specific emergency actions undertaken by a jurisdiction to protect lives and property immediately before, during, and following an emergency. WFRC reviewed EOPs as part of this planning process.

- **Floodplain Management Plans** identify steps and implementation strategies to effectively deal with floodplains. FEMA uses a scoring system is used to rate communities. Those with higher scores will receive higher discounts (in 5% increments) on flood insurance.

- **Stormwater Management Plans** identify water policies for an entire watershed. Such policies can include: preservation of habitats, water quality and supply, open space development, land preservation, pollution prevention and construction regulations.

- **Environmental reviews** explain how development affects the land and its resources.

- **Capital Improvement Plans**. Cities plan for costs related to infrastructure, public facilities, and public safety. These plans identify projects, prioritize them and identify ways of funding them. Such plans can include disaster reduction costs or mitigation measures in flood-prone areas or retrofitting buildings for seismic strengthening.

The jurisdictions that make up this Region have incorporated various mitigation measures. The following tables identify, by county, existing land use ordinances, management practices and plans currently in place.

DAVIS COUNTY														
	Bountiful	Centerville	Clearfield	Clinton	Farmington	Fruit Heights	Kaysville	Layton	North Salt Lake	South Weber	Syracuse	West Bountiful	Woods Cross	Unincorporated County
Avalanches	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Earthquakes, Faults, Geologic Hazards	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	N	N	Y
Floodplains	Y	Y	Y	n/a	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Foothills & Canyons	Y	Y	N	n/a	Y	Y	Y	Y	N	Y	N	N		Y
Groundwater	Y	Y	N	Y	Y	N	Y	Y	Y	N	N	N	Y	Y
Habitat	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
Lakes, Streams, Riparian Areas	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	N	Y
Landslides	Y	Y	N	n/a	Y	Y	Y	Y	Y	Y	N	N	n/a	Y
Mountains & Forest Zones	Y	N	N	n/a	N	N		N	N	N	N	N	n/a	Y
Pollution & Air Quality (General Plan)	N	N	N	N	N	N	N	Y	N	N	N	Y	Y	Y
Prime Agricultural Lands	N	N	N	Y	Y	N	Y	Y	N	N	N	N	N	Y
Ridgelines	Y	N	N	n/a	N	N	N	N	N	N	N	N	n/a	N
Steep Slopes	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	n/a	Y
Watersheds	Y	N	N	N	Y	Y	Y	Y	N	N	N	Y	Y	Y
Wetlands (Army Corps)	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	Y
Wild Land Fire	Y	N	N	N	Y	N	Y	Y	N	N	N	N	N	Y
Sensitive Lands	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y

Table 5-2. Natural Hazard & Environmental Quality Ordinances, Davis County

DAVIS COUNTY	Bountiful	Centerville	Clearfield	Clinton	Farmington	Fruit Heights	Kaysville	Layton	North Salt Lake	South Weber	Syracuse	West Bountiful	Woods Cross	Unincorporated County
Emergency Management Plan	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Stormwater Management Plan	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Growth Management Plan	Y	Y	N	N	-	N	-	Y	N	-	-	N	Y	N
Community Rating System	9	9	N	N	N	N	N	N	N	N	N	9	N	N
General Plan Land Use Update	2008	2008	2008	2006	1998	2008	2008	2008	2001	2008	2006	2007	2006	2006
General Plan Transportation Update	2008	2008	2008	1984	1998	2008	2008	2008	2001	2008	2006	2007	2008	2006
General Plan Housing Update	2008	2008	2008	1984	1998	2008	2008	2008	2001	2008	2006	2007	2004	2006

Table 5-3. Natural Hazard and Environmental Planning, Davis County *Sunset, West Point - unable to obtain information

MORGAN COUNTY	Morgan City	Unincorporated County
Avalanches	Y	n/a
Earthquakes, Faults, Geologic Hazards	Y	Y
Floodplains	Y	Y
Foothills & Canyons	Y	Y
Groundwater	Y	Y
Habitat	Y	Y
Lakes, Streams, Riparian Areas	Y	Y
Landslides	Y	n/a
Mountains & Forest Zones	Y	n/a
Pollution & Air Quality (General Plan)	N	Y
Prime Agricultural Lands	Y	Y
Ridgelines	Y	N
Steep Slopes	Y	n/a
Watersheds	Y	Y
Wetlands (work with Army Corps)	Y	Y
Wild Land Fire	Y	Y
Sensitive Lands	Y	Y

Table 5-4. Natural Hazard & Environmental Quality Ordinance, Morgan County

MORGAN COUNTY		
	Morgan City	**Unincorporated County**
Emergency Management Plan	Y	Y
Stormwater Management Plan	Y	N
Growth Management Plan	Y	Y
Community Rating System Classification	N	N
General Plan Land Use Update	-	2008
General Plan Transportation Update	-	2008
General Plan Housing Update	-	2008

Table 5-5. Natural Hazard and Environmental Planning, Morgan County

SALT LAKE COUNTY	Alta	Bluffdale	Cottonwood Heights	Draper	Herriman	Holladay	Midvale	Murray	Riverton	Salt Lake City	Sandy	South Jordan	South Salt Lake	Taylorsville	West Jordan	West Valley	Unincorporated County
Avalanches		N	N	N	n/a	N	N	n/a	N	N	N	N	n/a	N	N	n/a	Y
Earthquake, Faults, Geologic Hazards		N	Y	Y	n/a	Y	N	Y	Y	Y	Y	N	N	Y	N	N	Y
Floodplains		Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Foothills & Canyons		N	Y	Y	Y	Y	Y	n/a	Y	Y	Y	N	N	N	Y	N	Y
Ground-water		N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Habitat		Y	N	Y	N	N	N	n/a	Y	Y	Y	N	N	N	N	N	N
Lakes, Streams, Riparian Areas		Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	N	N
Landslides		Y	Y	Y	N	Y	N	n/a	Y	N	Y	N	N	N	N	N	N
Mountains & Forest Zones		N	Y	Y	Y	N	N	n/a	N	N	N	N	N	N	N	N	Y
Pollution & Air Quality (General Plan)		N	N	Y	N	N	N	Y	N	Y	N	Y	N	N	Y	N	N

SALT LAKE COUNTY	Alta	Bluffdale	Cottonwood Heights	Draper	Herriman	Holladay	Midvale	Murray	Riverton	Salt Lake City	Sandy	South Jordan	South Salt Lake	Taylorsville	West Jordan	West Valley	Unincorporated County
Prime Agricultural Lands		N	N	N	N	N	N	n/a	Y	N	N	Y	N	N	Y	N	N
Ridgelines		Y	Y	N	Y	Y	N	n/a	N	N	Y	N	N	N	N	N	Y
Steep Slopes		Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	Y	N	Y
Watersheds		Y	Y	Y	N	Y	N	N	Y	Y	Y	N	N	N	Y	N	N
Wetlands		Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	N	Y	N	N
Wild Land Fire		N	Y	N	Y	Y	N	n/a	N	Y	Y	N	N	N	N	N	N
Sensitive Lands		N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	Y	Y	N

Table 5-6. Natural Hazard & Environmental Quality Ordinance, Salt Lake County

SALT LAKE COUNTY	Alta	Bluffdale	Cottonwood Heights	Draper	Herriman	Holladay	Midvale	Murray	Riverton	Salt Lake City	Sandy	South Jordan	South Salt Lake	Taylorsville	West Jordan	West Valley	Unincorporated County
Emergency Management Plan	-	-	Y	Y	Y	Y		Y			Y		Y		Y	Y	
Stormwater Management Plan	-	Y	Y	Y	N	Y		Y			Y		Y		Y	Y	
Growth Management Plan	-	N	Y	Y	N	Y		n/a			Y		N		Y	Y	
Community Rating System Classification	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
General Plan Land Use Update	2005	-	2008	2007	2006	2007	2000		2006		2008		2008		2003		
General Plan Transportation Update	2005	-	2005	2007	2000	2007	2000		2006				2008				
General Plan Housing Update	2005	-	2008	2000	2000	2007	2000		2006		2008		2008		2008		

Table 5-7. Natural Hazard and Environmental Planning, Salt Lake County *Alta, Salt Lake City, South Jordan, Taylorsville, Salt Lake County- Unable to obtain information

TOOELE COUNTY								
	Grantsville	Ophir	Rush Valley	Stockton	Tooele City	Vernon	Wendover	Unincorporated County
Avalanches	N	N	N	N	N	N	N	N
Earthquakes, Faults, Geologic Hazards	N	N	N	N	N	N	N	N
Floodplains	N	N	N	N	Y	N	Y	Y
Foothills & Canyons	N	N	N	N	Y	N	N	N
Groundwater	N	N	N	N	N	N	N	Y
Habitat	N	N	N	N	Y	N	N	N
Lakes, Streams, Riparian Areas	N	N	N	N	N	N	N	N
Landslides	N	N	N	N	N	N	N	N
Mountains & Forest Zones	N	N	N	N	Y	N	N	N
Pollution & Air Quality (General Plan)	N	N	N	N	Y	N	Y	N
Prime Agricultural Lands	N	N	N	N	N	N	N	N
Ridgelines	N	N	N	N	Y	N	N	N
Steep Slopes	N	N	N	N	Y	N	N	Y
Watersheds	N	N	N	N	N	N	Y	N
Wetlands (work with Army Corps)	N	N	N	N	N	N	N	Y
Wild Land Fire	N	N	N	N	N	N	N	N
Sensitive Lands	Y	N	N	N	Y	N	N	N

Table 5-8. Natural Hazard & Environmental Quality Ordinance, Tooele County

TOOELE COUNTY								
	Grantsville	Ophir	Rush Valley	Stockton	Tooele City	Vernon	Wendover	Unincorporated County
Emergency Management Plan	Y	N	N	N	Y	N	Y	Y
Stormwater Management Plan	N	N	N	N	Y	N	N	Y
Growth Management Plan	N	N	N	N	N	N	N	Y
Community Rating System Classification	N	N	N	N	N	N	N	N
General Plan Land Use Update	2001				2007		2001	2006
General Plan Transportation Update	2001						2001	2006
General Plan Housing Update	2001						2001	2006

Table 5-9. Natural Hazard and Environmental Planning, Tooele County

WEBER COUNTY																
	Farr West	Harrisville	Hooper	Huntsville	Marriott-Slaterville	North Ogden	Ogden	Plain City	Pleasant View	Riverdale	Roy	South Ogden	Uintah	Washington Terrace	West Haven	Unincorporated County
Avalanches	n/a	n/a	n/a	n/a	n/a	Y	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	N
Earthquakes, Faults, Geologic Hazards	Y	N	N	N	N	Y	Y	N	Y	Y	N	Y	-	-	-	Y
Floodplains	N	Y	N	N	Y	Y	Y	N	n/a	Y	N	Y	--	-	-	Y
Foothills & Canyons	n/a	n/a	N	N	n/a	Y	N	N	Y	N	Y	N	-	-	-	N
Groundwater	N	Y	N	N	N	Y	N	N	Y	N	N	N	-	-	-	N
Habitat	N	N	N	N	N	Y	N	N	N	N	N	N	-	-	-	N
Lakes, Streams, Riparian Areas	N	Y	N	N	N	Y	N	N	N	N	N	N	-	-	-	Y
Landslides	n/a	n/a	N	N	N	Y	Y	N	N	N	N	Y	-	-	-	Y
Mountains & Forest Zones	n/a	n/a	N	N	N	n/a	N	N	N	N	N	N	-	-	-	Y
Pollution & Air Quality	N	Y	N	N	N	N	N	N	Y	N	N	N	-	-	-	N
Prime Agricultural Lands	N	N	Y	N	N	N	N	N	N	N	N	N	-	-	-	Y
Ridgelines	n/a	n/a	N	N	n/a	N	N	N	N	N	N	N	-	-	-	N
Steep Slopes	n/a	n/a	N	N	n/a	Y	Y	N	Y	Y	N	N	-	-	-	Y
Watersheds	N	N	N	N	N	Y	Y	N	Y	N	N	N	-	-	-	N
Wetlands	N	Y	Y	N	N	Y	N	N	Y	N	N	N	-	-	-	N
Wild Land Fire	n/a	n/a	N	N	N	Y	N	N	N	N	N	N	-	-	-	Y
Sensitive Lands	N	Y	N	N	N	Y	Y	N	Y	Y	N	Y	-	-	-	N

Table 5-10. Natural Hazard & Environmental Quality Ordinance, Weber County

WEBER COUNTY																
	Farr West	Harrisville	Hooper	Huntsville	Marriott-Slaterville	North Ogden	Ogden	Plain City	Pleasant View	Riverdale	Roy	South Ogden	Uintah	Washington Terrace	West Haven	Unincorporated County
Emergency Management Plan	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y		Y		Y
Stormwater Management Plan	Y	Y	Y	N	Y	Y	Y		Y	N						Y
Growth Management Plan	N	N	N	N	N	Y	N		N	N						Y
Community Rating System Classification	Y	Y														
General Plan Land Use Update		2008	2004	2000	2001	2002	2007		2006							2007
General Plan Transportation Update		1997	2004	2000	2008	2007	2007		2006							2007
General Plan Housing Update		1997	2004	2000	2007	2002	2007		2006							2007

Table 5-11. Natural Hazard and Environmental Planning, Weber County

*Empty Cell= unable to obtain information

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. manages the Building Code Effectiveness Grading System (BCEGS). This program was implemented in 1995 and assesses the building codes in effect in a particular community as well as how well the community enforces its building codes. The BCEGS program assigns each municipality a BCEGS grade of 1 to 10 with 1 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.

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 (pages 66-67).

DAVIS COUNTY	**BCEGS Classification**		**Date**
	Residential	**Commercial**	
Bountiful	3	3	2006
Centerville	3	3	2004
Clearfield	3	3	2004
Clinton	4	2	2005
Davis County	4	4	2006
Farmington	3	3	2005
Fruit Heights	3	4	2006
Kaysville	3	2	2004
Layton	3	3	2004
North Salt Lake	4	4	2003
South Weber	4	4	2004
Syracuse	4	3	2006
West Bountiful	99	99	2006
West Point	99	99	2003
Woods Cross	99	99	2006

Table 5-12. Building Code Effectiveness Grading Reports, Davis County

MORGAN COUNTY	**BCEGS Classification**		**Date**
	Residential	**Commercial**	
Morgan	4	3	2007
Morgan County	4	4	2006

Table 5-13. Building Code Effectiveness Grading Reports, Morgan County

SALT LAKE COUNTY	BCEGS Classification		Date
	Residential	Commercial	
Alta	99	99	2005
Bluffdale	5	4	2007
Cottonwood Heights	No rating	No rating	
Draper	3	2	2005
Holladay	No rating	No rating	
Midvale	3	2	2004
Murray	2	2	2005
Riverton	4	3	2005
Salt Lake City	3	4	2007
Salt Lake County	99	99	2005
Sandy	2	2	2004
South Jordan	4	4	2004
South Salt Lake	3	3	2002
Taylorsville	4	3	2005
West Jordan	3	3	2004
West Valley City	2	2	2004

Table 5-14. Building Code Effectiveness Grading Reports, Salt Lake County

TOOELE COUNTY	BCEGS Classification		Date
	Residential	Commercial	
Grantsville	99	99	1999
Stockton	99	99	1999
Tooele	3	3	2003
Tooele County	2	2	2003
Wendover	99	99	2003

Table 5-15. Building Code Effectiveness Grading Reports, Tooele County

WEBER COUNTY	BCEGS Classification		Date
	Residential	Commercial	
Farr West	4	3	2007
Huntsville	3	3	2003
Marriott-Slaterville	2	2	2006
North Ogden	4	3	2004
Ogden	3	3	2004
Plain City	5	5	2003
Roy	3	4	2005
South Ogden	3	3	2005
Uintah	3	3	2003
Washington Terrace	2	2	2004
Weber County	3	3	2005

Table 5-16. Building Code Effectiveness Grading Reports, Weber County

Community Name	Entry Date	Effective Date	Class
Bountiful	10/01/91	10/01/91	9
Centerville	05/01/02	05/01/02	9
North Ogden	10/01/93	05/01/03	8
West Bountiful	10/01/96	10/01/96	9

Table 5-17 Community Rating System Scores, WFRC

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/city managers. 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.

Political Willpower

Wasatch Front region public officials have shown support for pre-disaster planning in the following ways:

<u>Community Development Documents</u>
Elected officials have adopted updated community development documents to reduce the risk of emergencies and 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, there is support from residents for 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 for disaster is recommended for open space or lower intensity uses.

<u>Emergency Planning Training Courses</u>
Wasatch Front region residents have supported emergency planning training sponsored by the State of Utah's Division of Homeland Security and local governments such as: CERT (Community Emergency Response Team), Local Emergency Planning Committees (LEPC), Hazardous Materials (HAZMAT), Site Plans and Ordinances, Real Estate Requirements, and Hazard Mitigation

Part VII. 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, the intensity/magnitude of a hazard and the probability of its occurrence. Hazard identification was initiated through an extensive process that utilized the following:

- Core Planning Team
- Local Working Groups
- Technical Team
- Community and Public individuals
- Elected Officials
- City and County Agencies
- Utah Division of Homeland Security
- Utah Geological Survey
- Utah Automated Geographic Reference Center

The natural hazards in Table 7-1 (next page) below have the potential 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 7-2 (page 71) identifies those hazards on a county level for easy reference.

The Wasatch Front Regional Council, with 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 hazards that presented the greatest risk to each of the counties. The geographic extent of each hazard is identified through maps in every county section. The hazard intensity/magnitude and probability profiles are also found in each county section.

County jurisdictions contributed to the risk assessment analyses performed for the county when located within an identified hazard boundary (See Section E). Drought, infestation and severe weather are considered regional hazards and have been profiled as such.

Hazard	How Identified	Why Identified
Earthquake	Review of County Emergency Operations Plans Review of past disaster declarations Input from City and County Emergency Operations Managers, USGS, UGS, Utah DHLS, 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. Yearly, Utah averages approximately 13 earthquakes having a magnitude 3.0 or greater. Earthquakes can create fire, flooding, hazardous materials incident, transportation, and communication limitations. The Wasatch Front has recorded large earthquakes in the past and can be expected to experience large earthquakes in the future.
Landslide	Input from City and County Emergency Operations Managers, USGS, UGS, NCDC, Utah DHLS, and community members	Have caused damage in the past to residential and commercial infrastructure. Can be life threatening. Generally occur in known historic locations therefore risks exist throughout much of the Wasatch Front. To increase community awareness.
Wildland Fire	Review of County Emergency Operations Plans Review of Community Wildfire Plans Input from County Emergency Managers, Utah DHLS, Utah FFSL, Utah FS, NWS, FEMA, and local community members	Serious threat to life and property. Increasing threat due to urban growth in WUI 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. To increase community awareness.
Problem Soils	Review of County Emergency Operations Plans Input from community members, Utah, DHLS, 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 DHLS 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. To increase community awareness. To incorporate mitigation measures into existing plans to help serve local residents.
Flood	Review of past disaster declarations Input from City and County Emergency Operations Managers, Utah DWS, UGS, Utah Army Corps of Engineers, Utah DHLS, and community members Review of Flood Insurance Studies, Floodplain maps, and Flood Insurance Rate Maps	Several 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. Topography and climate lead to cloudburst storms and heavy precipitation can result in flash flooding throughout most of the Wasatch Front.

Table 7-1. Local Hazards Identification

Hazard	How Identified	Why Identified
Drought	Review of Utah State Water Plan Input from community members, Utah DHLS, NWS, NCC, and NCDC	Affects local economy and residents. Reduces available water in reservoirs impacting culinary, irrigation, and municipal water supplies. Drought periods may extend several years. Secondary threat associated with wildfire. Utah is the nation's second driest state. Can impact farming and ranching operations.
Infestation	Review of Utah Department of Agriculture and Food Annual Insect Report and the Utah Forest Insect and Disease Report Input from community members, UDAF, Utah FFSL, and the Utah State University Extension Service	Consistently affects this region. Declined forest health and agriculture losses. Previous experiences have affected the residents of the Wasatch Front. Results in economic loss. Destruction can be severe and is very costly to mitigate. To better understand mitigation and response techniques.
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. Results in economic loss. Lightning is number one cause of natural hazard death in Utah. Can be costly to recover from. Affects the young and old more severely.
Radon	UGS Maps Utah Division of Radiation Control Testing Data.	Is odorless and colorless Can cause lung cancer over time

Table 7-2. Regional Hazards Identification

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.

	Davis County	Morgan County	Salt Lake County	Tooele County	Weber County
Earthquake	X	X	X	X	X
Landslide	X	X	X	X	X
Wildland Fire	X	X	X	X	X
Problem Soils		X	X	X	
Dam Failure	X	X	X	X	X
Flood	X	X	X	X	X
Drought	X	X	X	X	X
Infestation	X	X	X	X	X
Severe Weather	X	X	X	X	X
Radon	X	X	X	X	X

Table 7-3. County Hazard Identification

B. Hazard Profile

This section describes the causes and characteristics of each identified hazard, including its *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, hazard history, and maps of the hazard's geographic location or extent. The hazards were profiled based on history of occurrence, local input, county emergency operations plans, 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. 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.

In determining hazard magnitude a scale was used to identify the level of damage on a countywide basis from Catastrophic to Negligible (Table 7-4).

	Jurisdiction Affected	Risk
Catastrophic	More than 50%	Extreme or High
Critical	25-50 %	Moderate
Limited	10-25%	Moderate
Negligible	Less than 10%	Low

Table 7-4. Hazard Profile

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 where geographic data was available. Hazard histories are provided for each county. These histories were taken from the Spatial Hazard Events and Losses Database for the United States (SHELDUS). Histories for each county were condensed into charts, tables and graphs in each county hazard profile section.

Maps were created using GIS software to identify the location and extent of each identified hazard area. Hazard maps were created for every identified hazard within the region. The following risk assessment maps were created for each county:

Dam/Reservoir Sites
Earthquake Epicenters and Fault Zones
Flood Zones
Ground-shaking Potential
Landslide Susceptibility
Liquefaction Potential
Problem Soils
Wildfire
Combined Structural Hazards

The following risk assessment maps were created at the regional level:

Drought
Infestation
Severe Weather
Radon

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 overlaid with the mapped hazards using GIS software.

Potential Loss Estimates

Potential dollar loss estimates were identified using this same method; 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 not 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. Areas vulnerable to multiple structurally-threatening hazards are mapped in each chapter.

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 titled, Understanding Your Risks: Identifying Hazards and Estimating Losses, Utah DHLS historical data and GIS data.

The information sources used to complete the vulnerability assessment portion of this Plan include; Utah DHLS, County GIS departments, county Assessor's Office, HAZUS-MH data, and the Utah Automated Geographic Reference Center (AGRC). This data was compiled into GIS layers that were used as overlays to identify critical facilities, municipalities, roads, and residents. 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 Wasatch Front Natural Hazards Pre-Disaster Mitigation Plan. For most hazards a comparison was made between digital hazard data and Transportation Analysis Zone (TAZ) demographic information.

Statewide digital data was obtained from Utah Automated Geographic Reference Center (AGRC) for problem soils only. 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 census estimates were 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 determine vulnerability for all hazards was identical. The number of households and population vulnerable to each hazard was determined using WFRC Transportation Analysis Zone (TAZ) data and Block Data from the 2000 Census data. The Block Data from the 2000 Census database, or TAZ 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 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.

The number of acres for all hazards was determined for each city and the unincorporated county. Once an acre total was identified it was overlaid on the Census Block data or TAZ data to determine the total number of homes impacted. The number of homes impacted was then multiplied by the average housing value to determine the total value of potential loss. 2006 average house values from the U.S. Census Bureau were used for Davis, Salt Lake and Weber Counties. 2000 U.S. Census Bureau average house values for Morgan and Tooele Counties were multiplied by the rate of increase for Weber County. This produced an average house value of $203,000 for Morgan County and $148,650 for Tooele County. 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 - Multihazards. 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 that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy. 2007 TAZ data was aggregated to census blocks to update population data within HAZUS-MH.

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 casualties. 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 inventoried. Once the length of vulnerable infrastructure was determined it was multiplied by cost estimate information from HAZUS-MH.

In addition to the linear features, point data for 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, flood, landslides, dam failure, 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, electrical, resulting in incomplete numbers for these features
- Lack of digital parcels data for Morgan and Tooele 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 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. Data manipulation and maps were created as a planning tool, to be used by interested persons within the WFRC Region. This information should not take the place of accurate field verified mapping from which ordinances need to be based.

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 Strategies, Objectives, Actions

Using the findings from the risk assessment and the capabilities assessment as a guide, several mitigation strategies and implementing 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 groups 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 each county section 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 Social, Technical, Administrative, Political, Legal, Economic, Environmental (STAPLEE) method identified in the FEMA How-To Guides. The STAPLEE method of prioritization emphasizes the effectiveness of the actions with respect to their cost, as well as their social, technical, administrative, political, legal, environmental, and economic effects. Each action is 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 the Region has been described. These are general descriptions about each hazard to give an idea of what, why, when, and how the hazards occur.

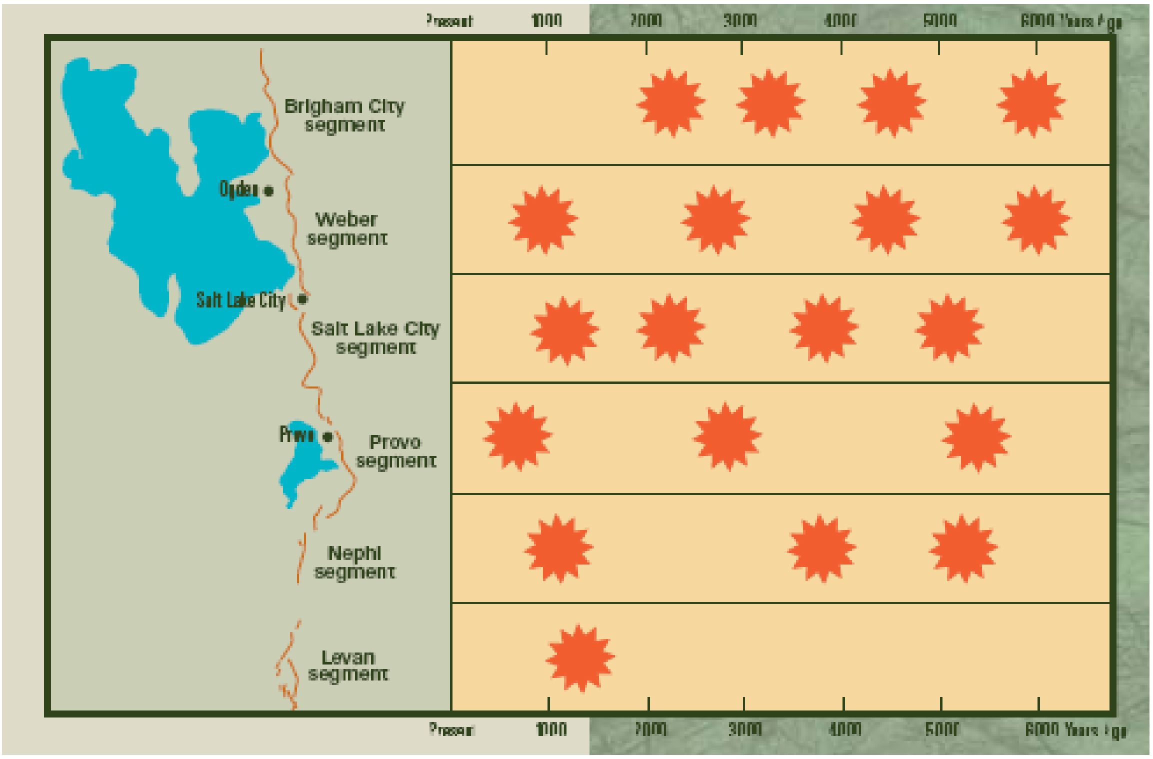


Figure 7-1. Wasatch Fault Segments and Timeline of Major Ruptures (Source: "The Wasatch Fault," Utah Geological Survey)

1. Earthquake

The Utah Geologic Survey defines an earthquake as the result of "…sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface" (UDCEM 1991). 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.

Utah experiences approximately 700 earthquakes each year, and approximately six of those have a magnitude 3.0 or greater (Table 7-5, this page). On average, a magnitude 5.5 or greater earthquake occurs in Utah every 10 years.

Generally, in order for humans to feel an earthquake it 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.

<u>Locations and Activity:</u> 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 (UDCEM 1991).

The earthquake history of the Wasatch Fault is complicated by the fact that we have not had a large earthquake since the first pioneers first arrived in the valley in 1847.

The last major earthquake in the Wasatch Front was approximately 1,350 years before present. Yet, when looking at the region, the potential for a large earthquake exists considering that "since 1850 at least 16 earthquakes (excluding aftershocks) of magnitude 6.0 or greater have occurred within the Intermountain Seismic Belt (ISB)" (UDCEM 1991). 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 the Hurricane, Paragonah, and Sevier faults. The other significant hazard areas in Central Utah are the Stansbury, Joes Valley, and Gunnison faults (UDCEM 1991). 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. The most recent surface-faulting earthquake on the Wasatch fault occurred 400 years ago on the Nephi segment" (UDCEM 1991) (Figure 6-1). The two largest measured 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." (Lund 2005)

Utah's most damaging earthquake was of a smaller magnitude (5.7), which occurred near Richmond in Cache Valley in 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.

"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." (Lund 2005)

On average, Utah experiences a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) 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.

<u>Secondary Hazards</u>: Associated earthquake hazards include ground shaking, surface fault rupture and tectonic subsidence, soil liquefaction, flooding, avalanches, dam failure, fire, and slope failure.

<u>Ground Shaking</u>: 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.

	Wasatch Front	**Utah**
Magnitude	***Frequency***	***Frequency***
≥3.0	3 per year	6 per year
≥4.0	1 every 2 years	1 per year
≥5.0	1 every 10 years	1 every 4 years
≥5.5	1 every 20 years	1 every 10 years
≥6.0	1 every 50 years	1 every 20 years
≥6.5	1 every 120 years	1 every 50 years
≥7.0	1 every 330 years	1 every 150 years

Table 7-5. Average Earthquake Frequency *(Source: UUSS unpublished data in UGS PI-38 1996)* *excludes foreshocks, aftershocks and human-triggered seismic events

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. Aftershocks can occur erratically for weeks or even months after the main earthquake event. (UDCEM 1991)

<u>Surface Fault Rupture and Tectonic Subsidence</u>**:** 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 1934 Hansel Valley earthquake resulted in a surface displacement of approximately 1.6 feet. The highest potential for surface faulting exists in the central segments of the Wasatch fault. Also, earthquakes having a magnitude of 6.5 or greater could result in surface faulting of 16 to 20 feet 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 of subsidence will be in the fault zone and will gradually diminish out into the valley (UDCEM 1991).

<u>Soil Liquefaction</u>**:** Liquefaction occurs when there is a sudden large decrease in shear strength of sandy soils. It is 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) and 2) ground shaking must be strong enough to cause susceptible soils to liquefy (Lips 1999). 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 several miles at speeds 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. (UDCEM 1991)

<u>Slope Failure</u>**:** 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. (UDCEM 1991)

<u>Flooding:</u> "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." (UDCEM 1991)

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 (UDCEM 1991).

Sensitive Clays: Sensitive clays are a soil type that loose strength when disturbed and result in liquefaction or collapse. The resulting type of ground failure is similar to liquefaction (UDCEM 1991).

Subsidence: A settling or sinking of the earth's crust in loose granular materials such as gravel that do not contain clay. Western Utah is subject to this type of ground settlement (UDCEM 1991).

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 (UDCEM 1991).

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 (UDCEM 1991).
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 storms that last several days with a less intense rainfall can produce a flooding event (UDCEM 1991).

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 Basin has several terminal lakes, such as the Great Salt Lake and Sevier Lake, which mean there is no outlet to the sea. These types of lakes are subject to considerable variations in water levels because the only outflow is by evaporation. Successive wet or dry periods lasting several years can result in a large change in size of terminal lakes. Development near this type of lake during a dry period is risky and certain to get flooded during wet periods (UDCEM 1991).

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 channels can also play a role in flooding. Trash and debris can obstruct passageways (UDCEM 1991).

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", the highest level of five hazard classes given by the U. S. Geological Survey. The three main contributing factors to slope failure include areas with moderate to steep slopes, conductive geology, and high precipitation. The main elements that cause slope failure include precipitation events, topography and vegetation (UDCEM 1991). 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 (UDCEM 1991).

<u>Rock Falls and Rock Topples</u> 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.

<u>Debris Slides and Debris Flows</u> 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.

<u>Slumps</u> 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 such as lawn watering and irrigation may place excess water on already unstable ground by adding water weight to the material and raise 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 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 Wildland-Urban Interface (WUI) 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 (UDCEM 1991).
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 (UDCEM 1991).

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 occur 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 (UDCEM 1991).

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 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 (UDCEM 1991).

Weather factors include temperature, humidity, precipitation, and wind. Weather affects the ease with which a fuel ignites, the intensity at which it burns, and how easy or difficult fire control may be.

High temperatures increase fire danger because it heats fuels and reduces water content, which increases flammability. Humidity influences fuel ignition and how intensely fuel burns. A decrease in relative humidity causes fuels to dry, promoting easier ignition and more intense burning. Wind speed can increase burning intensity and the direction that the fire moves. 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 well ahead of the main fires starting spot fires (UDCEM 1991).

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 WUI areas increase the risks to firefighters significantly. Legally, federal wildland protection agencies seldom have the responsibility to protect structures. The legal responsibility for protecting structures on non-federal wildlands varies widely among state forestry agencies (UDCEM 1991).

5. Dam Failure

Dams and associated water delivery systems serve various functions and are built by different agencies and entities including; the Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, cities, counties, and private irrigation companies. Dams are built for hydroelectric power generation, flood control, recreation, water storage for irrigation, as well as municipal and industrial uses. Utah's dry climate makes it critical for the storage of the winter snowmelt runoff for uses all year round. 84% of Utah's stored water is behind federal dams, while 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 it can collect and distribute the greatest amount of water. Dam sites with strong impermeable bedrock are the best in terms of strength. Many 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 (UDCEM 1991).

"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" (UDCEM 1991).

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 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 away. 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 then fails internally or overtops and washes 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 (UDCEM 1991).

"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" (UDCEM 1991). Over two hundred Utah dams are rated as high-hazard dams.

6. Drought

According to the National Drought Mitigation Center, 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" (NDMC 2006). Drought is also related to the timing and effectiveness of precipitation. 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 that impacted.

Usually, a one to two year drought affects only agriculture, while a three-year drought may significantly impact culinary water in the local areas and communities.
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 (NDMC 2006).

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 (NDMC 2006).

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 (NDMC 2006).

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 (NDMC 2006)

Socioeconomic drought occurs when the physical water shortage begins to affect people (NDMC 2006). 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 (NDMC 2006).

Measuring Drought:

Palmer Drought Severity Index (PDSI): Developed 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 (NDMC 2006).

Surface Water Supply Index (SWSI): Developed in 1982, the SWSI index uses the same basic classifications as the Palmer Drought Index and is designed to complement the Palmer Index in the western states. The SWSI is more of an indicator of surface water conditions and is 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 (NDMC 2006).

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 (NDMC 2006).

A drought analysis review of 33 gauging stations data 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 mountains 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 have decreased. 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

Winter Storm: Winter storms gain 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 warm air is advancing, it will ride 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 (Scholastic 2008).

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. Bridges and overpasses are likely to freeze first. (NWS 2001)

Heavy Snow will sometimes "immobilize a region by stranding commuters, stopping the flow of supplies, disrupting emergency and medical services, close infrastructure and services" (NWS 2001). When heavy snow occurs with high winds, blowing snow or blizzard conditions may exist. (NWS 2001).

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" (UDCEM 1991). 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 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 causing ground shaking. The two main natural factors that affect avalanche activity include weather and terrain and large, frequent storms combined with steep slopes. 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 annually kill more people than any other natural hazard, and ironically, are often triggered by the victim. Each winter an average of four people dies in Utah due to avalanche activity (UDCEM 1991).

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 (UDCEM 1991).

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, the strong sun on south facing slopes produce more wet avalanches (UAC 2008).

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-slab 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-slab avalanches usually travel between 60-80 miles per hour within 5 seconds of the fracture and are the deadliest form of avalanche (UAC 2008).

Wet-slab 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 (UAC 2008).

Avalanches can result in loss of life as well as economic losses. At risk are some communities, individual structures, roads, ski areas, snowmobilers, backcountry skiers, snowshoers, snowboarders, and climbers. One of the major consequences of 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 (UAC 2008).

<u>Severe Thunderstorms</u> usually last around 30 minutes and are typically only 15 miles in diameter (NWS 1999), but all produce lightning, the "number one weather-related killer" in Utah (NWS

2008). Thunderstorms can also lead to flash flooding from heavy rainfall, strong winds, hail and tornadoes or waterspouts (NWS 1999).

Tornado: Expressed as "a violently rotating column of air extending from a thunderstorm to the ground" (NWS 1999), a tornado is often on the edge of the updraft or next to the air coming down from the thunderstorm. A 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 greater than 250 miles per hour with a damage zone of 50 miles long and greater than 1 mile wide (NWS 1999). Most tornadoes in Utah typically have winds less than 110 miles per hour, are no wider than 60 feet and are on the ground longer than "a few minutes" (Brough, et al. 2007).

A change in wind direction and an increase in wind speed along with increasing height create a 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 (NWS 1999).

Scale: Tornadoes are classified by the National Weather Service using the Fujita Scale, which relates wind speed to damage to determine tornado intensity. The scale uses numbers from 0 through 5 with the ratings based on the amount and type of wind damage (SPC 2007). This scale has recently been modified and is now referred to as the Enhanced Fujita Scale. The Enhanced Fujita Scale classifications are listed below:

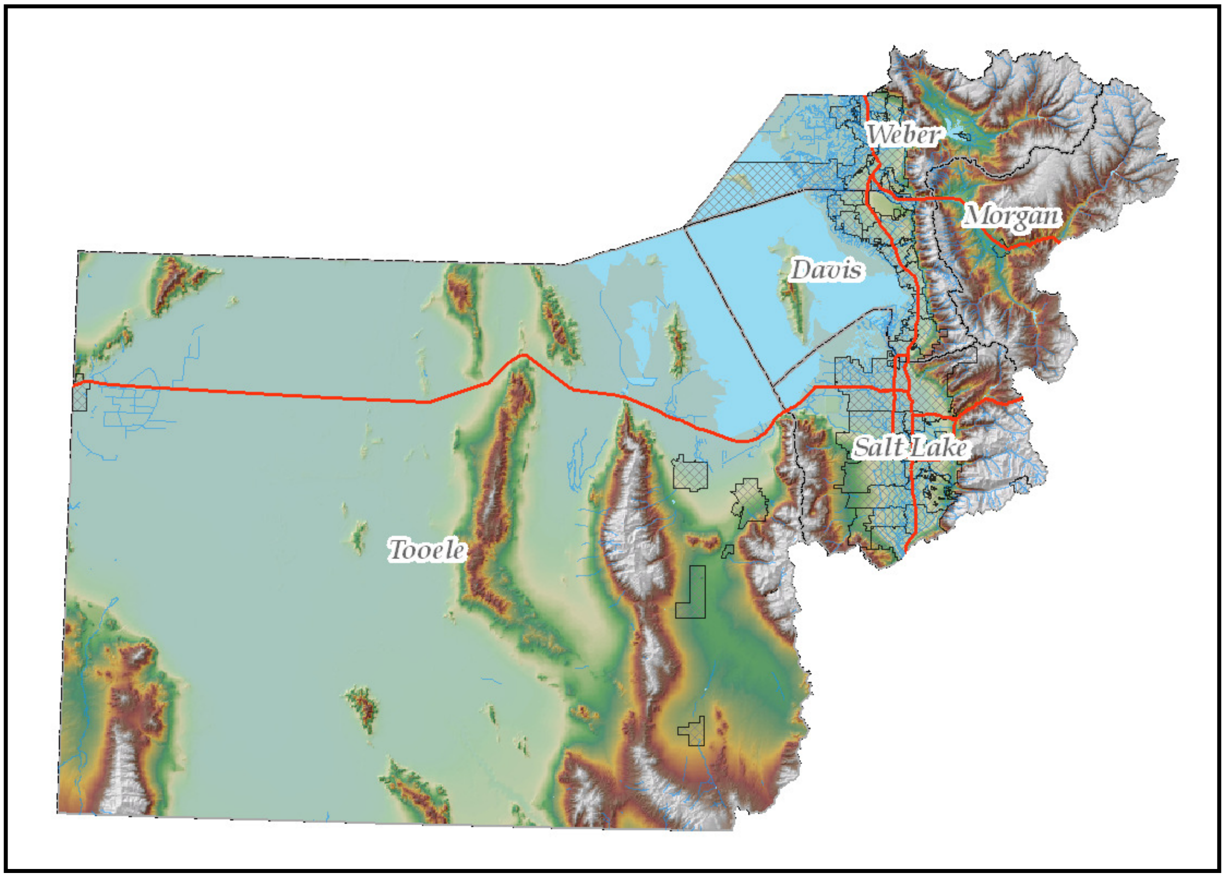
Enhanced Fujita Scale
EF-0: 65-85 mph, Light damage, downed tree branches, chimney damage
EF-1: Winds 86-110 mph, Moderate damage, mobile home damage
EF-2: Winds 111-135 mph, Considerable damage, mobile home demolished, trees uprooted
EF-3: Winds 136-165 mph, severe damage, roofs and walls torn down, trains overturned, cars thrown
EF-4: Winds 166-200 mph, Devastating damage, well-constructed walls leveled
EF-5: Winds over 200 mph, incredible damage, homes lifted off foundation and carried, autos thrown as far as 100 feet.
(SPC 2007a)

Waterspouts are weak tornadoes that form over warm water, and in Utah generally occur with cold, late fall or late winter storms (Brough, et al. 2007).

Extreme Heat kills more people in the United States each year than any other weather-related hazard (NOAA 2008). Extreme heat is defined as "summertime weather that is substantially hotter and/or more humid than average for a location at that time of year" (EPA 2006). Extreme heat poses multiple threats to persons and infrastructure. Not only may personal health be affected through heat cramps, heat exhaustion or heat stroke (EPA 2006), but power grids are substantially burdened through the increased use of air conditioning, potentially resulting in brownouts or blackouts.

Certain populations are especially vulnerable during these events. These include the very young and elderly, the poor and homeless, reclusive persons, persons with physical or mental impairment, persons using specific medications, illicit drugs or alcohol, or persons strenuously working or playing outdoors (EPA 2006).

Extreme Cold: Prolonged exposure to the cold can cause frostbite or hypothermia and can become life threatening (NWS 2001). Increasing winds can increase the risk to this hazard.



Map 8-1. Wasatch Front Region

Part VIII. Regional Hazards

Certain natural hazards are widespread with no unique risk affecting a single jurisdiction. To adequately examine the scope of these hazards, they must be analyzed on a regional level. Regional hazards examined in this section include severe weather (high winds, fog, severe storms which can produce thunderstorms, lightning, hail, tornado, and heavy precipitation, extreme temperatures and avalanche), drought, insect infestation and radon.

Severe weather has caused considerable losses for the region. Although drought is also a weather-related hazard, it is treated separately here and continues to be an issue in the region. Insect infestations regularly irritate farmers, gardeners and arborists alike. Refer to each county section for more information on historical hazard costs.

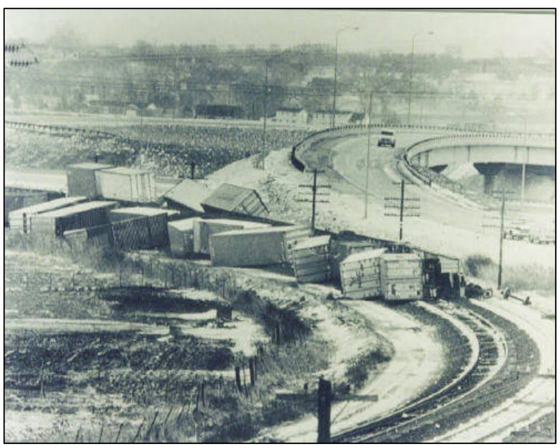
Most jurisdictions in this plan have not developed mitigation strategies for these regional hazards. There are several reasons. There may be a relatively minor jurisdictional impact, or the simple inability to mitigate the risk of a specific, or the high cost of mitigating the risk would result in a very minor return on public fund investment.

1. Severe Weather

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	***Probability***	*X*	*Highly Likely*
		Critical (25-50%)			*Likely*
	X	*Limited (10-25%)*			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Occur in localized areas throughout the region. Although many severe weather phenomena generally have recognizable patterns of recurrence, it is difficult to identify exactly when and where the next event will take place.				
Seasonal Pattern	Year round				
Conditions	Vary based on latitude, elevation, aspect and land forms				
Duration	Severe weather hazards generally last hours and can persist for days.				
Secondary Hazards	Wildfire, flooding				
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, Utah DHLS, local input, and review of historic events and scientific records.				

Description of Location and Extent



Wasatch Front, April 4-6, 1983 – 70 mph "East Winds" derailed this train in the Lagoon area. Peak gusts were recorded at 104 mph. *(Source: Utah's Weather and Climate, Photo: Ogden Standard Examiner)*

High Winds

High winds can occur with or without the presence of a storm and are 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 (see Map 8-2 page 96), and can expect regional high wind future events.

Canyon winds can bring wind gusts greater 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 have also damaged roofs, destroyed and knocked down large trees and fences, overturned tractor trailers and railroad cars, and downed small airplanes.

Fog

Temperature inversions often occur during the winter months as a result of high pressure trapping cold air in the valley. These inversions keep cold, moist air trapped on the Wasatch Front valley floor forming super-cooled fog. This fog can cause visibility restrictions and icy surfaces. Wind is needed to clear the inversion and fog. The Great Salt Lake has been shown to affect the prevalence of fog, especially when lake levels are high (Hill 1987).

Severe Storms

Severe storms can include thunderstorms, lightning, hailstorms, heavy snow or rain, extreme cold and avalanche. These storms are generally related to high precipitation events during the summer and winter months and can happen anywhere in the region. Damage can be extensive especially for agriculture, farming, and transportation systems; they can also disrupt business due to power outages.

Thunderstorms

Strong, rising air currents bring warm, moist air from the surface into the upper atmosphere where it condenses forming heavy rains, hail, strong winds and lightning. Based on historical evidence thunderstorms can strike anywhere in the region, mainly during the spring and summer months

Salt Lake Valley, September 3rd, 1983 - Thunderstorms produce 0.5" – 1.5" hail *(Source: Utah's Weather and Climate, Photo: National Weather Service)*

Hailstorms

Hailstorms occur when freezing water (in thunderstorm 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, damage can be extensive (especially when combined with high winds). See Map 8-3 (page 97) for spatial distributions of hail events.

Lightning

Lightning is the electric discharge between clouds or from a cloud to the earth. In Utah, lightning causes the highest number of weather-related fatalities (NWS 2008). Lightning casualties occur most frequently during the summer monsoonal flow in July and August. See Table 8-1 for the number of casualties caused by lightning. Lightning is also the primary cause of wildland fires in Utah (NWS 2008), which could cause casualties or be disruptive to the economy. Map 8-4 (page 98) shows the annual distribution of lightning strikes for region.

County	Deaths	Injuries
Davis	1	3
Morgan	1	2
Salt Lake	8	42
Tooele	2	10
Weber	2	4

Table 8-1. Lightning Casualties 1958-2007
(Source : NWS 2008)

Lewis Peak, North Ogden, Utah, August 8th, 2003 – Lightning *(Source: Utah's Weather and Climate, Photo by Gene Poncelet)*

Tornado

Great Salt Lake, September 12th, 1998 – Waterspout *(Photo: KTVX News 4)*

Salt Lake City Tornado, August 11, 1999 – Orange fireball is a power sub-station exploding (*Photo: KTVX News 4)*

Historically, atmospheric conditions have not been favorable for tornado development in Utah due to a dry climate and mountainous terrain. Utah is one of the lowest ranked in the nation for incidences of tornadoes with only one F2 or stronger tornado every seven years. Utah averages about two tornados per year which typically occur between May and August.

Despite this fact, interactions of the relatively cool air of the Great Salt Lake and relatively warm air of urban areas could create situations more favorable for tornado development. This phenomenon possibly contributed to the formation of the August 1999 Salt Lake City tornado (Dunn and Vasiloff 2001) which was the costliest disaster in Salt Lake County history causing over $170 million in damages.

Tornado distribution for the region (Map 8-5 page 99) suggests many tornadoes are funnel clouds aloft coming into contact with the increasing elevation of the region's foothills and mountains.

Heavy Precipitation

East Bench, Salt Lake Valley, October 18, 1984 – 22 inches of snow falls in 24 hours. (*Source: Utah's Weather and Climate, Photo: Salt Lake Tribune)*

Heavy amounts of precipitation from rain or snow can result in flash flood events. 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. Heavy snow can cause a secondary hazard in avalanches.

Much of the valley's development has occurred on old alluvial fans from the canyon mouths. During heavy rain events, water and debris collect on these same alluvial fans, damaging residential, commercial property and infrastructure. See Map 8-6 (page 100) for the regional flash flood hazard.

Extreme Temperatures

Temperatures in Utah can reach the extreme ends of the thermometer. Winter months often experience temperatures below zero degrees Fahrenheit. Summer temperatures regularly reach into the nineties with many days above 100 degrees Fahrenheit. Drastic temperature changes also occur, even in matter of hours. Temperature swings in such a short period of time can cause severe emotional stress in people, sometimes resulting suicide.

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. Especially vulnerable to extreme cold are the young, elderly, homeless and animals. Wind chill can further the effects of extreme cold. See Map 8-7 (page 101) for the average annual occurrences of freezing temperatures for the region.

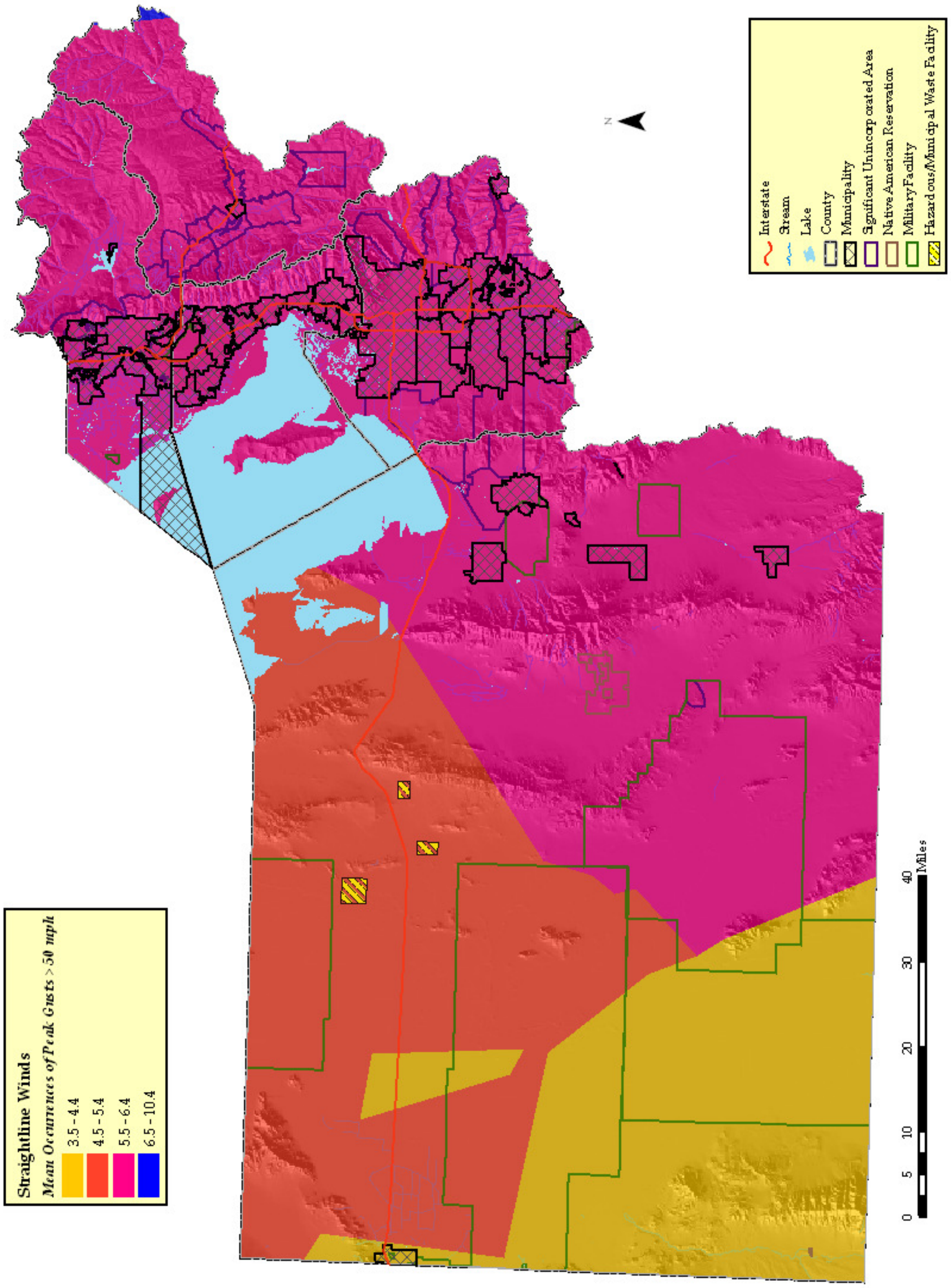
Extreme heat not only causes discomfort, but can lead to heat exhaustion or heat stroke. Extreme heat also places severe strain on electrical systems due to the widespread use of evaporative coolers and air conditioners. This strain can lead to brownouts or blackouts leaving many without electrical power. See Map 8-8 (page 102) for the average days above 90° Fahrenheit annually.

Avalanche

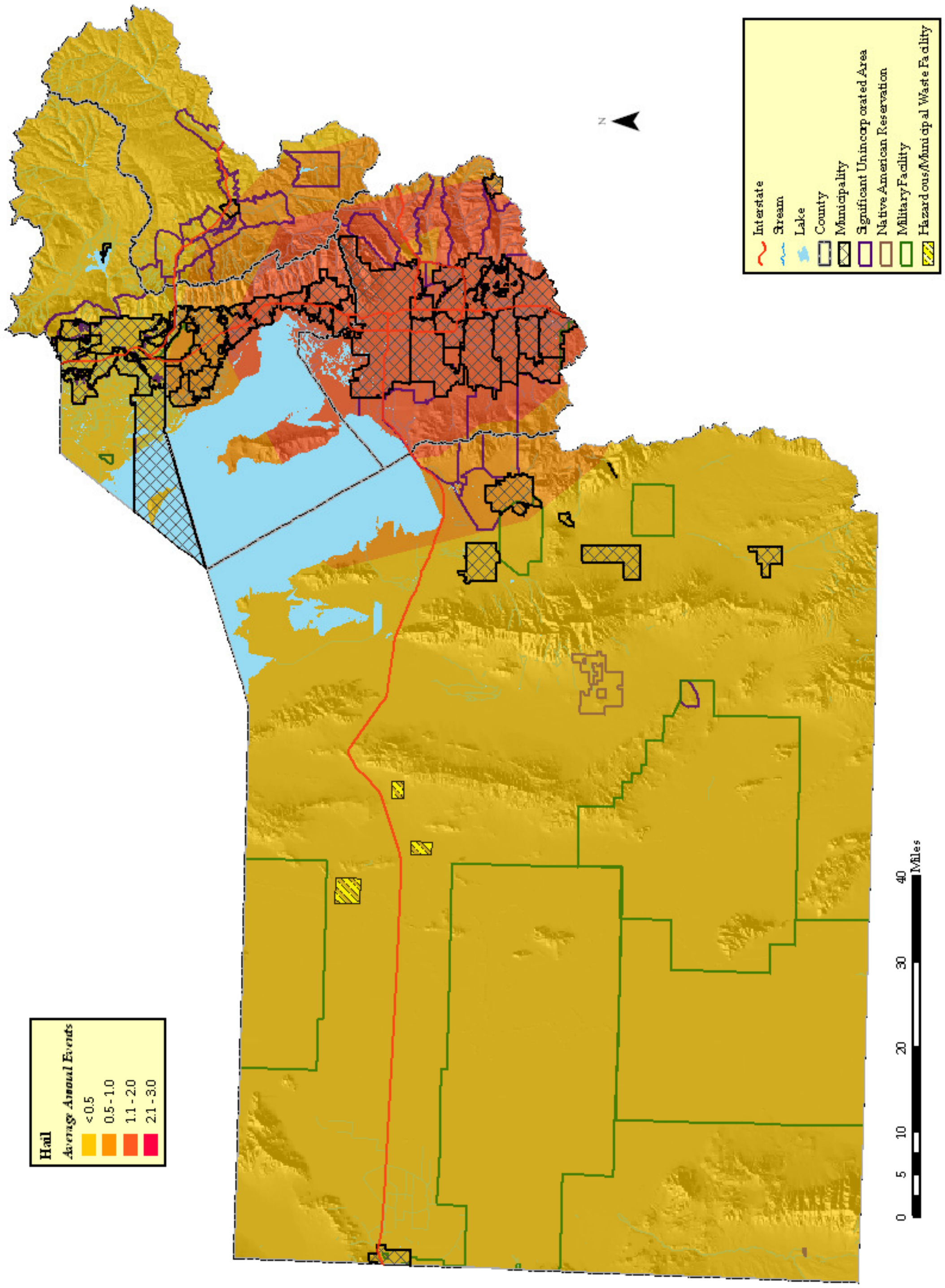
White Pine, Little Cottonwood Canyon, December 23rd, 1988 – two to three feet of snow deposited in the mountains causes many avalanches *(Source: Utah's Weather and Climate, Photos: National Weather Service)*

Heavy snows, high winds, extreme temperatures and steep mountain slopes combine to form avalanche hazards in the foothills and mountainous areas of the region. Even though most avalanches occur in wildland areas, recreational endeavors – hiking, hunting, mountain climbing, skiing, snowboarding, snowmobiling and other wintertime activities – bring the population into contact with avalanche-prone areas. Due to the immense popularity of these activities, avalanches are actively mitigated within well-traveled areas. Persons venturing into the backcountry are more at risk. Homes and businesses along the foothills and in mountain areas have been damaged from avalanches.

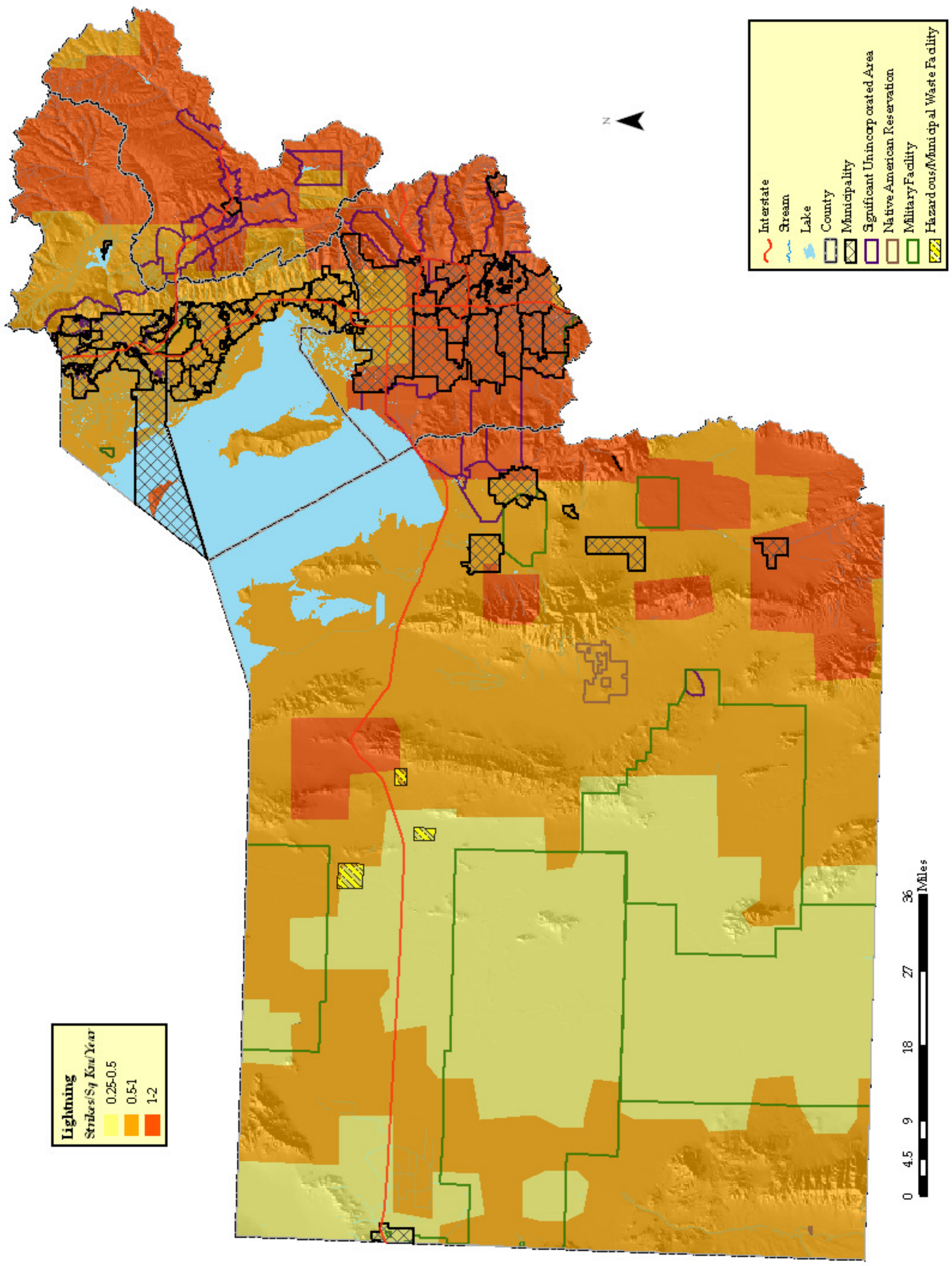
The majority of avalanches occur on slopes between 30 and 50 degrees and with terrain barren of vegetation. Types of avalanches include wet and dry slab. *Wet-slab avalanches* occur most often in warming conditions on southerly-facing slopes. *Dry-slab avalanches* occur mostly on northerly facing slopes in mid-winter. Wind can accelerate snow deposition leading to larger and/or more frequent avalanches (UAC 2008).



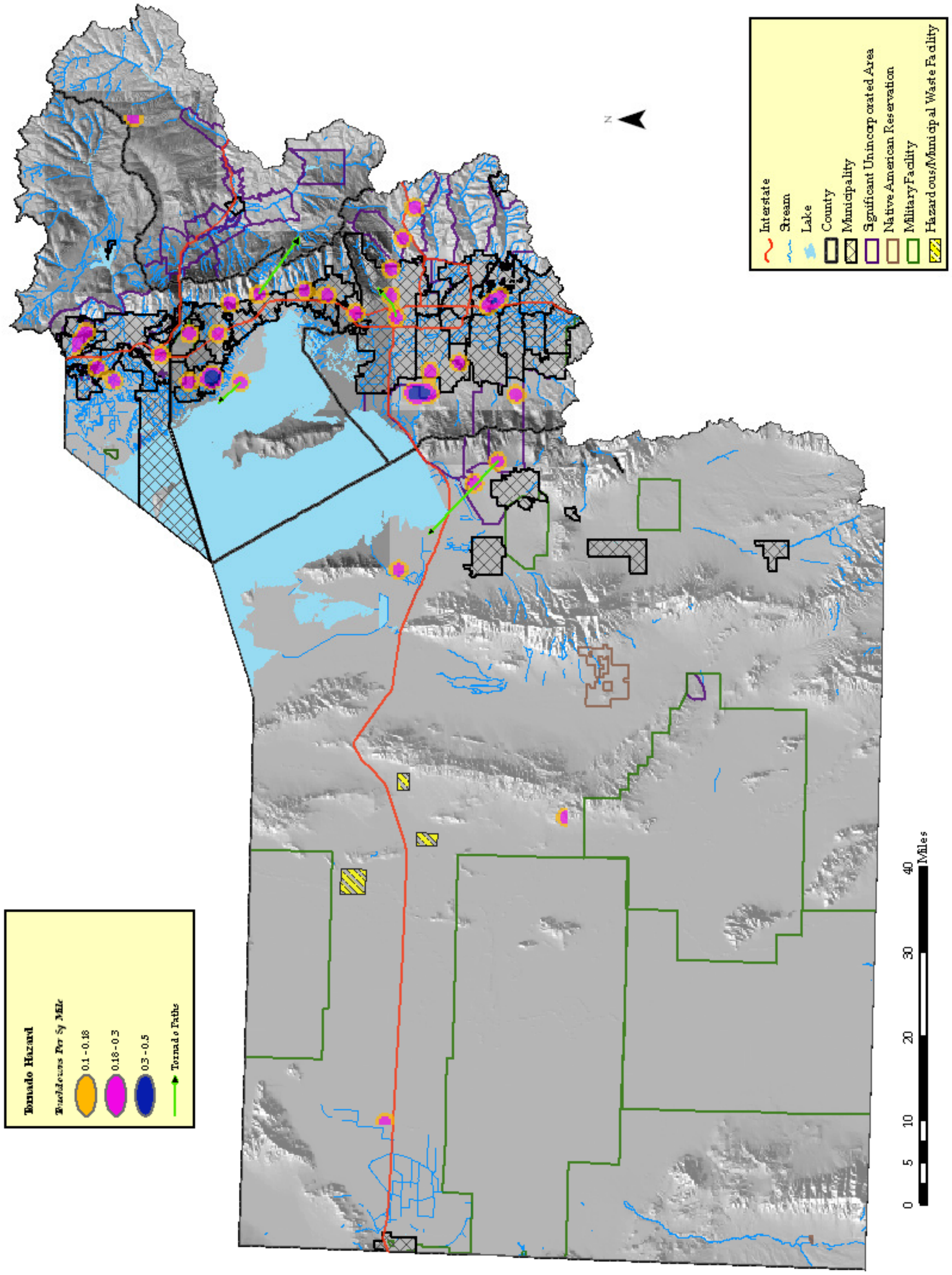
Map 8-2 Regional Hail Hazard (Source: National Climatic Data Center)



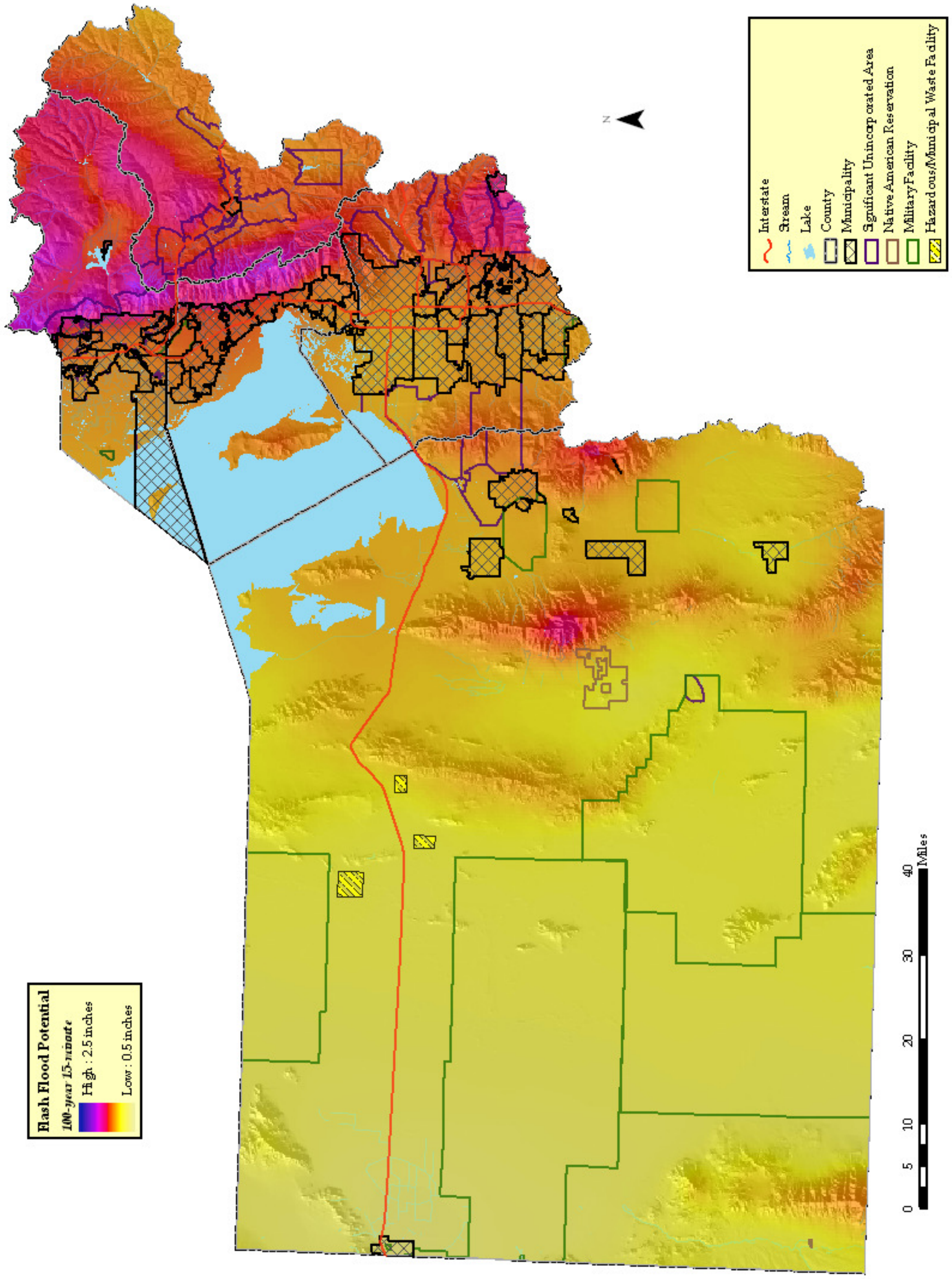
Map 8-3 Regional Hail Hazard (Source: National Climatic Data Center)



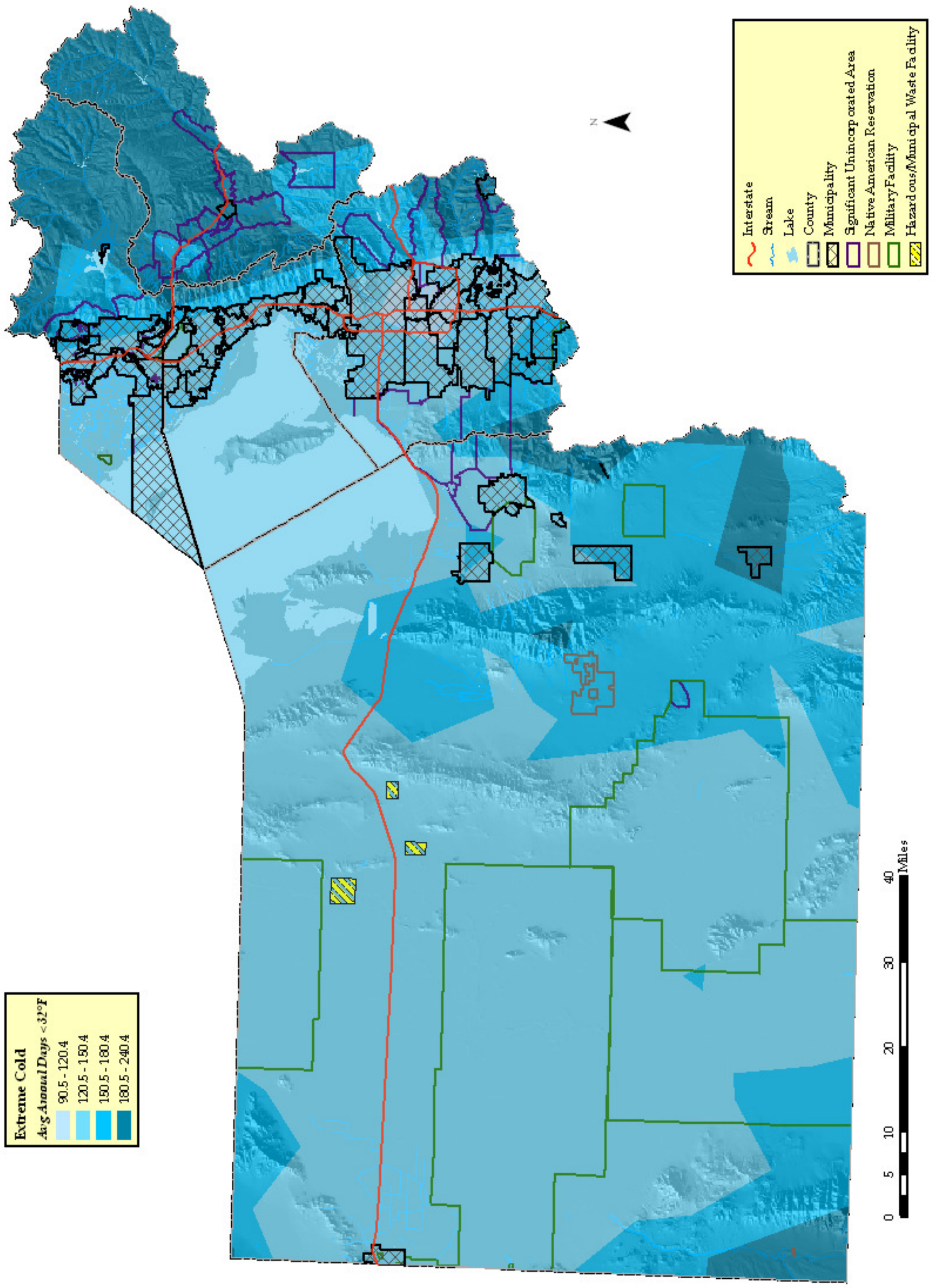
Map 8-4 Regional Lightning Hazard (Source: National Climatic Data Center)



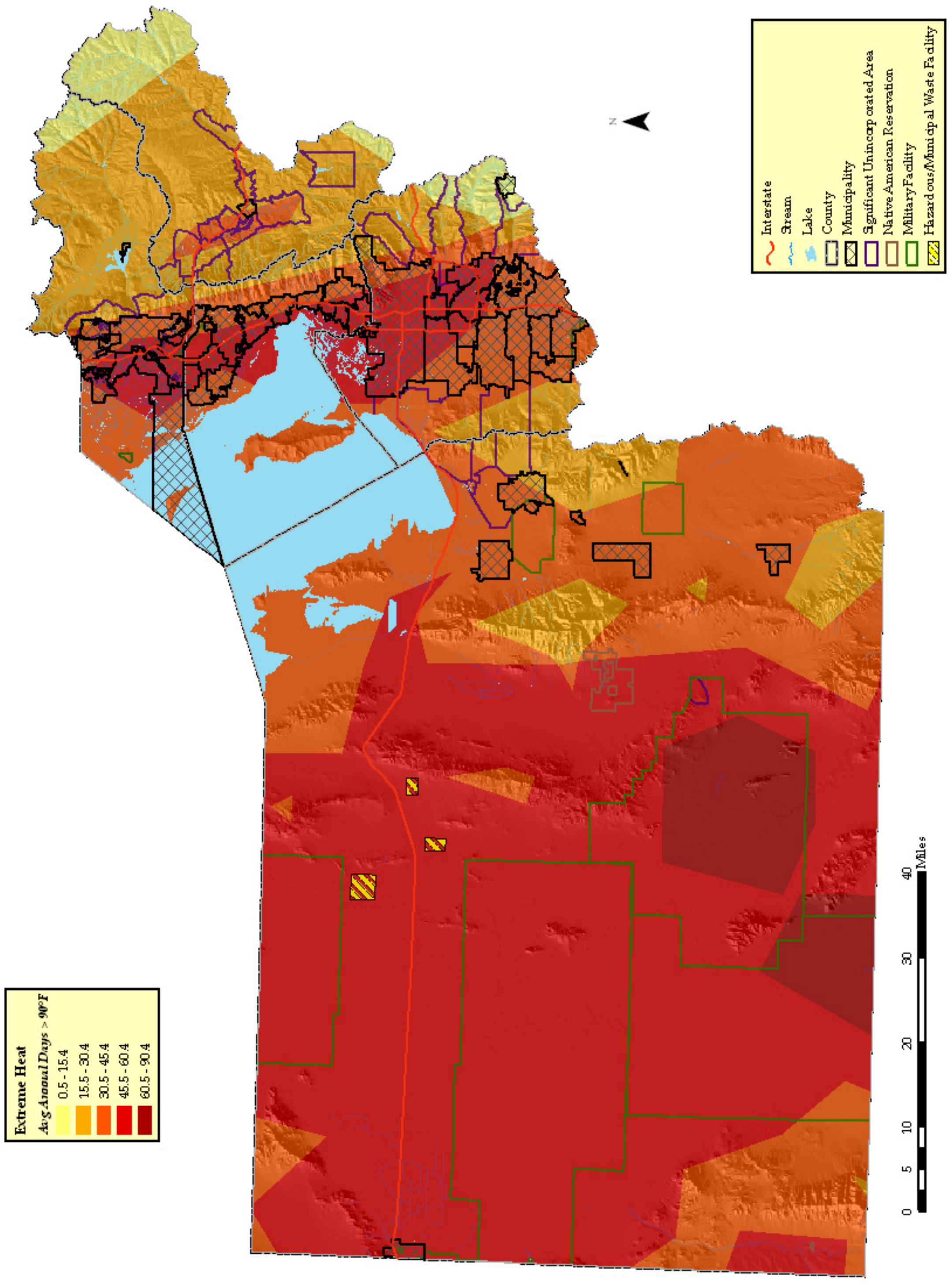
Map 8-5 Regional Tornado Hazard (Source: NWS Storm Prediction Center)



Map 8-6 Regional Flash Flood Hazard (Source: NWS Hydrometeorological Design Studies Center)



Map 8-7 Regional Extreme Cold Hazard (Source: National Climatic Data Center)



Map 8-8 Regional Extreme Heat Hazard (Source: National Climatic Data Center)

2. Drought

Hazard Profile

<table>
<tr><td rowspan="4">Potential Magnitude</td><td></td><td>Catastrophic (>50%)</td><td rowspan="4">Probability</td><td></td><td>Highly Likely</td></tr>
<tr><td>X</td><td>Critical (25-50%)</td><td>X</td><td>Likely</td></tr>
<tr><td></td><td>Limited (10-25%)</td><td></td><td>Possible</td></tr>
<tr><td></td><td>Negligible (< 10%)</td><td></td><td>Unlikely</td></tr>
<tr><td>Location</td><td colspan="5">Region wide</td></tr>
<tr><td>Seasonal Pattern</td><td colspan="5">Summer</td></tr>
<tr><td>Conditions</td><td colspan="5">Meteorological Drought: Lack of precipitation
Agricultural Drought: Lack of water for crop production
Hydrologic Drought: Lack of water in the entire water supply
Socioeconomic Drought: Lack of water sufficient to support population</td></tr>
<tr><td>Duration</td><td colspan="5">Months, Years</td></tr>
<tr><td>Secondary Hazards</td><td colspan="5">Wildfire, dust storms, air quality</td></tr>
<tr><td>Analysis Used</td><td colspan="5">National Weather Service, Utah Climate Center, Utah Division of Water Resources, Newspapers, Local input.</td></tr>
</table>

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 emerging from drought conditions experienced since 1999. 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.

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 or less	Extreme drought

Table 8-2 Palmer Drought Severity Index (NDMC 2006)

The Palmer Drought Severity Index (PDSI) developed by Wayne Palmer in the 1965, measures drought severity using temperature, precipitation and soil moisture (Utah Division of Water Resources 2007a). The PDSI has become the "semi-official" drought index as it is standardized across various climates. The index uses zero as normal and assigns a number between +6 and -6, with dry periods having negative numbers and wet periods expressed using positive numbers (Table 8-2) (NDMC 2006).

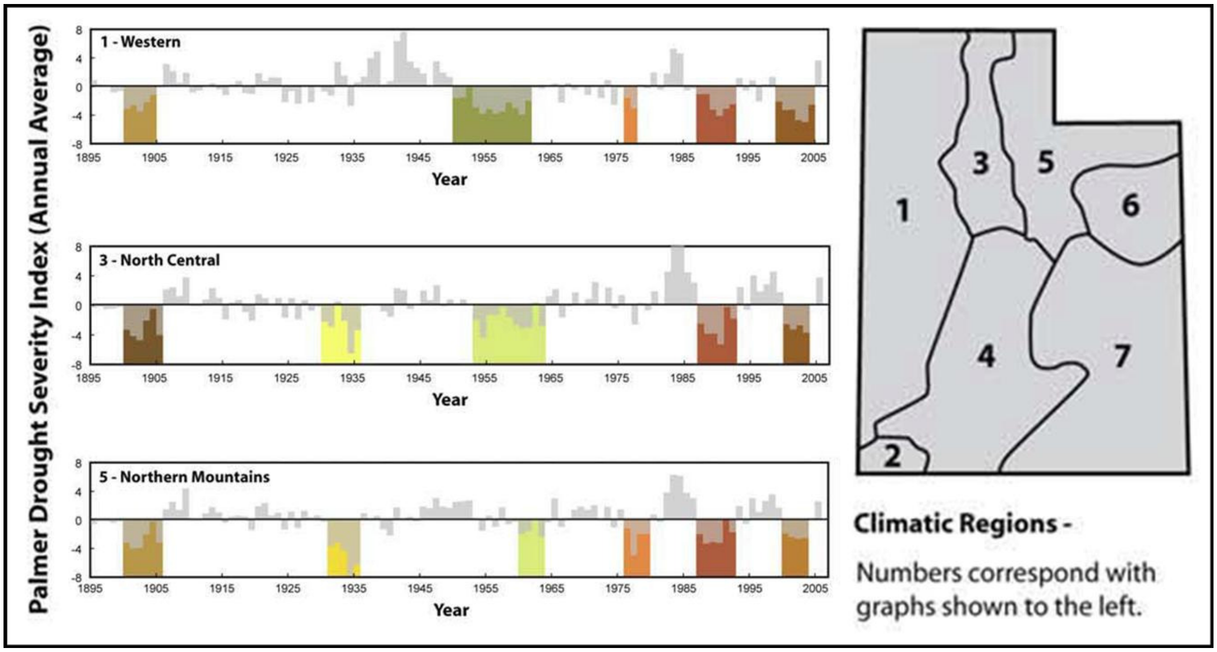


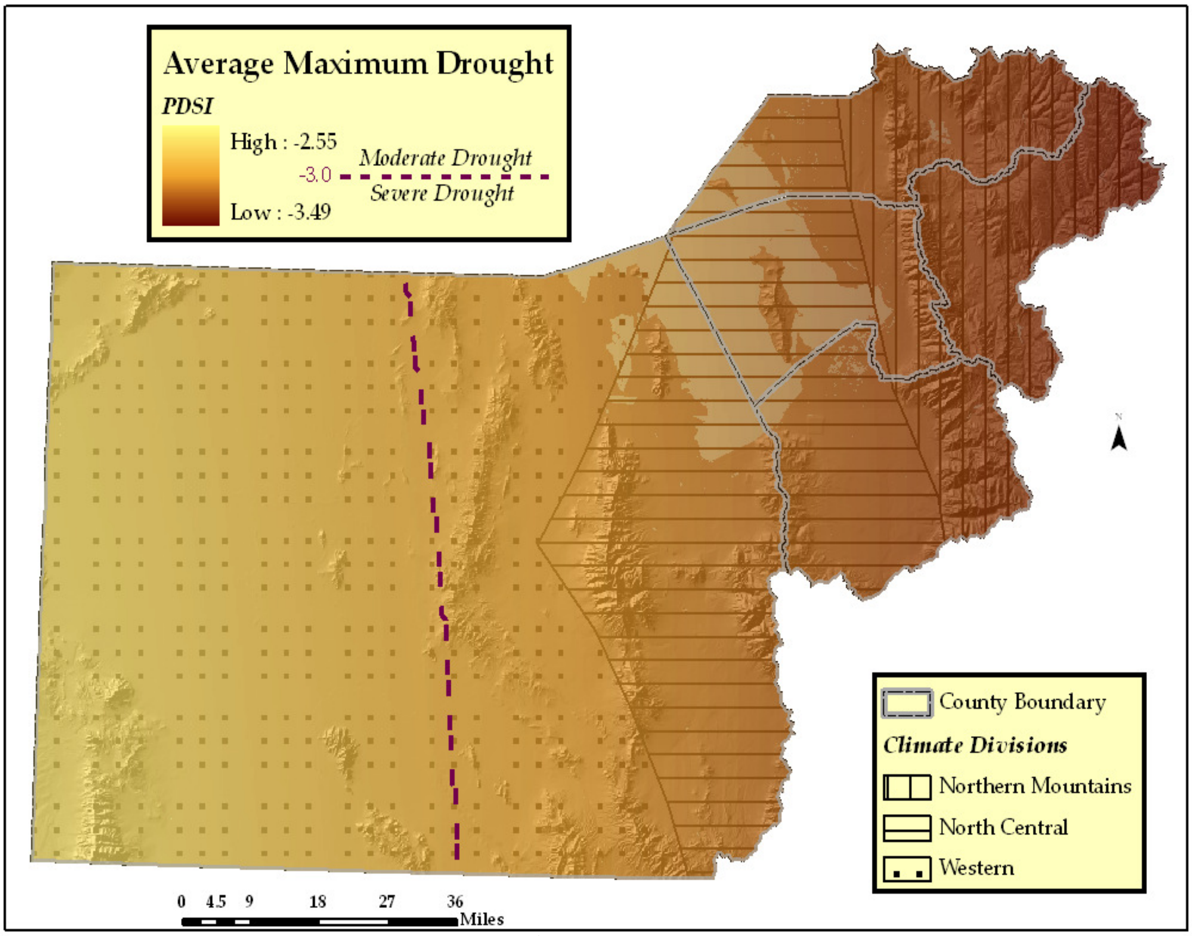
Figure 8-1 Annual Average PDSI *(Modified from* Utah Division of Water Resources 2007a*)*

The planning area falls within three climatic regions: the Western region (1), the North Central region (3), and the Northern Mountains region (5) (See Figure 8-1). Each of these regions has differing characteristics, but often experience similar drought periods. The three regions experience mild drought (PDSI ≥ -1) every 2.6-3.3 years, moderate drought (PDSI ≥ -2) every 3.7-5.2 years, and severe drought (PDSI ≥ -3) every 6.9-8.5 years. The Western region typically experiences droughts more frequently and the Northern Mountains region typically experiences droughts less frequently (Utah Division of Water Resources 2007a).

Conversely, the Northern Mountains region averages more severe drought conditions at its peak than the Western region (Map 8-9 page 105). It may be Northern Mountains region simply has more water to lose as the Wasatch and Uinta Mountains receive much more precipitation on average. The North Central region falls between both regions in all drought conditions, but is most similar to the Northern Mountains region.

The most severe drought period in recorded history for the North Central and Northern Mountains regions occurred in 1934 at the height of the Great Depression (Figure 8-1 above) and during the same drought period (1930 to 1936) that caused the "Dust Bowl" on the Great Plains. The Western regions driest year on record occurred more recently, in 2004. The longest drought period varies from 12 years in the Western region (1950-1961), 11 years for the North Central region (1953-1963), and 6 years for the Northern Mountains (twice; 1900-1905 and 1987-1992) (Utah Division of Water Resources 2007a).

Times of extended drought can turn into socioeconomic drought, or drought that begins to affect the general population. When this occurs, reservoirs, wells and aquifers are low and conservation measures are required. Some forms of water conservation are water-use restrictions, implementation of secondary water or water recycling and xeriscaping. Other conservation options include emergency water agreements with neighboring water districts or transporting water from elsewhere.



Map 8-9 Average Maximum Drought Year (Dai, et al. 2004)

3. Infestation

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)		X	*Likely*
	X	*Limited (10-25%)*			*Possible*
		Negligible (< 10%)			*Unlikely*

Location	Dependent on vegetation and climate preference of individual insect species
Seasonal Pattern	Typically spring and summer months
Conditions	Varies with insect species
Duration	Months, years
Secondary Hazards	Wildfire, dust storms, landslides due to dead vegetation
Analysis Used	Utah Department of Agriculture and Food (UDAF), United States Forest Service (USFS), Utah Division of Forest, Fire, and State Lands (UDFFSL)

Description of Location and Extent

Insect infestation has been largely kept at bay due to the ongoing efforts of the Utah Department of Agriculture and Food (Table 8-3). Several threats still exist in the Wasatch Front study area, particularly from Cereal Leaf beetles, Japanese beetles, Gypsy moths, Mormon crickets and grasshoppers, and various wood borers and bark beetles.

The Cereal Leaf beetle first appeared in Utah in 1984 in Morgan County. The beetle is currently found in all Wasatch Front counties. Cereal Leaf beetles feed on grains and can cause much damage to these crops. To combat the spread of the Cereal Leaf beetle, the Utah Department of Agriculture and Food (UDAF) has introduced a parasitic wasp. (UDAF 2007a)

Africanized Honey Bee	European Corn Borer[3]	Grasshopper*[2]
Apple Maggot[1]	Egyptian Cottonworm[2]	Red Imported Fire Ant
Cherry Fruit Fly[1]	Silver Y Moth[2]	Black Imported Fire Ant
Asian Gypsy Moth[1]	False Codling Moth[1]	Mosquito/West Nile Virus*[2]
Rosy (Pink) Gypsy Moth[1]	North American Gypsy Moth*[2]	Woodwasp[4]
Siberian Silk Moth[1]	Japanese Beetle[4]	Exotic Woodborers
Nun Moth[1]	Mormon Cricket*[2]	Exotic Bark Beetles
Cereal Leaf Beetle*[2]	* Detected in Wasatch Front study area, 2007	
[1] Traps in all Wasatch Front counties except Morgan County [2] Traps in all Wasatch Front counties	[3] Traps in Davis and Weber counties only [4] Traps in Davis, Salt Lake and Weber counties only	

Table 8-3 Insects Currently Monitored by Utah Department of Agriculture and Food (UDAF 2007a)

Mormon crickets and grasshoppers regularly are found in the Wasatch Front study area. In small numbers, these insects do not cause much of a problem, but when their populations explode, great hordes can devastate crops. The following except from the 2007 Annual Insect Report by UDAF outlines how these populations can explode:

"Often the damage done to agricultural commodities is increased by the effects of warmer weather and drought. Mild winters and hot, dry weather speed up the maturation process of these insects and allow more of them and their eggs to survive the cold. Drought also cuts into the population of birds and rodents that prey on them, and the fungal diseases that decrease insect numbers."

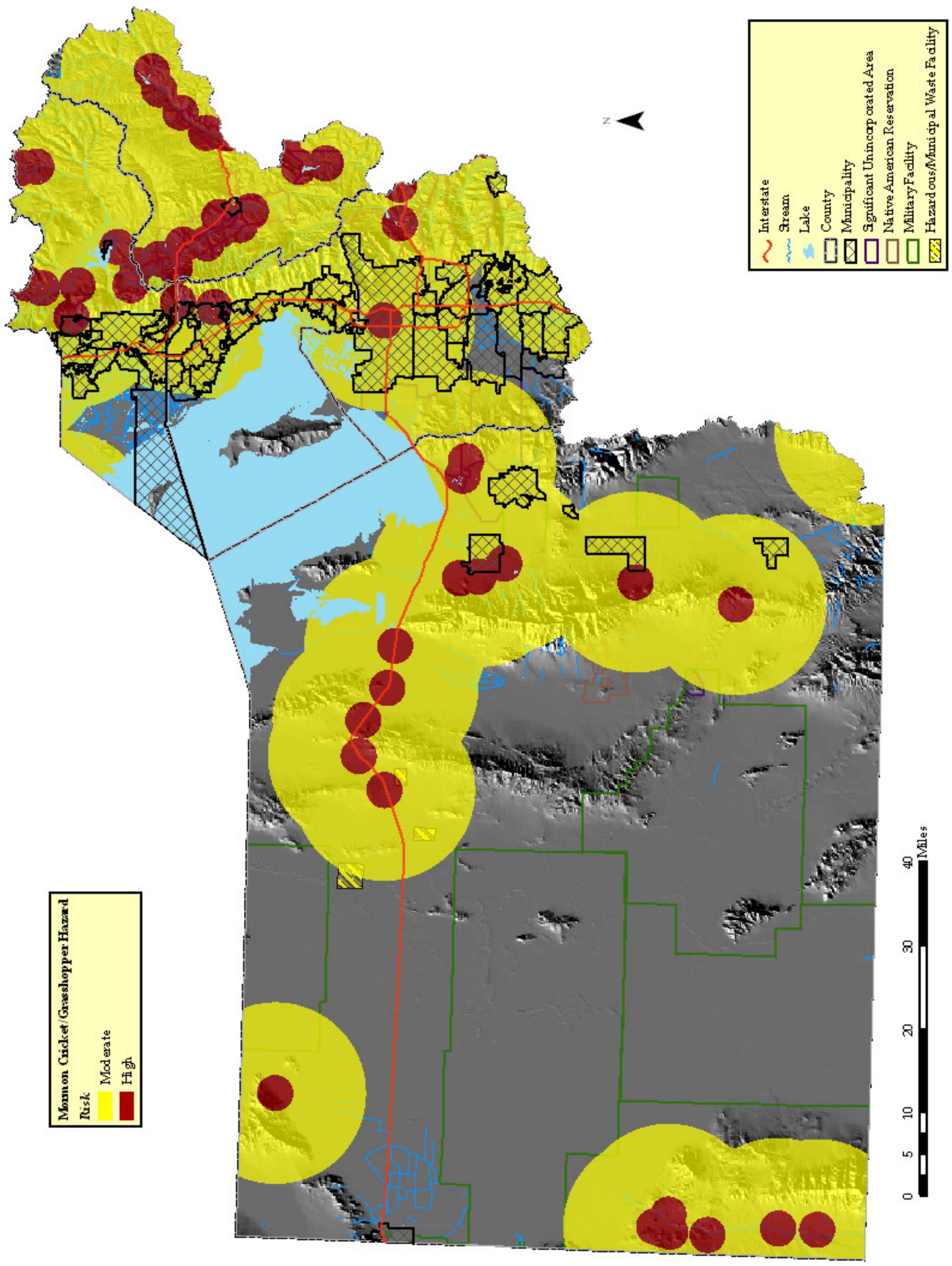
UDAF has used aerial treatment and ground baiting to manage populations of Mormon crickets and grasshoppers with success. Due to this success, no treatment is planned for 2008 (UDAF 2007a). See Map 8-10 (page 108) for the Mormon cricket and grasshopper hazard potential.

Another insect of concern in the region is the North American Gypsy moth. Utah is an ideal breeding ground for the gypsy moth with an "arid climate, mountainous terrain, and lack of effective natural predators" (Watson 2007). The moths can be very destructive through the defoliation of tree leaves (UDAF 2007a). The Gypsy moth was first found in the state in 1988 with the population rapidly growing the following year.

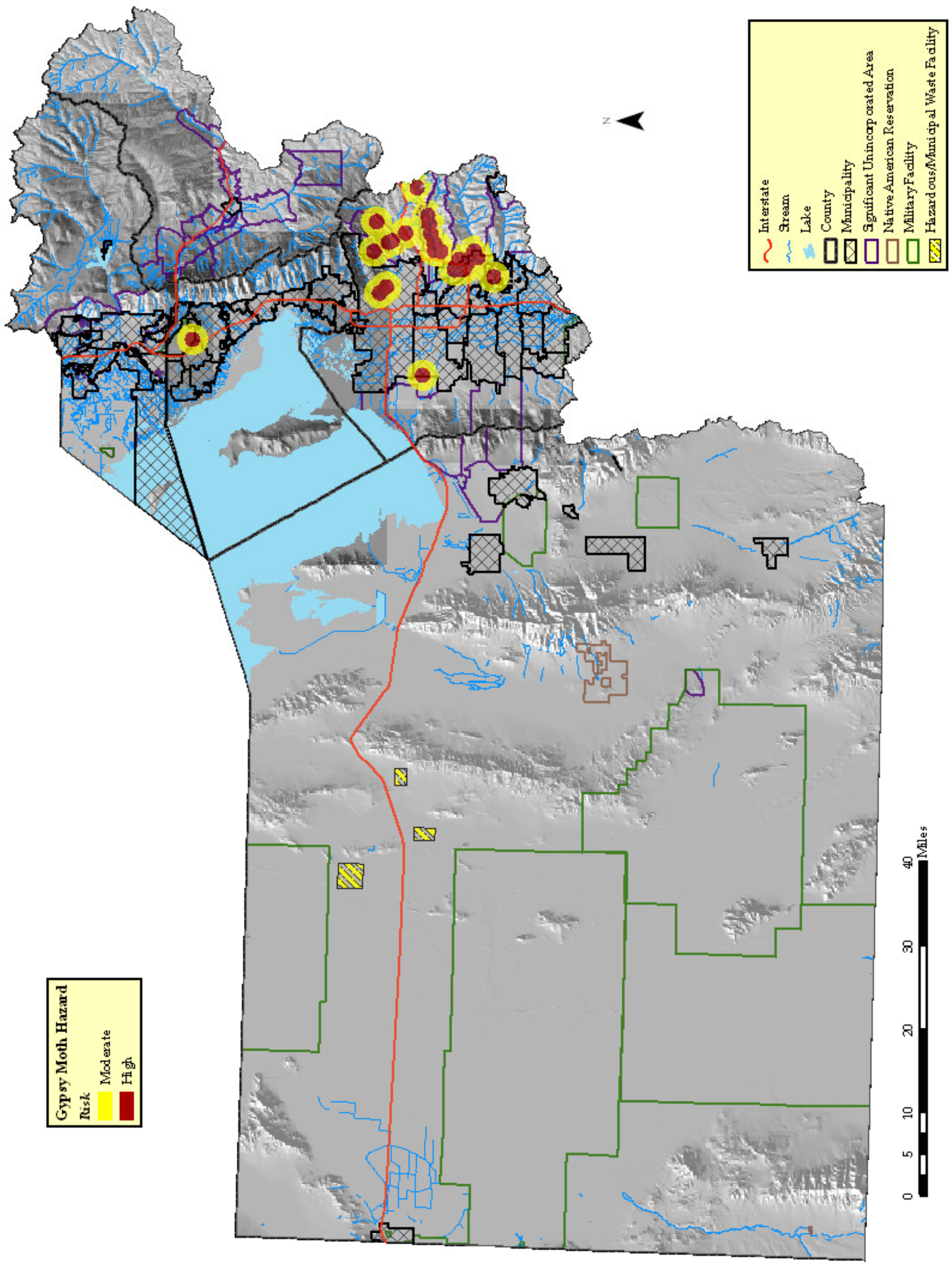
Treatment programs administered by UDAF using natural bacteria have proven very effective in controlling populations. Less than 3 moths per year have been caught in UDAF traps since 2000 in the entire state. The two moths in 2007 were found in separate locations in Salt Lake County (Watson 2007). See Map 8-11 (page 109) for Gypsy moth hazard potential.

Example of Bark Beetle Infestation – Before and After (UDFFSL 2003)

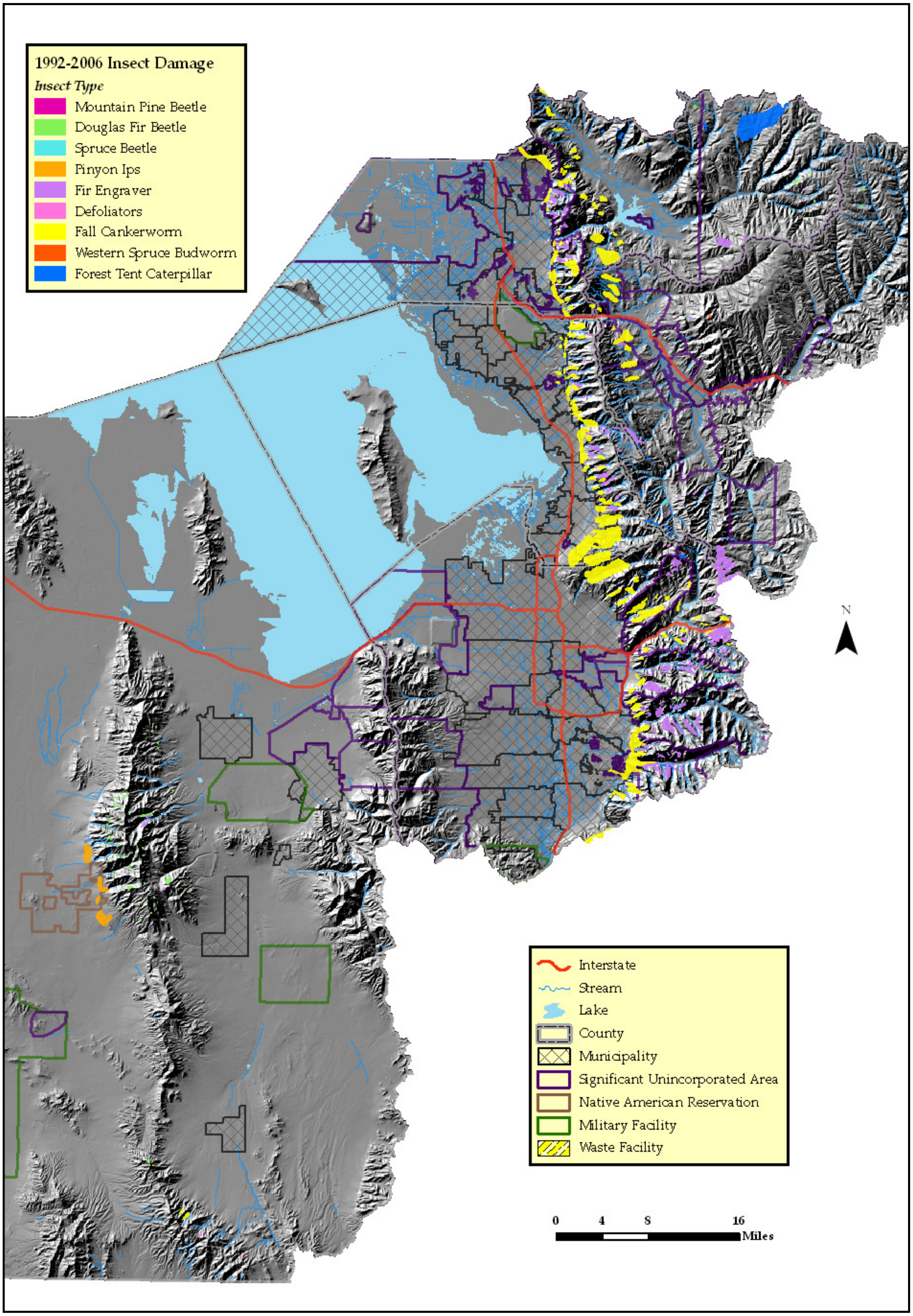
Wood borers and Bark beetles are a distinct problem for all trees in the Wasatch Front area. Like many other insect hazards in the area, drought has helped Wood borer and Bark beetle populations to grow and expand due to stressed trees (Matthews, et al. 2005). Likewise, overall warming trends in the western United States have allowed these insects to survive the winters promoting multiple reproduction cycles. Insecticides and general thinning of trees has proven to be the most effective methods of control (UDFFSL 2003). See Map 8-12 (page 110) for damages caused by Wood borers, Bark beetles, and other insects.



Map 8-10 Mormon Cricket and Grasshopper Hazard Potential (Source: UDAF)



Map 8-11 Gypsy Moth Hazard Potential (Source: Utah Department of Agriculture and Food)



Map 8-12 Damage from Other Insects (FHP 2008)

4. Radon

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*			*Likely*
		Limited (10-25%)		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Region wide				
Frequency	Year-round, continuous				
Conditions	Buildings over top of soils containing high amounts of decaying uranium which is commonly found in Utah				
Duration	Years				
Secondary Hazards	Unknown				
Analysis Used	Information and maps provided by the Utah Geological Survey and the Utah Division of Radiation Control				

Description of Location and Extent

Radon gas can be found in most Utah homes. The gas comes from the small particles of uranium in rocks and soil which decay to radium. In turn, the radium breaks down further into radon. As the radon moves up through the ground, it can enter a home through cracks and gaps in walls and floors if not properly vented. To a lesser degree, radon can also enter the home through water supply pipes. (UDRC 2008a)

At low levels, radon gas is relatively harmless. Large amounts (above 4 PicoCuries) over a long period of time can lead to lung cancer. Radon is the second–leading cause of lung cancer behind cigarette smoking. The best way to ensure radon is properly eliminated from the home is to test for radon using an inexpensive test purchasable through the Utah Safety Council (**www.utahsafetycouncil.org**). A positive high result would require proper ventilation of the excessive radon using either a passive or active soil depressurization system. For further information, please see the Utah Division of Radiation Control, Indoor Radiation Program website (**www.radon.utah.gov**). (UDRC 2008a, 2008b)

In the Region, radon is likely present in higher concentrations in homes in the Wasatch Mountains and its foothills due to the types of geologic formations found there. Through collections of tests performed by various households in the county, households containing higher levels of radon were found to roughly follow the patterns predicted by geologic formation. Sites further from the mountains and foothills generally have lower concentrations of radon. Radon does not pose a threat to infrastructure.

In Davis County, radon is likely present in higher concentrations in homes in the Wasatch Mountains and its foothills due to the types of geologic formations found there. Through collections of tests performed by various households in the county, households containing higher levels of radon were found to roughly follow the patterns predicted by geologic formation.

In Morgan County, radon is found in higher concentrations in homes in the unincorporated areas of northeastern Croydon, East Canyon Resort, south central Milton, Mountain Green, Peterson, Round Valley and Snow Basin Resort due to the types of geologic formations found in those locales.

Due to the types of geologic formations found in Salt Lake County, radon gas is likely present in higher concentrations in homes in the Wasatch and Oquirrh Mountains and their foothills. Through collections of tests performed by various households in the county, households containing higher levels of radon were found to roughly follow the patterns predicted by geologic formation. One exception is the area just south of Interstate 80 in western Salt Lake City

Tooele County has a considerable threat from radon gas, especially in eastern areas. Radon gas is likely present in higher concentrations in homes in those areas due to the types of geologic formations found there.

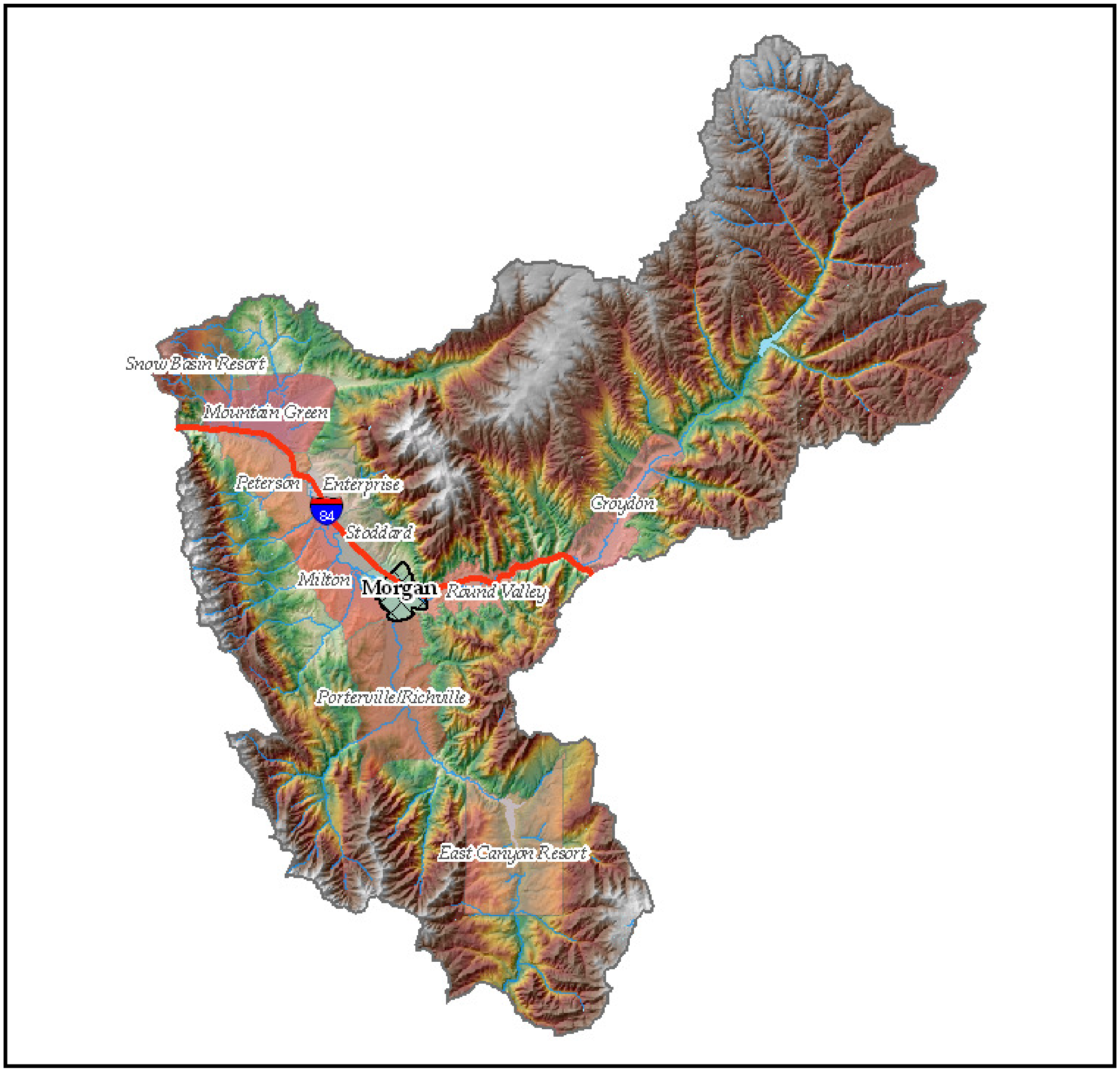
In Weber County, radon gas is likely present in higher concentrations in homes in the Wasatch Mountains and its foothills due to the types of geologic formations found there. Through collections of tests performed by various households in the county, households containing higher levels of radon were found to roughly follow the patterns predicted by geologic formation. Sites further from the mountains and foothills generally have lower concentrations of radon.

Vulnerability Analysis

The following table contains vulnerabilities for wind hazards with regard to critical facilities. Results are not weighted relative to each hazard, but rather, based solely on the hazard itself. Hazard determinations are taken from the maps in the preceding regional hazard sections. It is not possible to accurately determine specific vulnerabilities from hail, lightning, tornado or radon hazards.

Critical Facilities	**Number of Buildings Vulnerable to Wind**				
	Davis	***Morgan***	***Salt Lake***	***Tooele***	***Weber***
Amateur Radio Repeaters	12	4	64	13	4
Public Safety Repeaters	1	4	11	50	10
Electric Generation Facilities	1	1	5		3
Emergency Operations Centers	1	2	15	1	22
Fire Stations	16	3	57	10	20
Hospitals	3		30	1	2
Oil Facilities	7		2		
Police Stations	14	1	25	4	10
Schools	88	3	246	26	68
Water Treatment Facilities	3		7	4	2

Table 8-4. Critical Facilities Number of Buildings Vulnerable to Wind



Map 10-1. Morgan County

Part X. Morgan County

Morgan County is the third smallest county in Utah in area, consisting of 610 square miles. Elevation ranges from 4,895 feet at Mountain Green to Thurston Peak at 9,706 feet. Entry into the county from the Great Salt Lake Valley is through Weber Canyon, which opens on both the east and northwest sides of the county. The landscape includes high mountains, steppe valleys, the Weber River valley, and two smaller streams, East Canyon Creek and Lost Creek, each with reservoirs in their upper reaches.

Morgan County includes one municipality Morgan City, the county seat, and ten unincorporated areas - Croydon, East Canyon Resort, Enterprise, Milton, Mountain Green, Peterson, Porterville/Richville, Round Valley, Snow Basin Resort and Stoddard. Land ownership in Morgan County is 90% private, 5% federal, 3% state and 2% underwater. Morgan County has the highest percentage of privately owned land in the state.

The Wasatch National Forest extends into the north side of the county. Summit County lies to the east and south. Davis, Weber and Salt Lake Counties are on the western border. Rich County borders on the northeast.

Morgan County's population was projected at 8,134 persons for 2006 (UPEC 2007) which are concentrated primarily in the areas of Morgan City and Mountain Green. Because of Morgan County's close proximity to Salt Lake, Davis and Weber Counties, the population is increasing rapidly. The county is expected to continue growing along the Interstate 84 corridor, with the highest concentration of new development in the southern and western portions of the county. Development is occurring in areas that once were agricultural or farmland. Morgan County prides itself in its rural setting and this is recognized in county codes and ordinances for planned development.

Historically, agriculture, mainly livestock, crop and mink pelt production, has been the primary type of economic activity in Morgan County. Recently, manufacturing, trade, government and construction have begun to diversify the economy. The principle employer is Hill Air Force Base (Morgan County Emergency Operations Plan). Some larger employers include Morgan County School District, Holcim US, Inc., Browning, IGA Grocery, Precision Supplied Components LLC, and Morgan County (UDWS 2007b). The 2005 labor force totaled 3,792 persons with 3,633 employed and 159 unemployed. Per capita income was $26,844 and the average monthly non-farm wage for 1,831 non-farm jobs was $2,237 (UDWS 2006). The industries with the highest total payrolls included construction, manufacturing and wholesale trade in the private sector and education and public administration in the public sector (UDWS 2006). The 2005 total wages for the county were $49,951,005 (UDWS 2006). Total personal income in 2005 was $191.3 million (BEA 2007).

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 provide a starting point for predicting where future events could potentially occur. The following historical hazard event statistics were consolidated from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) of the Hazards and Vulnerability Research Institute. The database records reported natural hazard events for Morgan County which caused greater than $50,000 in damages. The monetary figures are in 2005 dollars.

Risk Assessment

The risk assessment process revealed the following for the identified hazards of earthquake, flood, dam failure, wildland fire, slope failure, infestation, severe weather and drought. Infestation, severe weather, radon and drought are considered to be regional hazards and can be found in Part XII. Risk assessment maps were completed for each hazard and are included in each section. Refer to Part VI for an explanation of the risk assessment process. According to this data there are a total of 7 critical facilities in Morgan County. Table 10-1 below outlines the total number of critical facilities within the county with moderate or greater levels of risk.

Number of Structures with Moderate or Greater Vulnerability (% of Total)								
Critical Facilities	**Total**	**Dam Failure**	**Flood**	**Ground Shaking**	**Liquefaction**	**Problem Soils**	**Slope Failure**	**Wildfire**
Amateur Radio Repeaters	**4**	0 (0%)	0 (0%)	4 (100%)	0 (0%)	0 (0%)	0 (0%)	4 (100%)
Emergency Operations Centers	**1**	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Fire Stations	**2**	1 (50%)	1 (50%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Police Stations	**1**	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Schools	**4**	3 (100%)	3 (100%)	4 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table 10-1. Critical Facilities Vulnerability Matrix for Local Hazards, Morgan County

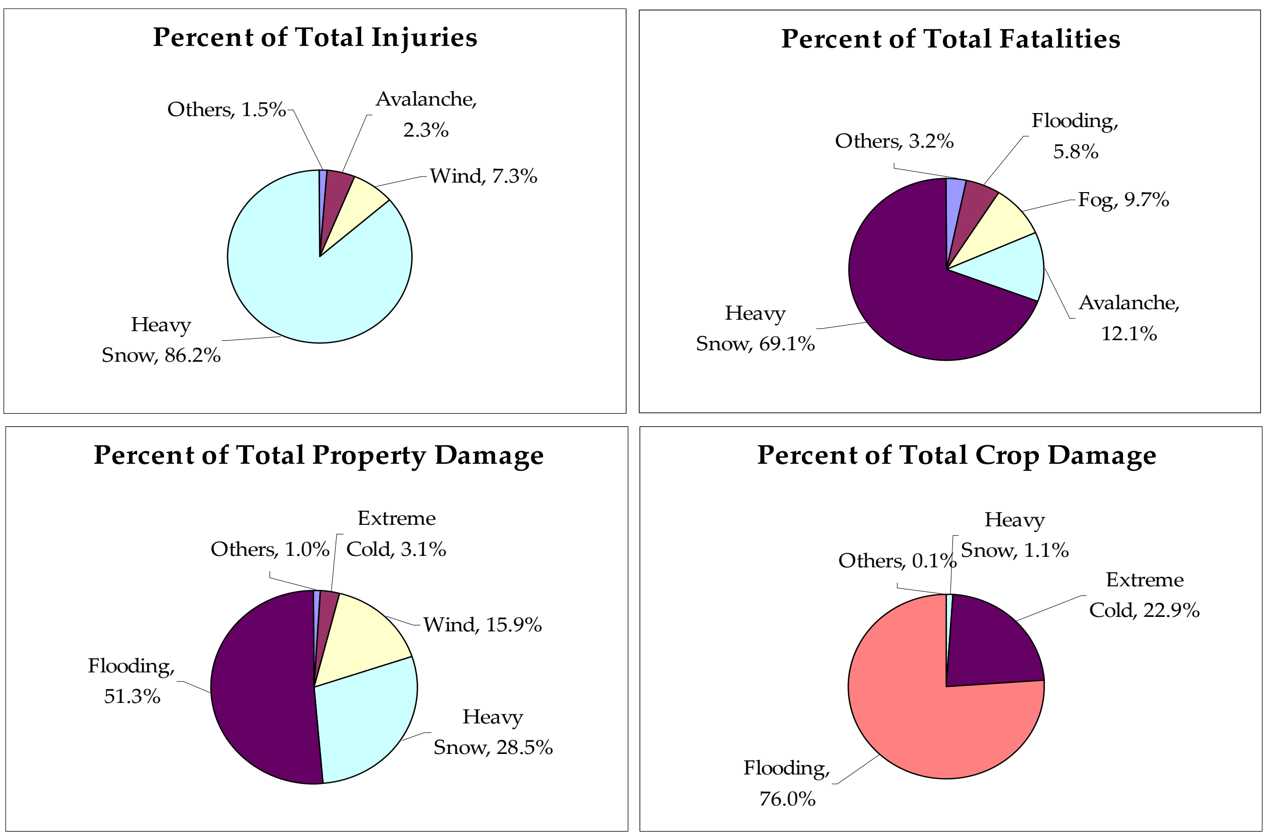


Figure 10-1. Major Disaster Event Averages 1962-2005, Morgan County (HVRI 2007)

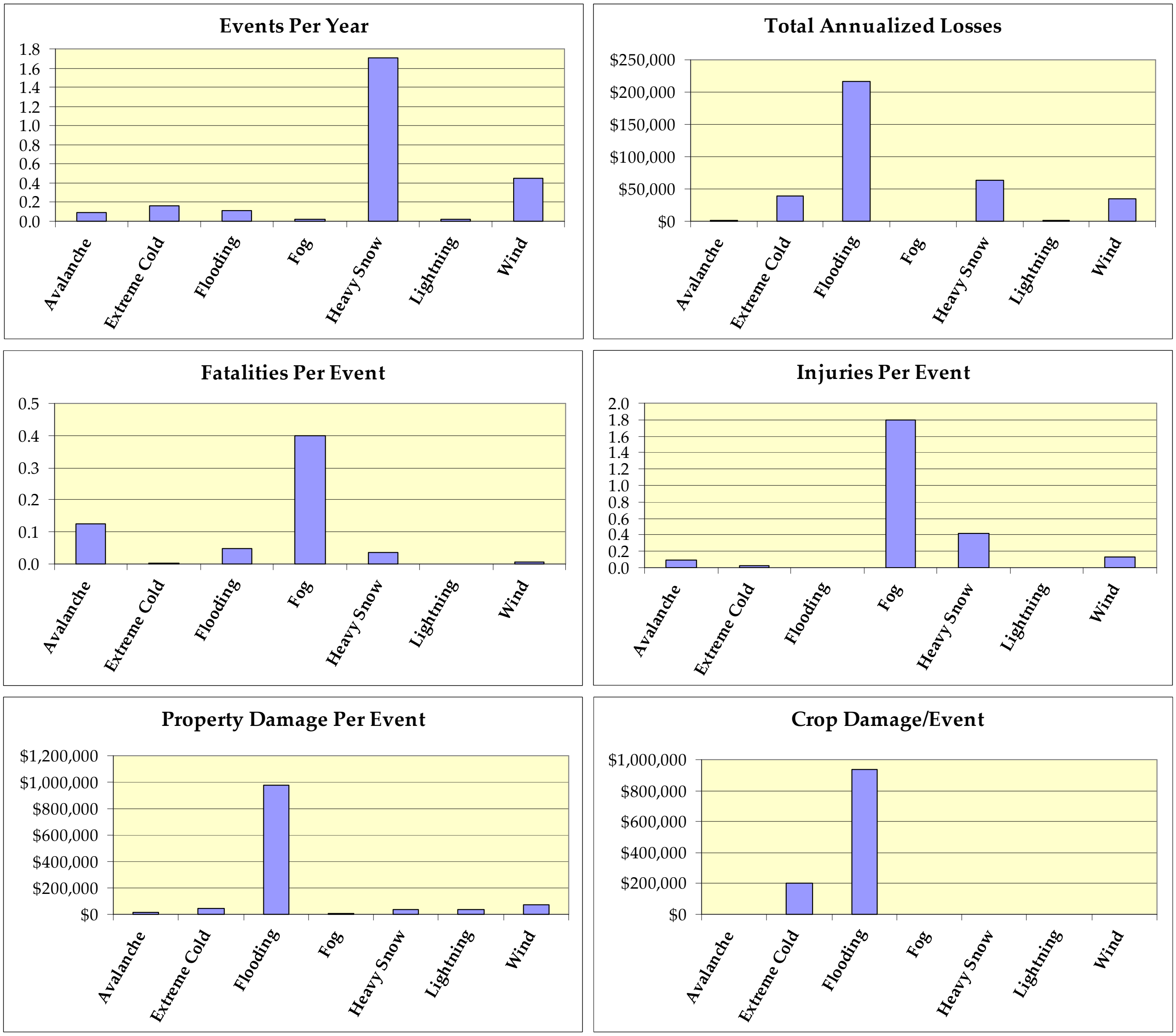


Figure 10-2. Major Disaster Annual and Per Event Averages 1962-2005, Morgan County (HVRI 2007)

1. Earthquake Hazard Profile

Potential Magnitude	X	*Catastrophic (>50%)*	***Probability***		*Highly Likely*
		Critical (25-50%)		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Western portion of the county, which is closest to the Intermountain Seismic Belt has the highest probability of being affected by an earthquake. Ground shaking would be felt throughout the entire county. Surface fault rupture could occur in areas of known historic fault zones.				
Seasonal Pattern	None				
Conditions	Liquefaction potential exists within areas that have a high ground water table. The soil is comprised of old lakebed sediments in certain areas. Historic movement along faults is evident such as the Intermountain Seismic Zone and Wasatch Fault.				
Duration	Actual ground shaking will be under one minute. Aftershocks can occur for weeks or even months.				
Secondary Hazards	Fire, landslide, rock falls, avalanche, flooding, liquefaction				
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DHLS, AGRC. HAZUS-MH				

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 (UGS 2002). 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 (McCalpin and Nishenko 1996 in UGS 2002). The average repeat time on any single segment ranges from about 1,200-2,600 years. Major earthquakes on the five central segments occurred 250 to 2,900 years ago (Lund 2005). The Weber Segment of the Wasatch Fault runs from North Salt Lake to Willard Bay. The Weber Segment has produced four large earthquakes over the past 4,000 years (McCalpin and Nishenko 1996, in UGS 2002), making it one of the most active fault segments. The Salt Lake Segment underlies the Salt Lake valley. Smaller fault zones also pose a threat to Morgan City; include the Morgan, East Canyon, and Saleratus Creek fault zones (UGS 2002). The best data thus far is from the Morgan Fault which has a maximum potential of a 6.5-7.0 Richter magnitude fault rupture (Hecker 1993 in UGS 2002).

The recent historical record of earthquakes in Morgan County shows no events greater than Richter magnitude 4.0. Map 10-2 (page 158) illustrates the locations of earthquakes epicenters in Morgan County since 1962, along with approximate Richter magnitude. Fault groups are provided to show relative locations of epicenters to faults located within the county.

A 0.2-second spectral acceleration map (Map 10-3 page 159) was created due to the predominance of one- and two-story buildings in the County. This frequency of ground shaking causes the greatest amount of damage in these structures (UGS 2008).

The mapped values indicate the maximum probable force (as a percentage of gravity) a one-to-two-story building would experience during a 2,500-year event (2% probability of exceedance in 50 years), which corresponds roughly to a Richter magnitude 7.1 event along the Wasatch Fault. For example, Morgan City would likely experience around 1g of lateral force during the event. Poorly constructed buildings will likely experience damage at around 0.1g (10% of gravity) (FEMA 1995). Local geologic structure and shaking duration are not accounted for in this map, and will likely cause significant variability in damages during an actual event.

Name	Fault Type	Length (km)	Time of most recent deformation	Recurrence Interval
East Canyon (East Side) fault	Unknown	24	<1.6 million years ago	Unknown
East Canyon fault, Northern section	Normal	25.9	<1.6 million years ago	Unknown
East Canyon fault, Southern section	Normal	25.9	<750,000 years ago	Unknown
Morgan fault, Central section	Normal	16.6	<8320±100 14C yr B.P.	25,000-100,000 years
Morgan fault, Northern section	Normal	16.6	<750,000 years ago	Unknown
Morgan fault, Southern section	Normal	16.6	<750,000 years ago	Unknown
Saleratus Creek fault	Normal	38	<750,000 years ago	Unknown

Table 10-2. Active Faults in Morgan County *(UGS 2002, Lund 2005) ^{14}C yr B.P.=Radiocarbon 14 years before present*

Liquefaction hazard for Morgan County is low (Map 10-4 page 160). The river valleys have a minimal risk. This does not minimize the effect that an earthquake will have on the County as the ground shaking risk remains high.

Vulnerability Analysis

A vulnerability analysis was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH)**. The following numbers were based on a probabilistic 2,500-year event with a Richter magnitude of 7.1. An arbitrary 5.9 event located in close proximity to the County's most populated areas was also modeled. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH, please see Part VII or the HAZUS-MH Technical Manual (Earthquake Model) at www.fema.gov/hazus).*

Building Damage

HAZUS-MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 10-3 lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage. Also listed are the estimated monetary losses to structures, contents/inventory and income.

Category	Number of Structures with > 50% Damage		Category	Estimated Losses	
	Morgan M5.9	2500-yr M7.1		Morgan M5.9	2500-yr M7.1
Residential	80	758	**Structural Losses**	$1,023,000	$11,772,580
Commercial	4	24	**Non-Structural Losses**	$3,600,000	$37,701,470
Industrial	1	8	**Content Losses**	$1,439,000	$12,760,820
Government	1	9	**Inventory Losses**	$76,000	$717,160
Education	0	1	**Income & Relocation Losses**	$909,000	$10,179,540
Totals	**86**	**800**	**Totals**	**$7,047,000**	**$72,414,410**

Table 10-3. Building Damage Counts and Estimated Losses

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in Table 10-4. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage >50%		Estimated Losses	
		Morgan M5.9	2500-yr M7.1	Morgan M5.9	2500-yr M7.1
Waste Water Facilities	2	1	2	$16,313,000	$36,722,000
Waste Water Pipelines	735 km	38 leaks/breaks	801 leaks/breaks	$137,000	$2,886,000
Potable Water Pipelines	1,225 km	48 leaks/breaks	1,014 leaks/breaks	$173,000	$3,649,000
Natural Gas Pipelines	490 km	41 leaks/breaks	857 leaks/breaks	$146,000	$3,085,000
Highway Bridges	80	13	31	$1,419,000	$10,842,000
Railway Bridges	1	0	0	$0	$4,000
Airport Facilities	1	0	1	$1,273,000	$2,157,000
Total Losses				**$19,461,000**	**$59,345,000**

Table 10-4. Damage to Transportation and Utilities

Debris Removal

Table 10-5 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 at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	Morgan M5.9	2500-yr M7.1
Brick, Wood & Others	1,000 tons / 40 loads	12,000 tons / 480 loads
Concrete & Steel	2,000 tons / 80 loads	27,000 tons / 1,080 loads

Table 10-5. Debris Generated/Number of Loads

Fire Following

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 10-6 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Morgan M5.9	2500-yr M7.1
Ignitions	0	0
Persons Exposed	0	0
Value Exposed	$0	$0

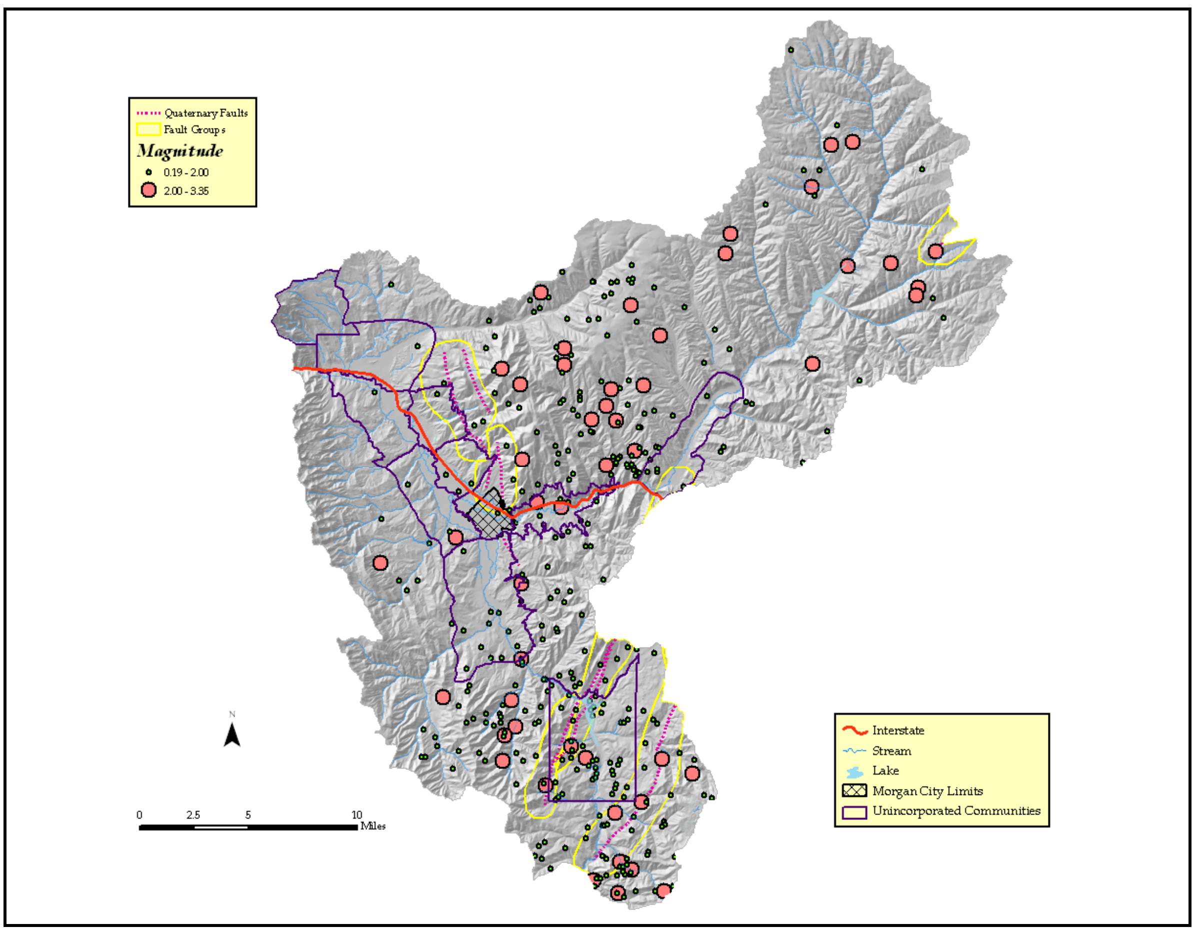
Table 10-6. Fire Following Event, Population Exposed, and Building Stock Exposed

Casualties

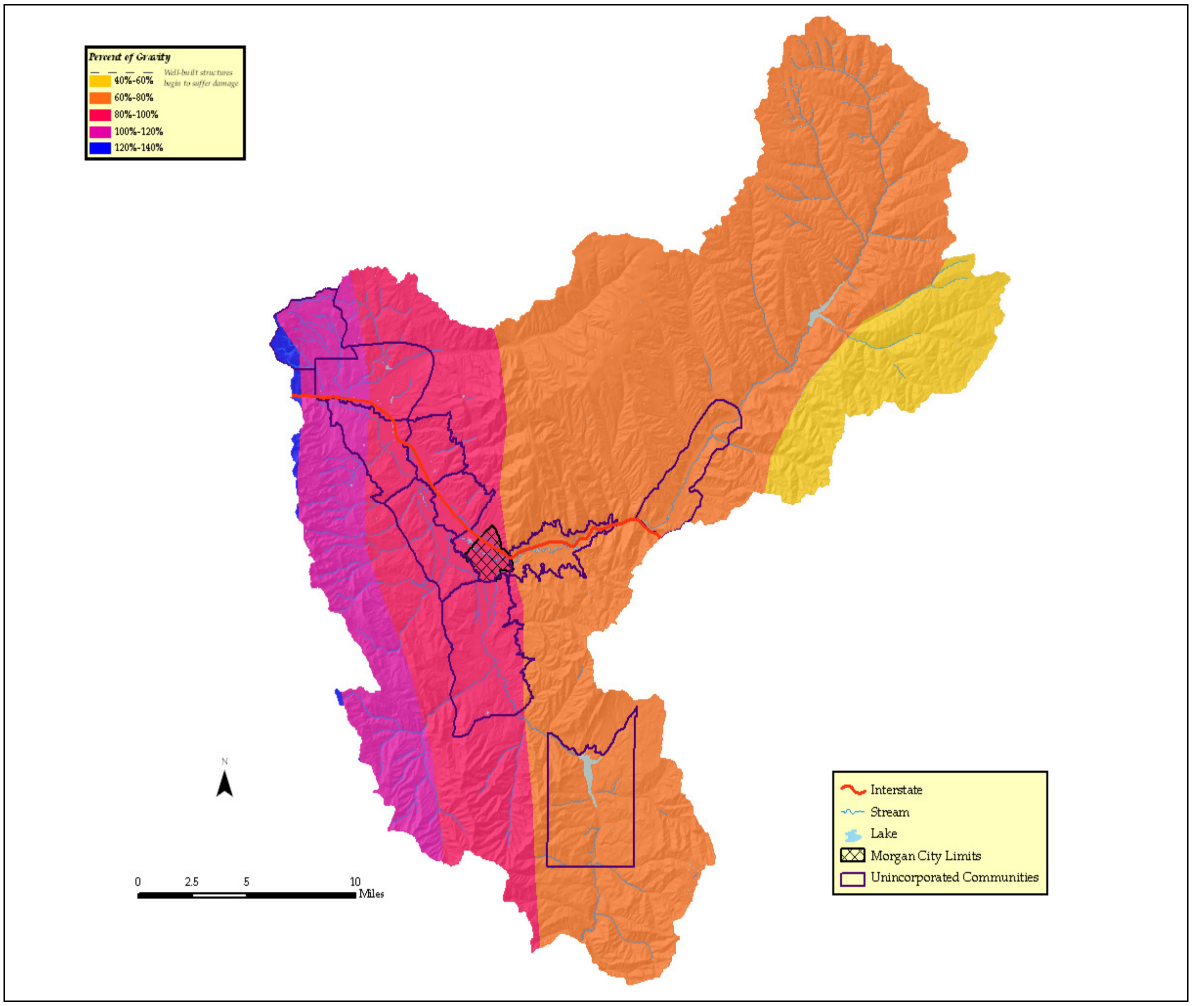
Table 10-7 estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons. The daytime scenario (2 p.m. local time) assumes a commercial concentration. The commute scenario (5 pm. local time) assumes a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major) and fatalities.

Night Event	Morgan M5.9	2500-yr M7.1	Day Event	Morgan M5.9	2500-yr M7.1	Commute Event	Morgan M5.9	2500-yr M7.1
Minor	2	30	Minor	2	42	Minor	2	35
Major	0	8	Major	0	14	Major	0	10
Fatalities	0	2	Fatalities	0	4	Fatalities	0	3

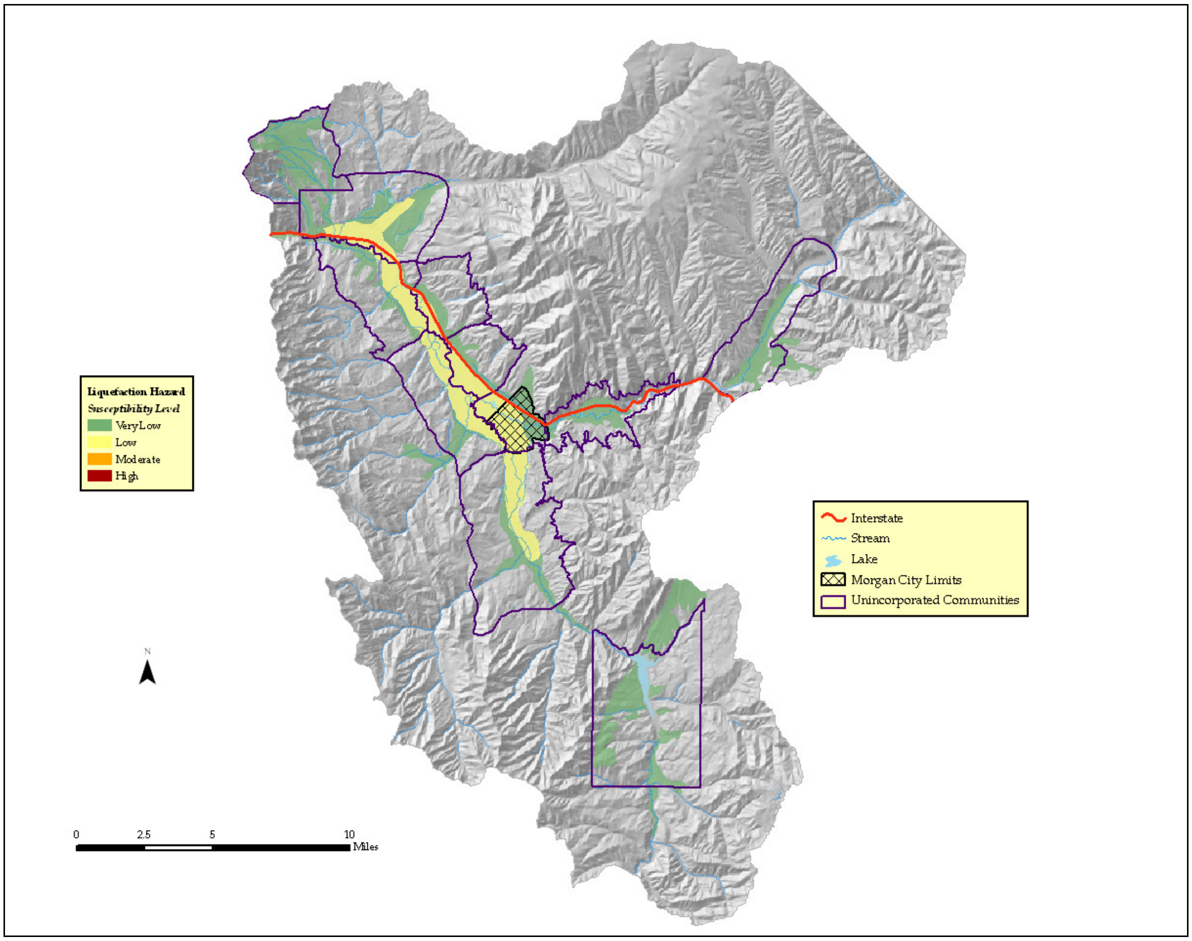
Table 10-7. Casualties



Map 10-2. Historical Earthquake Epicenters and Faults, Morgan County 1900-2007 (UUSS 2007)



Map 10-3. Ground Shaking Hazard Map, Morgan County (NSHMP 2002)



Map 10-4. Liquefaction Hazard Map, Morgan County (Solomon, et. al 2004)

2. Flood

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Weber River and its tributaries				
Frequency	Spring, late summer				
Conditions	Cloudburst Storms and Heavy Snowfall Runoff				
Duration	Flooding can last anywhere from hours to days and even months.				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of FIS, FIRM, HAZUS-MH				

Description of Location and Extent

Flooding is largely associated with heavy rainfall from cloudburst storms. Morgan County has also experienced rapid snowpack melt, resulting in flooding and flash flooding. Historical events suggest flooding poses the most significant reoccurring threat. 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 (Map 10-5 page 163). Lost Creek has experienced flooding because bridges become obstructed with debris acting as a dam. Gordon Creek has also flooded in the past due to a perched channel. Sewer and water lines cross the Weber River and the spring flooding of 1983 caused a sewer line to break. This sewer line is now encased with concrete so should no longer pose a problem. Another flood event similar to those of 1952 and 1983-1984 could cause the Como Bridge to fail due to age. A 100-year flood event would cause Deep Creek to experience overbank flooding. Agricultural flooding is also of concern because of the amount of farmlands and irrigation canals.

Island Road along East Canyon Creek through Richville, as well as the 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. See Map 10-5 for the flood hazard in Morgan County.

Vulnerability Assessment

The vulnerability assessment for flooding in Morgan County was obtained from HAZUS-MH**. Vulnerability was assessed for both 100-year (NFIP Zone A) and 500-year (NFIP Zone B or Zone X (shaded)) flood events. Total monetary losses include structures, contents and business interruption. Analysis was completed using Flood Insurance Rate Maps (FIRM). Only streams which contained detailed flood cross-section data could be used. Consequently, the results should be considered conservative. (**For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the HAZUS-MH Technical Manual (Flood Model) at www.fema.gov/hazus)

	Acres Flooded	Population Displaced	Number of Structures with at Least Moderate Damage	
			Residential Units (Total Losses)	*Commercial/Industrial Units* (Total Losses)
100-year Flood	3019.72	539	*117* **$6,370,000**	*0* **$2,850,000**
500-year Flood	3259.56	595	*130* **$8,050,000**	*0* **$3,480,000**

Table 10-8. Morgan County Flood Hazard

Agricultural Losses

Agricultural losses are listed in Table 10-9. Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15th.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$23,375	$31,167	$24,332	$32,442

Table 10-9. Agricultural Losses, April 15th Scenario

Vehicle Losses

Table 10-10 contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$416,921	$518,385
Nighttime Scenario	$521,329	$637,730

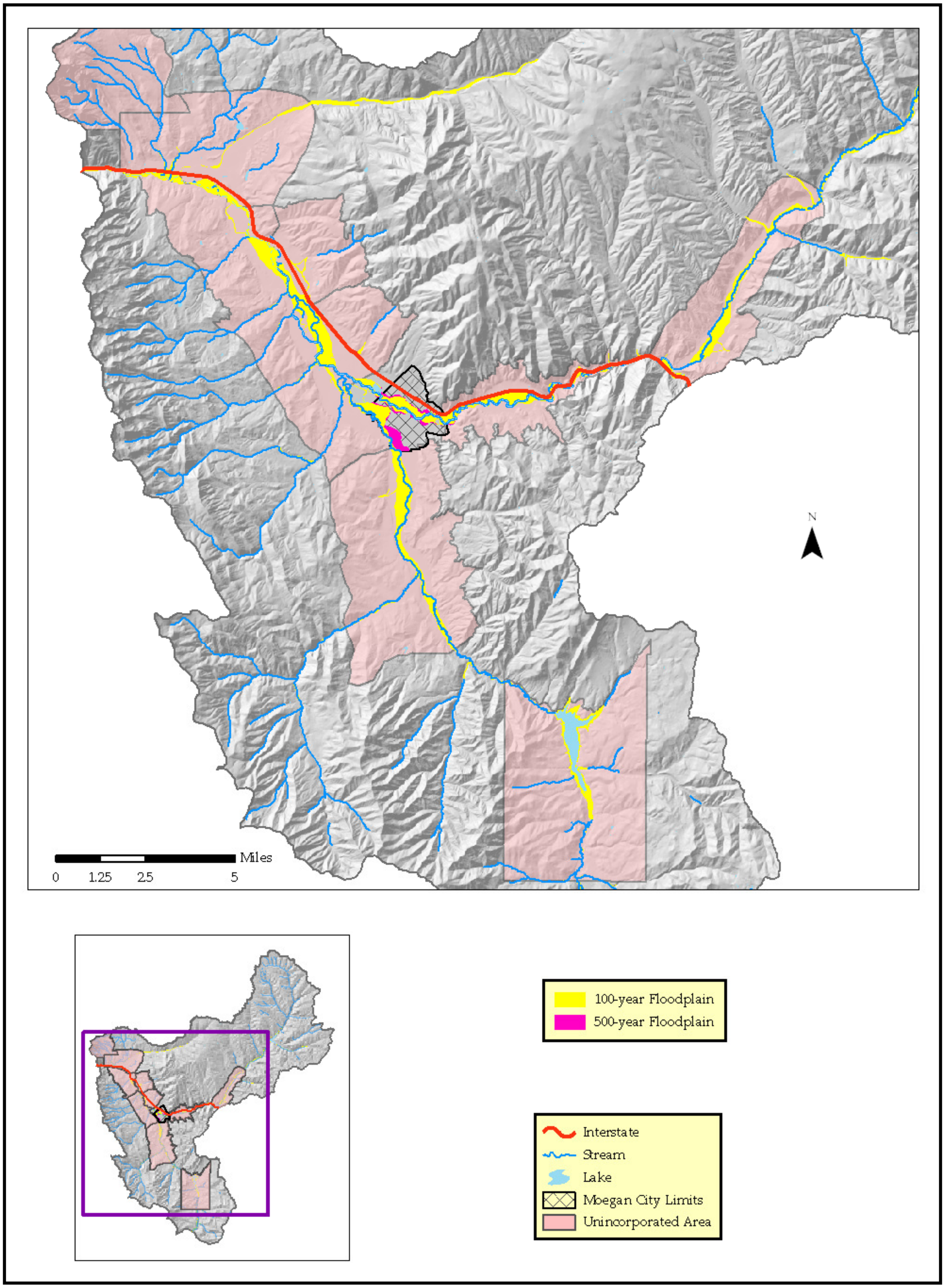
Table 10-10. Vehicle Losses

Debris Removal

Table 10-11 shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	759 tons/31 loads	940 tons/38 loads
Structures	110 tons/5 loads	124 tons/ 5 loads
Foundations	118 tons/5 loads	135 tons/6 loads
Totals	**987 tons/41 loads**	**1,199 tons/49 loads**

Table 10-11. Debris Generation and Removal



Map 10-5. 100-year (NFIP Zone A) and 500-Year Floodplains (NFIP Zone B) (NFIP 1990a)

3. Slope Failure

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	See Map 10-6				
Frequency	Spring and summer; after heavy or long-duration precipitation				
Conditions	Usually caused by the stress release of over-weighted soils, shallow groundwater in certain soils, or loosening of rock and debris.				
Duration	Hours to years				
Secondary Hazards	Flooding (natural dams), traffic accidents				
Analysis Used	Information and maps provided by UGS, DHLS				

Description and Extent

Landslides are a significant hazard in Morgan County due to the prevalence of clay soils and ample precipitation. Clay soils can hold much water. Morgan County's mountainous terrain allows for a substantial annual snowpack and high water table. This groundwater acts as an excellent lubricant allowing the soils to slide.

Rock fall near Devil's Slide, March 2004 (UGS 2004)

With increasing residential development, many prime building sites are now located on top of these soils, especially in the Mountain Green and Peterson areas (see Map 10-6 page 166). Notable active landslides are found along Creekside Drive in Mountain Green. Slides occurred in 2001 and 2005-2006 causing over $1 million dollars in damages to homes, roads and utilities in the latter event (Elliot 2007b).

Another slope failure hazard in Morgan County is rock fall. The freezing and thawing of water trapped between cracks in rock formations can cause the rock to break apart. Gravity then takes over causing the rocks to fall downhill. This occurred in March of 2004, near Devil's Slide, when a large boulder dislodged from a high cliff breaking into several pieces. The largest of these weighed close to 250 tons and rolled down the hill nearly half mile before coming to rest (Elliot 2007b).

Vulnerability Assessment

Table 10-12 estimates infrastructure vulnerable to landslides in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 10-13 estimates the total area, population, and buildings vulnerable to landslides for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City. Major repair or replacement of Weber Basin Water Conservancy District (WBWCD) water distribution infrastructure would likely cost several millions of dollars in excess of that listed below.

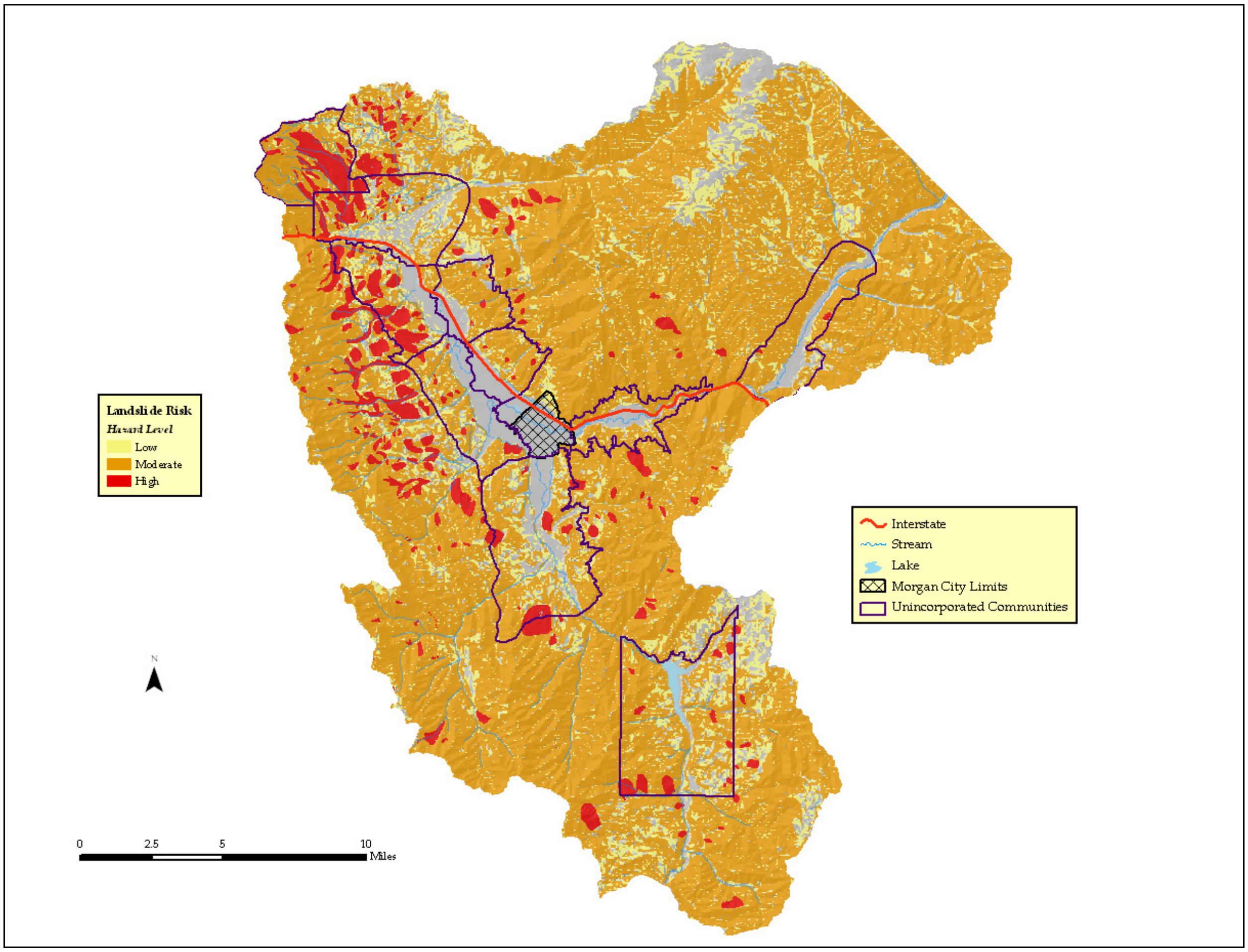
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	16.5 miles	$89,387,083
Highway Bridges	39 bridges	$43,348,782
Railway Segments	4.92 miles	$5,652,768
Railway Bridges	0 bridges	$0
Water Distribution Lines	904.90 miles	$18,099,375
Gas Lines	224.87 miles	$7,239,760
Sewer Lines	337.34 miles	$10,859,637
Total Estimated Infrastructure Replacement Cost		**$174,587,405**

Table 10-12. Infrastructure Vulnerable to Landslides, Morgan County

Incorporated	Acres in Hazard Area	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan City	74	231	73 $14,819,000	0

Unincorporated	Acres in Hazard Area	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Croydon	4,298.0	84	28 $5,684,000	3 $467,080
East Canyon Resort	9,216.1	0	0	0
Enterprise	2,355.9	209	69 $14,007,000	1 $5,301
Milton	2,822.5	690	230 $46,690,000	1 $12,489
Mountain Green	4,166.3	1,267	401 $81,403,000	18 $4,060,753
Peterson	3,658.3	440	156 $31,668,000	2 $1,798,602
Porterville/Richville	6,753.2	694	226 $45,878,000	4 $376,274
Round Valley	2,248.3	213	79 $16,037,000	3 $1,103,913
Snow Basin Resort	5,189.5	0	0	0
Stoddard	1,767.9	188	61 $12,383,000	1 $448,400

Table 10-13. Morgan County Landslide Vulnerability



Map 10-6. Morgan County Landslide Hazard (Giraud and Shaw 2007)

4. Wildland Fire

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Wildland-Urban Interface (WUI) areas near the foothills and in forested areas				
Frequency	Summer months				
Conditions	Areas affected by drought and/ or heavily overgrown with 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				
Secondary Hazards	Landslides, debris flows, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DHLS				

Description of Location and Extent

According to the Northern Utah Regional Wildfire Protection Plan, Morgan County experienced 444 fires during the period from 1973 to 2005 (UDFFSL 2007). Many of these fires occur in wildland areas. The threat of wildfires is steadily increasing in Morgan County. Residential development is spreading further into WUI areas each year with building permits in Morgan County up 21% in 2007 from the year prior (BEBR 2007).

The wildfire threat has had a significant effect on the County watersheds, including landslides, debris flows and other forms of erosion. Federal, state and local agencies have worked together to enforce ordinances and other programs to protect watersheds.

Wildland fire risk is found in Map 10-7 (page 169). The map layers were provided by the Utah Division of Forestry, Fire and State Lands and show four categories of wildfire risk (extreme, high, moderate, and low). These ratings cover all of Morgan County and are based on the type and density of vegetation in each area as well as the vulnerable population. Additional factors that influence fires (weather conditions, wind speed and direction) are not considered in this risk assessment.

Large areas of the County is at moderate or greater wildland fire risk. Morgan City has a low risk within most of its boundaries. A small area in the northern part of the city has extreme wildland fire risk. Unincorporated areas primarily affected include Enterprise, Milton, Mountain Green, Peterson, Snow Basin Resort and Stoddard. Development has been advancing further into WUI zones, with many of the most vulnerable homes also the most costly to replace. Without effective fuel reduction measures and sufficient defensible space, these areas may likely experience considerable losses.

Vulnerability Assessment

Table 10-14 estimates infrastructure vulnerable to wildland fire in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 9-15 (next page) estimates the total area, population and buildings vulnerable to wildland fire for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

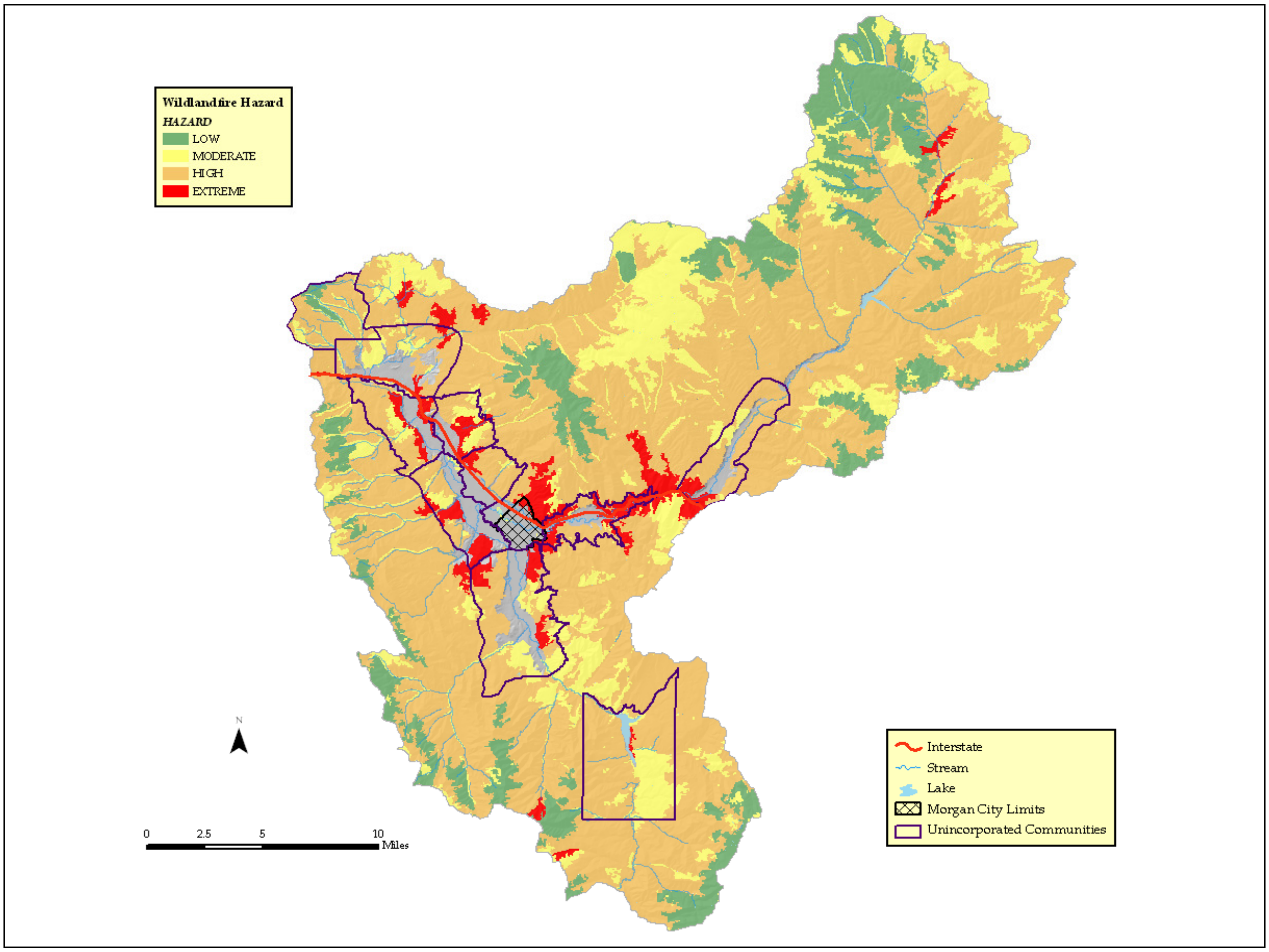
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	46.49 miles	$290,734,600
Highway Bridges	10 bridges	$2,878,644
Railway Segments	33.22 miles	$38,159,858
Railway Facilities	1 bridge	$44,100
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$331,817,202**

Table 10-14. Infrastructure Vulnerable to Wildland Fire, Morgan County

Incorporated	City Area (Acres)	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan City	1,934.8	39	30 $10,781,000	1 $450,948

Unincorporated	Acres in Hazard Area	Population in Hazard Area	Structures in Areas of Moderate or Greater Hazard	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Croydon	6,622.0	83	27 $5,481,000	3 $467,080
East Canyon Resort	13,462.3	0	118 $23,954,000	1 $80,217
Enterprise	3696.7	28	10 $2,885,000	5 $344,367
Milton	5,912.7	628	196 $39,642,500	3 $132,465
Mountain Green	8,206.1	2,003	625 $126,250,000	5 $1,774,996
Peterson	5,935.1	542	169 $34,138,000	8 $1,951,788
Porterville/Richville	12,164.2	175	55 $11,110,000	2 $874,405
Round Valley	3,812.4	34	10 $2,205,000	4 $1,421,129
Snow Basin Resort	5,643.5	0	0	0
Stoddard	3,309	43	14 $2,828,000	3 $308,477

Table 10-15. Morgan County Wildland Fire Vulnerability



Map 10-7. Wildfire Hazard Map, Morgan County (UDFFSL 2007)

5. Problem Soils

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
	X	***Limited (10-25%)***		*X*	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See Map 10-8 (page 172)				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Problem soils pose a significant threat to Morgan County. Expansive soils not only contribute to the landslide hazard, but may also cause subsidence or upheaval under building foundations, pipes and roads (Kaliser 1972). Limestone can erode into karst structures leaving a subsurface cavity vulnerable to collapse.

The primary type of expansive soil in Morgan County is clay. This soil can absorb significant quantities of water. When a home or road is placed over top of these soils, normal evaporation cannot take place. The clay begins to absorb more water than is evaporated and begins to expand causing heaving. During especially dry periods, these soils can contract significantly causing subsidence and ground cracking. Residents already living in these areas should avoid excessive watering, make sure sufficient water drainage is in place around the home, and plumbing and irrigation piping and fixtures are well protected from breakage or leaks (Kaliser 1972).

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way casing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Fortunately, many of the karst structures are located in undeveloped areas.

Vulnerability Assessment

Table 10-16 estimates infrastructure vulnerable to problem soils in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 10-17 estimates the total area, population and buildings vulnerable to landslides for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

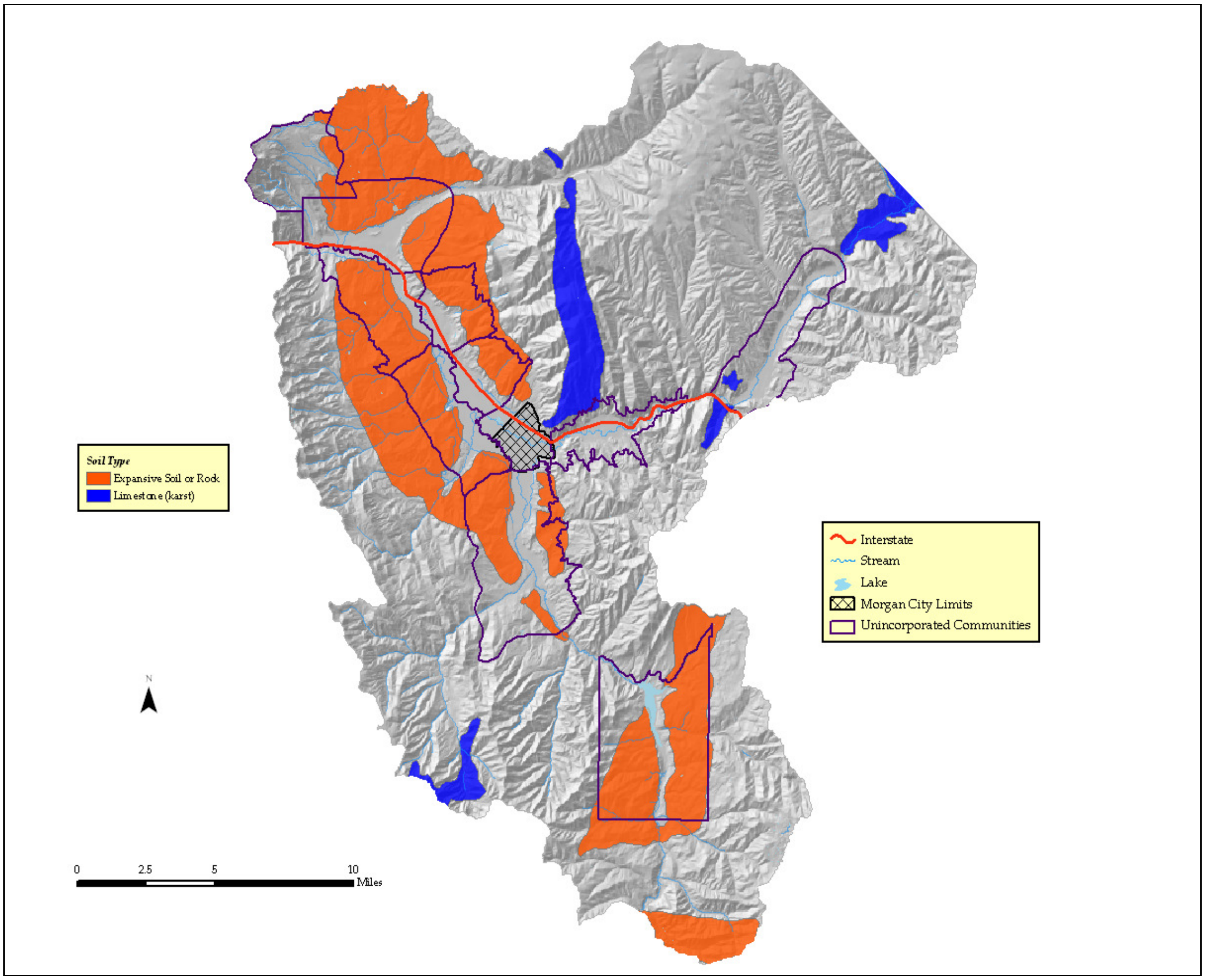
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	9.93 miles	$45,758,668
Highway Bridges	7 bridges	$3,974,239
Railway Segments	0.39 miles	$446,720
Railway Bridges	0 bridges	$0
Water Distribution Lines	153.02 miles	$4,925,119
Gas Lines	61.21 miles	$1,970,050
Sewer Lines	91.81 miles	$2,955,075
Total Estimated Infrastructure Replacement Cost		**$60,029,871**

Table 10-16. Infrastructure Vulnerable to Problem Soils, Morgan County

Incorporated	Acres in Hazard Area	Population in Hazard Area	Number of Structures in Hazard Area	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan	1	4	4 $812,000	0

Unincorporated	Acres in Hazard Area	Population in Hazard Area	Number of Structures in Hazard Area	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Croydon	4,298	0	0	3 $467,080
East Canyon Resort	19,342	0	15 $3,045,000	0
Enterprise	9,479	148	52 $10,556,000	1 $5,301
Milton	26,440	767	258 $52,374,000	1 $12,489
Mountain Green	20,801	751	235 $47,705,000	18 $4,060,753
Peterson	20,616	376	130 $26,390,000	2 $1,798,602
Porterville/Richville	6,753	694	226 $45,878,000	4 $376,274
Round Valley	2,317	12	3 $609,000	3 $1,103,913
Snow Basin Resort	12,457	0	0	0
Stoddard	4,020	123	41 $8,323,000	1 $448,400

Table 10-17. Problem Soils Vulnerability, Morgan County



Map 10-8. Problem Soils Hazard, Morgan County (Mulvey 1992)

5. Dam Failure

Hazard Profile

Potential Magnitude	X	***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
		Limited (10-25%)		X	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See Map 10-9, page 175				
Frequency	Rainy Day Failure: Spring, Late Summer Sunny Day Failure: Anytime				
Conditions	Rainy-day failure happens mainly during heavy precipitation events, can have some warning time. Sunny day failure happens without warning, usually resulting from sudden structural failure				
Duration	Hours to days				
Analysis Used	Review of BOR inundation maps and plans, FIS, Utah Division of Water Rights.				

Description of Location and Extent

Twenty-seven dams and irrigation impoundments are located in Morgan County. Four of these dams 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 have a moderate hazard threat. If they fail they have a low probability of causing loss of life, but would cause appreciable property damage. Mitigation efforts should be developed and pursued for these dams. Fifteen dams have a low hazard threat. If they were to fail there would be minimal threat to life and economic losses would be minor and damages would be limited to the owner of the dam. These dams should still be monitored. No hazard rating is provided for five dams.

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. For a list of high and moderate rated dams in Morgan County, please see Table 10-18 below. Dam locations can be found in Map 10-9 on page 175.

Name/Owner	Hazard Rating
Northwest	High
Wilkinson (Harry)	High
BOR East Canyon	High
BOR Lost Creek	High
Wardell Reservoir	Mod
Peterson Creek – Left Fork (Bohman Dam)	Mod
Morgan Secondary Water Assoc.	Mod

Table 10-18. High and Moderate Hazard Dams, Morgan County *(Source: Utah Division of Water Rights)*

Vulnerability Assessment

Table 10-19 estimates infrastructure vulnerable to dam failure in Morgan County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 10-20 estimates the total area, population and buildings vulnerable to dam failure for individual cities and unincorporated areas. Rail bridge vulnerability accounts only for the State Street Bridge in Morgan City.

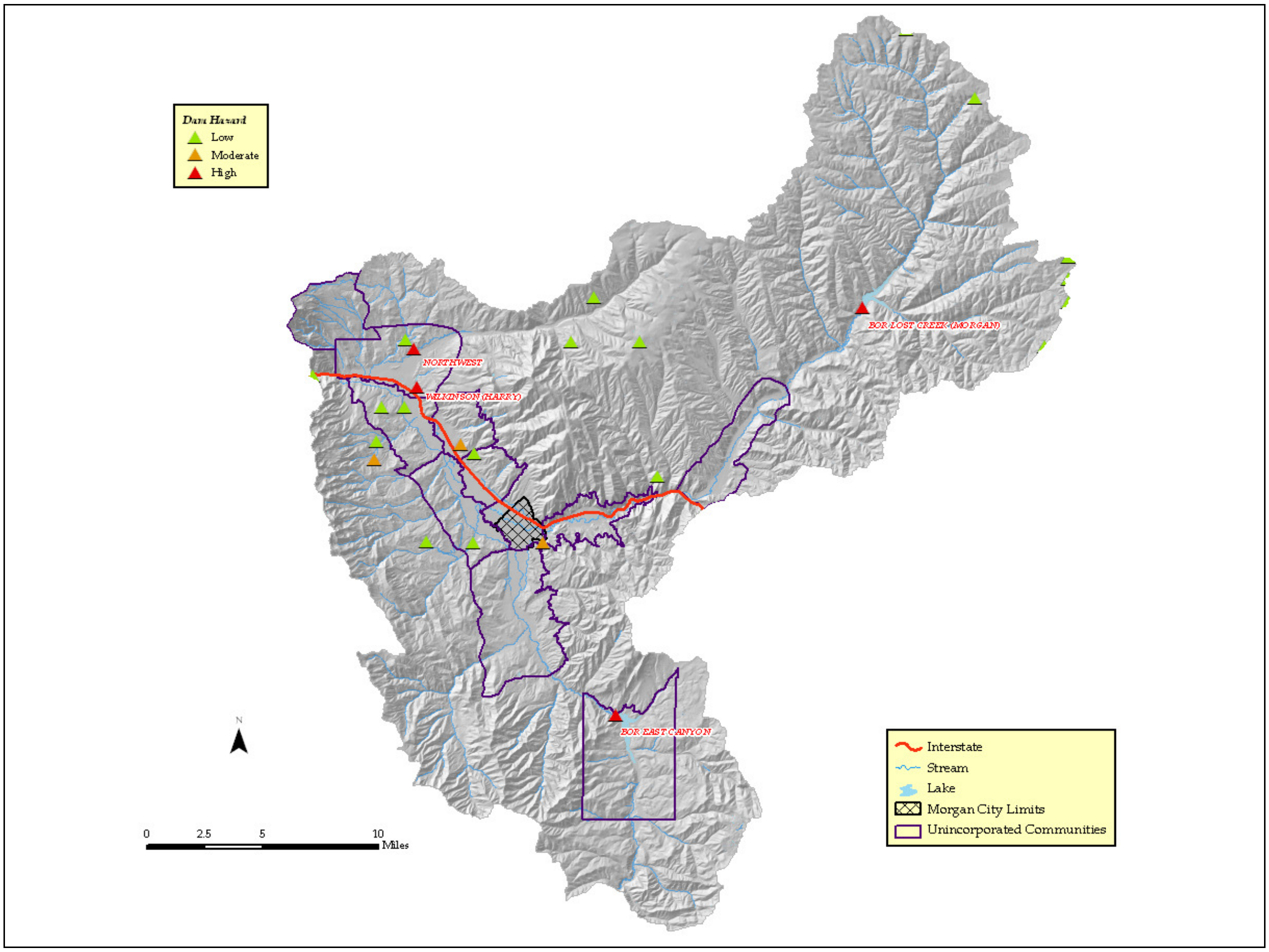
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	1.16 miles	$9,985,771
Highway Bridges	3 bridges	$629,324
Railway Segments	1.13 miles	$1,300,443
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$11,915,538**

Table 10-19. Infrastructure Vulnerable to Dam Failure, Morgan County

Incorporated	Acres in Hazard Area	Population in Hazard Area	Number of Structures in Inundation Area	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Morgan	74	231	73 $14,819,000	0

Unincorporated	Acres in Hazard Area	Population in Hazard Area	Number of Structures in Inundation Area	
			Residential Units (Replacement Cost)	Commercial Units (Annual Sales)
Croydon	4,298	84	28 $5,684,000	3 $467,080
East Canyon Resort	0	0	0	0
Enterprise	2,355	209	69 $14,007,000	1 $5,301
Milton	2,822	690	230 $46,690,000	1 $12,489
Mountain Green	4,166	1,267	401 $81,403,000	18 $4,060,753
Peterson	3,658	440	156 $31,668,000	2 $1,798,602
Porterville/Richville	6,753	694	226 $45,878,000	4 $376,274
Round Valley	2,248	213	79 $16,037,000	3 $1,103,913
Snow Basin Resort	0	0	0	0
Stoddard	1,767	188	61 $12,383,000	1 $448,400

Table 10-20. Dam Failure Vulnerability, Morgan County



Map 10-9. Dam Hazard Map, Morgan County (Utah Division of Water Rights 2007)

Hazards and Future Development

Census Population Estimates									
MCD/ County	**2000 Pop (July 1 est.)**	**2006 Pop (July 1 est.)**	**Absolute Change 2000-2006**	**% Change 2000-2006**	**AARC 2000-2006**	**Rank by 2000 Pop**	**Rank by Absolute Change**	**Rank by % Change**	**Rank by AARC**
Morgan County	7,181	8,888	1,707	23.8%	3.6%	22	14	6	13
Population by County and Multi-County									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	941,172	1,104,356	1,389,252	1,665,238	1,966,372	2,207,282	2,429,057	2,654,682	1.3%
Morgan County	4,950	5,561	7,181	10,183	16,200	24,595	34,290	46,596	3.8%
Households by County and Multi-County									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	*298,700*	*357,257*	*449,844*	*507,463*	*668,786*	*780,369*	*870,671*	*960,756*	*1.5%*
Morgan County	1,355	1,555	2,069	3,229	5,514	8,639	12,341	17,117	4.3%

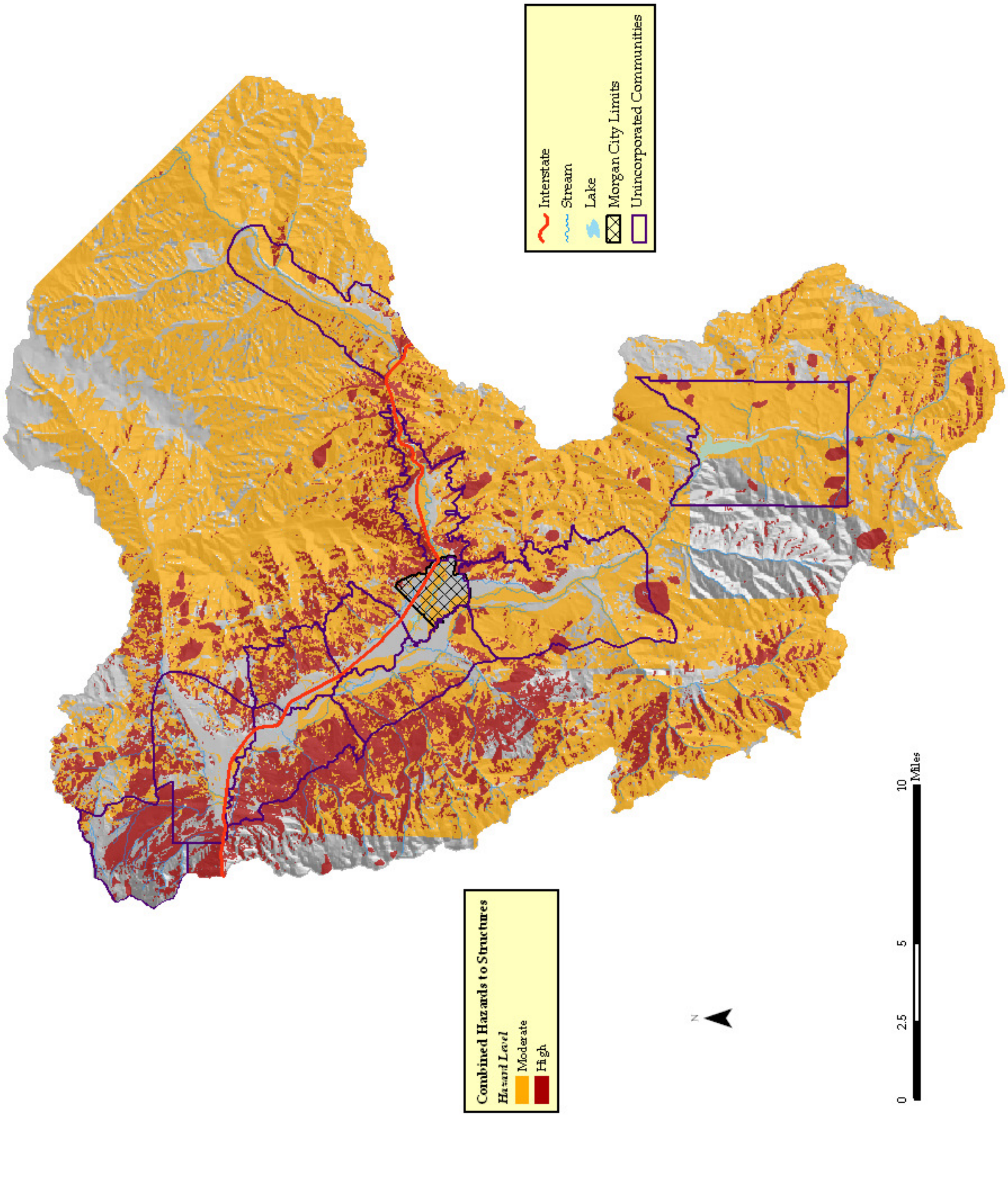
Table 10-21. Demographic and Economic Projections (UPEC 2007, 2008) All statistics are based on July 1 snapshot. AARC = Average Annual Rate of Change

Morgan County is experiencing rapid residential development. Since July 2000, Morgan County has seen a 25% increase in residential housing (BEBR 2007). Many have been built in extremely hazardous areas for landslide and wildland fire.

To assist its citizens in becoming less vulnerable to the landslide hazard, Morgan County enacted an ordinance requiring geotechnical studies to be performed prior to new construction. The County's General Plan restricts construction on slopes greater than 25 percent and requires grading standards for hillside development.

With the adoption of the 2006 Utah Wildland-Urban Interface Code, Morgan County is now better prepared to mitigate the potential for wildland fires affecting development within the County. The new codes give more power to building code enforcement to ensure necessary provisions are made for access, water supply and defensible space in the event of an actual fire. In some instances, the code enforcement officials have the authority to require fire protection plans to ensure property owners are sufficiently prepared.

Map 10-10 (page 177) shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, tornado, wildland fire and wind) in Morgan County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development is encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Map 10-10. Combined Hazards to Structures, Morgan County

Mitigation Strategies

The following mitigation strategies were formulated at a meeting for the Morgan County Mitigation Strategies Working Group on September 5th, 2007, at Morgan County Emergency Services. The Working Group sought to refine and expand on efforts already in place. Information on Working Group members can be found in Part III.

Dam Failure

Problem Identification: Federal, state, and private dams can impact Morgan County. Morgan County has poor community awareness and response systems.

Goal - Reduce loss of life and limit damage to property

Objective (Priority MEDIUM): Increase community awareness of dams that could impact the County

Action #1:	Educate community of evacuation routes
Time Frame:	1-2 years
Funding:	County
Estimated Cost:	Minimal
Staff:	Emergency Management

Action #2:	Tie dam failure notification system to reverse 911
Time Frame:	Over the next five years
Funding:	Unknown
Estimated Cost:	Undetermined
Staff:	Emergency Management

Drought

Problem Identification: The residents of Morgan County are unaware of the water conservation options that are available to them.

Goal - Decrease the impact of drought on the community

Objective (Priority LOW): Develop and promote water conservation measures.

Action #1:	Promote water conservation utilizing the Drought Contingency Plan
Timeframe:	Immediate
Funding:	County/Grant
Estimated Cost:	Minimal
Staff:	Emergency Management, Contract, Soil Conservation, Extension

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, Morgan City

Earthquake

Problem Identification: Critical facilities (public safety, commercial buildings, and 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 – Reduce loss of life and damage to property

Objective (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:	6 months – 1 year
Funding:	County
Estimated Cost:	Minimal
Staff:	County Emergency Services, Community Services Director

Action #2:	Facilitate a pre-earthquake damage assessment to evaluate critical facilities in need of retrofitting and the design criteria for the new county building
Time Frame:	Immediate – 1 year
Funding:	Grants, general fund
Estimated Cost:	Undetermined
Staff:	City/County Engineers, Consultant, Building Official

Action #3:	Work with the County businesses to ensure proper earthquake preparedness training
Time Frame:	1-5 years
Funding:	County / Grant
Estimated Cost:	Minimal
Staff:	Emergency Management, Community Services Director

Flood

Problem Identification: Morgan County has two major streams (East Canyon, Weber) and several smaller ones that threaten communities during spring runoff.

Goal #1 – Lessen impacts 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 Department

Action #2:	Work with water conservation districts, state legislators and other state agencies to increase flood storage area
Time frame:	2-3 years
Funding:	Unknown
Estimated Cost:	Unknown
Staff:	Emergency Management, County Engineer, State Floodplain Manager

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/Morgan City Floodplain Administrators, State Floodplain Manager, Community Services Director

Action #4:	Enact land use ordinances to preserve floodplain/open space due to increasing development pressure in floodplain areas. Pursue open space preservation in planning practice and floodplain development regulation.
Time Frame:	1-2 years
Funding:	Minimal
Estimated Cost:	Minimal
Staff:	Community Development Department

Action #5:	Form storm water improvement district for storm water disposal
Time Frame:	1-2 years
Funding:	Grants, taxes
Estimated Cost:	Undetermined
Staff:	County Engineer

Goal #2 – Reduce threat of unstable canals throughout the County

Objective #2 (Priority HIGH): Identify countywide canal systems

Action:	Map and assess the structural integrity of canal systems in the County. Determine the vulnerability of persons and infrastructure.
Time Frame:	1 year
Funding:	Federal grants
Estimated Cost:	Unknown
Staff:	County/City Public Works, Canal Companies, County Engineering, County GIS

Severe Weather

Problem Identification: Snowstorms, hail, thunderstorms, lighting, heavy rain, wind and avalanche impact Morgan County. This is intensified by Morgan County's remote location.

Goal #1 – Assist in protecting residents from the effects of severe weather

Objective#1 (Priority MEDIUM): Lessen the impact of severe storms to residents and businesses within Morgan County

Action #1:	Increase residents' awareness of the need for food storage for use during severe storms.
Time Frame:	1-3 years
Funding:	County, grants
Estimated Cost:	Minimal
Staff:	Emergency Management, Extension

Action #2:	Increase residents' awareness of where emergency shelters are located
Time Frame:	1-3 years
Funding:	County, grants
Estimated Cost:	Minimal
Staff:	Emergency Management/Contract

Action #3:	Establish the county in the National Weather Service Storm Ready program
Time Frame:	1 year
Funding:	County
Estimated Cost:	Minimal
Staff:	County Emergency Management, NWS, DHLS

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, Utah Avalanche Forecast Center.

Slope Failure

Problem Identification: Morgan County has a significant landslide threat. The community of Mountain 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 HIGH): Provide citizens with updated geologic hazards maps and information

Action:	Educate officials, landowners, and developers about geologic hazards
Time Frame:	1-2 years
Funding:	None
Estimated Cost:	None
Staff:	County Engineer/UGS

Objective #2 (Priority HIGH): Monitor historical landslide areas

Action #1:	Expand scope of mapping to identify active landslides and potential landslides
Time Frame:	Unknown
Funding:	Federal Grants
Estimated Cost:	Unknown
Staff:	Emergency Services, County Engineer, UGS, USGS

Action #2:	Develop and implement long term landslide hazard mitigation measures along the Gateway Canal.
Time Frame:	2-5 years
Funding:	PDM Grants, Weber Basin Water Conservancy District (WBWCD), U.S. Bureau of Reclamation
Estimated Cost:	Unknown
Staff:	WBWCD, Bureau of Reclamation

Goal #2 – Use land use ordinances to reduce the risk of slope failure to public and private property

Objective (Priority HIGH): Enact land use ordinance

Action:	Present to County/City Councils for adoption
Time Frame:	1 year
Funding:	Local funds
Estimated Cost:	Unknown
Staff:	County Engineer, County Planner, UGS

Wildfire

Problem Identification: Continuing non-compliance with existing building codes and fire codes

Goal #1 – Building and fire code compliance

Objective (Priority HIGH): Increase compliance with existing building and fire codes.

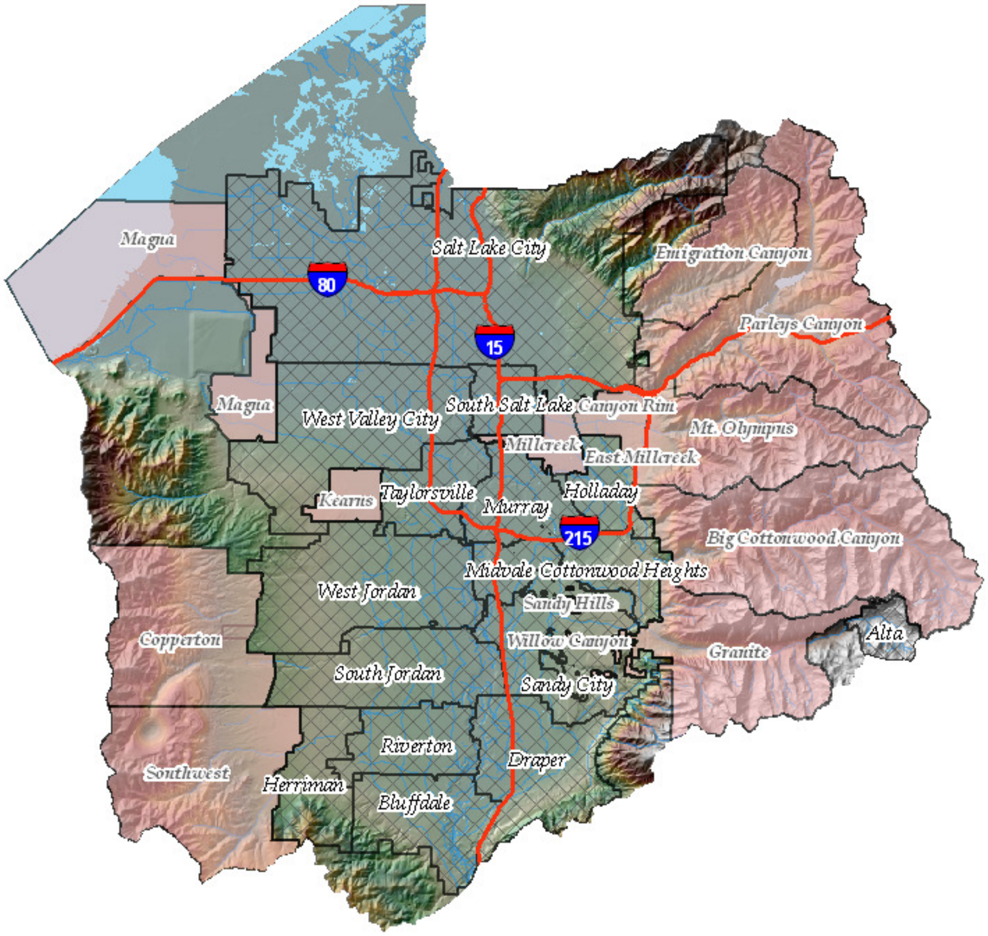
Action:	Continue to enforce current local, state and national codes.
Time Frame:	Ongoing

Funding:	Local, state and federal grants
Estimated Cost:	Unknown
Staff:	Local, state and federal agencies

Goal #2 – Wildfire community education

Objective (Priority HIGH): Reduce overall risk from wild fire through education programs - especially in Mountain Green, Trappers Loop, the area east of Porterville, and East Canyon.

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



Part XI. Salt Lake County

At 737 square miles, Salt Lake County is the fifth smallest county in land area (Governor's Office of Planning and Budget). Tooele County borders to the west while Summit County borders to the east. To the north, lie Davis and Morgan Counties with Utah County to the south. The Wasatch and Oquirrh Mountains form the east and west borders of the county respectively. The Great Salt Lake occupies much of the northwest corner of the county. Within Salt Lake County are fifteen incorporated areas (Alta, Bluffdale, Cottonwood Heights, Draper City, Herriman, Holladay, Midvale, Murray, Riverton, Salt Lake City, Sandy City, South Jordan, South Salt Lake, Taylorsville, West Jordan, and West Valley) and sixteen unincorporated areas with substantial populations: (Big Cottonwood, Camp Williams, Canyon Rim, Copperton, East Millcreek, Emigration Canyon, Granite West, Kearns, Magna, Millcreek, Mount Olympus, Parley's Canyon, Sandy Hills, Southwest, White City, and Willow Canyon). 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 relative to the amount of private and local government ownership in Utah.

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 primarily for commercial use 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. Many 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 may be redeveloped for commercial and residential purposes. Much of this land is currently held by Kennecott Utah Copper Corporation.

Salt Lake County is the backbone of Utah's economy, making up 50% of the job market. The service industry, the largest employment division within the County, supplies 26% of the area's wages. Trade is the second major component followed by government and manufacturing. The largest number of government-related employees in Utah is located in Salt Lake County. Salt Lake is a regional center for finance, health care, and high tech industries as well. Major employers include the University of Utah, State of Utah, Intermountain Healthcare, Granite School District, Jordan School District, Salt Lake County, Wal-Mart, Discover Financial Services Inc., Delta Airlines, United States Postal Service, Salt Lake City School District and Salt Lake City.

Both incorporated communities 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 Wildland-Urban Interface (WUI) 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 be a problem in this region and the response measures taken are kept up to date and include many mitigation measures.

Hazard History

Identifying past hazard events provides a starting point for predicting where future events could potentially occur. The following historical hazard event statistics were consolidated from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) of the Hazards and Vulnerability Research Institute. This database records reported natural hazard events which cause greater than $50,000 in damages. Monetary figures are in 2005 dollars (Figure 11-2).

Over $199 million in property losses were incurred during the August 1999 Salt Lake City tornado event. This single event caused more destruction than all other significant hazard events in Salt Lake County history combined. See Figure 11-3 for a visual comparison of historical hazard losses to property with and without the 1999 Salt Lake City tornado.

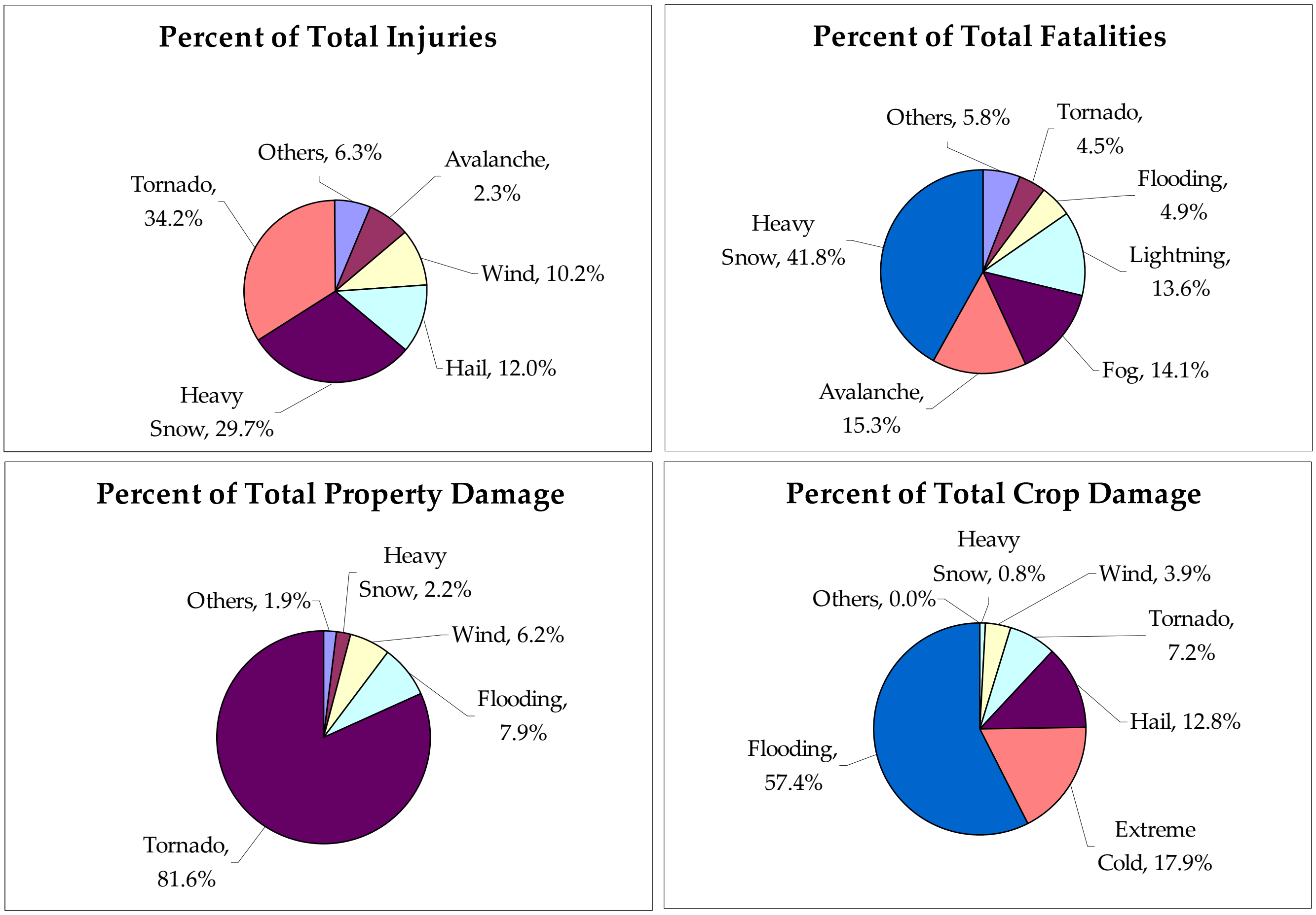


Figure 11-2. Major Disaster Event Averages 1962-2005, Salt Lake County, Percentages (HVRI 2007)

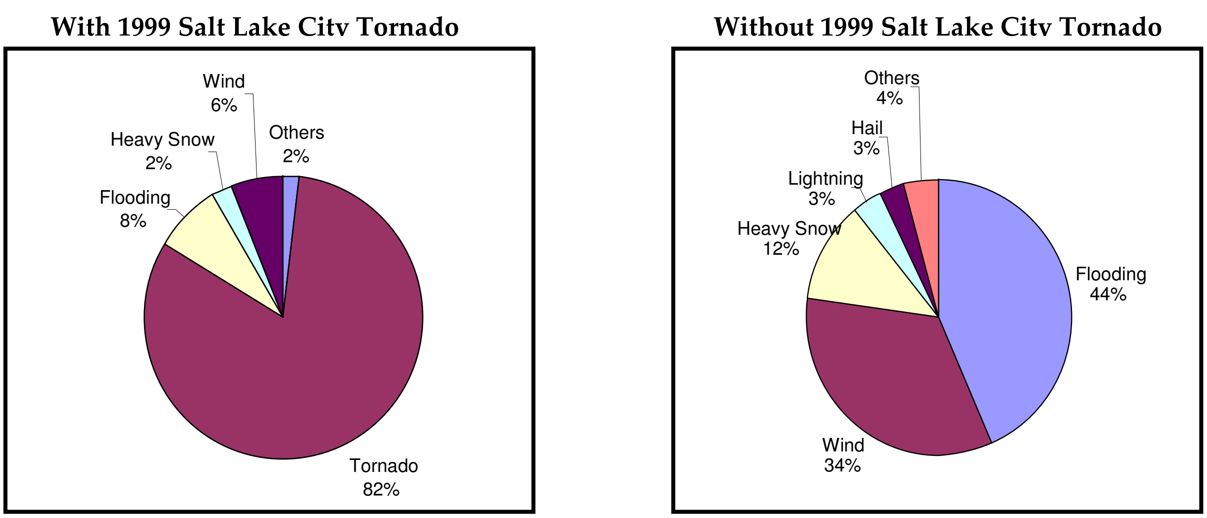


Figure 11-3. Hazard Property Loss Comparison, with and without 1999 Salt Lake City Tornado (HVRI 2007)

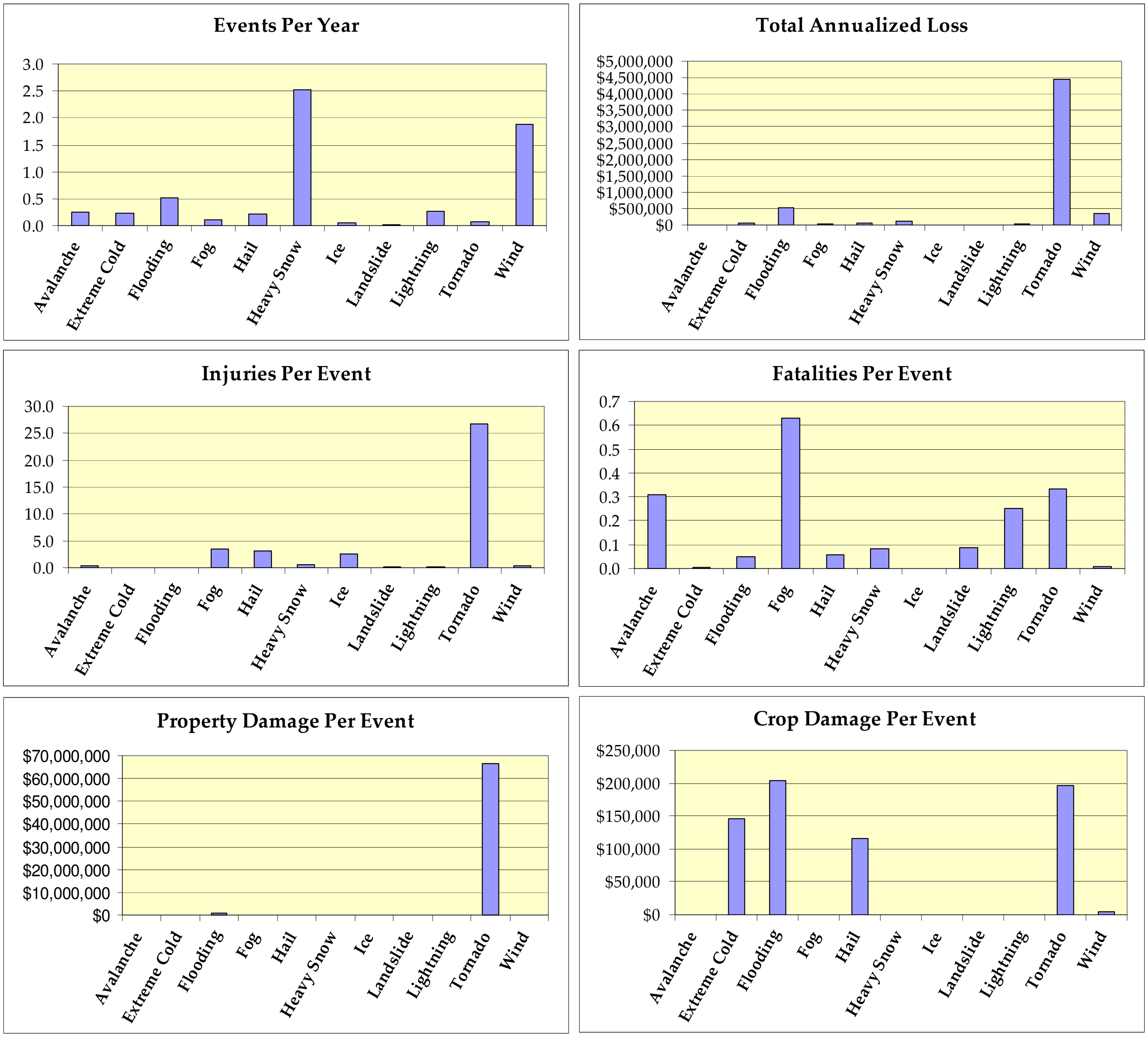


Figure 11-4. Major Disaster Event Annual and Per Event Averages 1962-2005, Salt Lake County (HVRI 2007)

Risk Assessment

A risk assessment hazard profile was completed for the following identified hazards: earthquake, wildland fire, flood, dam failure, slope failure, severe weather, drought, radon, and infestation. Severe weather, drought, radon and infestation are considered to be regional hazards and can be found in Part VIII. Table 11-1 identifies the highest level of risk each incorporated and unincorporated area has to each identified hazard. Table 11-1 examines vulnerability for critical facilities. Refer to Part VII for an explanation of the risk assessment process.

Number of Structures with Moderate or Greater Vulnerability (% of Total)								
Critical Facilities	**Total**	***Dam Failure***	***Flood***	***Ground Shaking***	***Liquefaction***	***Problem Soils***	***Slope Failure***	***Wildfire***
Amateur Radio Repeaters	64	2 (3%)	0 (0%)	64 (100%)	5 (8%)	0 (0%)	5 (8%)	10 (16%)
Public Safety Repeaters	11	0 (0%)	0 (0%)	11 (100%)	5 (46%)	0 (0%)	3 (33%)	5 (46%)
Electric Generation Facilities	5	2 (40%)	1 (20%)	5 (100%)	2 (40%)	0 (0%)	1 (20%)	0 (0%)
Emergency Operations Centers	15	1 (7%)	1 (7%)	15 (100%)	10 (67%)	0 (0%)	0 (0%)	0 (0%)
Fire Stations	57	4 (7%)	3 (5%)	57 (100%)	26 (46%)	0 (0%)	2 (4%)	1 (2%)
Hospitals	30	2 (7%)	0 (0%)	30 (100%)	12 (40%)	0 (0%)	2 (7%)	0 (0%)
Oil Facilities	2	0 (0%)	0 (0%)	2 (100%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)
Police Stations	25	5 (20%)	1 (4%)	25 (100%)	19 (76%)	0 (0%)	0 (0%)	0 (0%)
Schools	246	25 (10%)	0 (0%)	246 (100%)	108 (44%)	0 (0%)	0 (0%)	1 (1%)
Water Treatment Facilities	7	2 (29%)	2 (29%)	7 (100%)	2 (29%)	1 (14%)	2 (29%)	1 (17%)

Table 11-1. Critical Facilities Vulnerability Matrix for Local Hazards, Salt Lake County NA=Not Applicable

1. Earthquake

Hazard Profile

<table>
<tr><td rowspan="4">Potential Magnitude</td><td>X</td><td>Catastrophic (>50%)</td><td rowspan="4">Probability</td><td></td><td>Highly Likely</td></tr>
<tr><td></td><td>Critical (25-50%)</td><td>X</td><td>Likely</td></tr>
<tr><td></td><td>Limited (10-25%)</td><td></td><td>Possible</td></tr>
<tr><td></td><td>Negligible (< 10%)</td><td></td><td>Unlikely</td></tr>
<tr><td>Location</td><td colspan="5">Ground shaking will be felt throughout the entire county. Surface fault rupture can be found in areas of known historic fault movements. Liquefaction can be expected in areas of high to moderate liquefaction potential.</td></tr>
<tr><td>Seasonal Pattern</td><td colspan="5">None</td></tr>
<tr><td>Conditions</td><td colspan="5">Liquefaction potential within areas with shallow ground water. Soil that is comprised of old lakebed sediments. Historic movement along faults. Intermountain Seismic Zone, Wasatch Fault.</td></tr>
<tr><td>Duration</td><td colspan="5">Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.</td></tr>
<tr><td>Secondary Hazards</td><td colspan="5">Fire, landslide, rock falls, avalanche, flooding</td></tr>
<tr><td>Analysis Used</td><td colspan="5">Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DHLS, AGRC</td></tr>
</table>

Description of Location and Extent

The Wasatch Fault 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 these are 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.

The Wasatch Fault Zone appears to be one of the most frequent sources of large earthquakes. Also, because of geologic conditions, the secondary threats of earthquakes are high. Recent evaluation of the earthquake potential along the Wasatch Front indicates 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.

Name	Fault Type	Length (km)	Time of Most Recent Deformation	Recurrence Interval
East Great Salt Lake fault zone, Antelope Island section	Normal	35	586+201/-241 cal yr B.P.	4,200 years
Wasatch fault zone, Salt Lake segment	Normal	43	1,300±650 cal yr B.P.	1,300 years
West Valley fault zone, Granger segment	Normal	16	1,500±200 cal yr B.P.	2,600-6,500 years
West Valley fault zone, Taylorsville segment	Normal	15	2,200±200 cal yr B.P.	6,000-12,000 years

Table 11-2. Quaternary Faults, Salt Lake County (UGS 2002, UGS 2006) cal yr B.P.=calendar years before present

Other faults within Salt Lake County include the West Valley Fault Zone and the East Great Salt Lake Fault Zone. Each of these fault zones has much longer return interval (2,500 years or more) and is not expected to produce a major quake in the near future.

Significant earthquakes have occurred in Salt Lake County within the last 50 years. In 1962, a 5.2 Richter magnitude quake jolted the Magna area. In 1992, a magnitude 4.2 quake shook the southern portion of the County. For a map of earthquake epicenter distribution, see Map 11-2 (page 192).

Maps 11-3 and 11-4 (pages 193-194) represent probabilistic maps of ground shaking potential within Salt Lake County for a 2500-year event. This represents an event with an approximate magnitude of 7.5 on the Richter scale. Spectral acceleration of 0.2 seconds represents the frequency of shaking which affects primarily one- and two-story buildings. 1.0 second spectral acceleration represents the frequency most likely to affect buildings 3 stories or higher. Values are represented as a percent of the force of gravity. Ten percent of gravity (0.1G) is the threshold at which poorly-built structures begin to suffer significant damage (FEMA 1995).

Liquefaction is one of the secondary hazards associated with an earthquake and affects nearly all of Salt County. The County is located atop the ancient Lake Bonneville lakebed, which is made up of unconsolidated sandy soils. Much of the valley is also subject to shallow ground water and a relatively high earthquake threat. These three factors are prevalent in the northern quarter of the County. For a further explanation of the liquefaction threat, see Map 11-5 (page 195). The regional hazard identification section also provides a narrative explanation of liquefaction.

Vulnerability Assessment

Vulnerability of people and infrastructure to earthquake hazards in Salt Lake County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH).** The following numbers were based on a probabilistic 2500-year event with a Richter magnitude of 7.1 as well as an arbitrary 5.9 event located in close proximity to the county's most populated areas. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (**For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the HAZUS-MH Technical Manual (Earthquake Model) at www.fema.gov/hazus).

Building Damage

HAZUS-MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 11-3 lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage during an arbitrarily-determined Richter magnitude 5.9 (M5.9) earthquake scenarios or a probabilistic Richter magnitude 7.1 (M7.1) earthquake scenario. Also listed are the estimated monetary losses to structures, contents/inventory, and income.

Category	Number of Structures with > 50% Damage		Category	Estimated Losses	
	Salt Lake M5.9	2500-yr M7.1		Salt Lake M5.9	2500-yr M7.1
Residential	30,342	157,705	Structural Losses	$519,320,000	$3,419,030,470
Commercial	1,896	5,199	Non-Structural Losses	$1,818,647,000	$12,331,504,070
Industrial	495	1,367	Content Losses	$719,709,000	$4,114,455,740
Government	167	475	Inventory Losses	$29,216,000	$175,756,410
Education	51	159	Income and Relocation Losses	$623,140,000	$3,263,449,580
Totals	32,951	164,905	Totals	**$3,710,032,000**	**$23,304,196,270**

Table 10-3. Building Damage Counts and Estimated Losses

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in Table 11-4. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage >50%		Estimated Losses	
		Salt Lake M5.9	2500-yr M7.1	Salt Lake M5.9	2500-yr M7.1
Waste Water Facilities	5	2	4	$44,008,000	$146,243,000
Waste Water Pipelines	3.975 km	637 leaks/breaks	14,005 leaks/breaks	$2,294,000	$50,416,000
Potable Water Pipelines	6,625 km	805 leaks/breaks	17,706 leaks/breaks	$2,900,000	$63,744,000
Natural Gas Pipelines	2,650 km	681 leaks/breaks	14,970 leaks/breaks	$2,452,000	$53,893,000
Electrical Power Facilities	7	3	7	$92,024,000	$343,874,000
Communication Facilities	42	9	34	$242,000	$1,478,000
Highway Bridges	698	126	496	$81,646,000	$468,944,000
Railway Bridges	17	0	8	$9,000	$358,000
Railway Facilities	6	0	6	$3,494,000	$7,525,000
Bus Facilities	2	0	2	$490,000	$1,157,000
Airport Facilities	3	0	3	$2,675,000	$7,450,000
Total Losses				$232,234,000	$1,145,082,000

Table 11-4. Damage to Transportation and Utilities

Debris Removal

Table 11-5 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 at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	Salt Lake M5.9	2500-yr M7.1
Brick, Wood & Others	581,000 tons / 23,240 loads	3,356,000 tons / 134,240 loads
Concrete & Steel	1,195,000 tons / 47,800 loads	7,678,000 tons / 307,120 loads

Table 11-5. Debris Generated/Number of Loads

Fire Following

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 10-6 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Salt Lake M5.9	2500-yr M7.1
Ignitions	49	80
Persons Exposed	806	2,116
Value Exposed	$50,232,000	$120,188,000

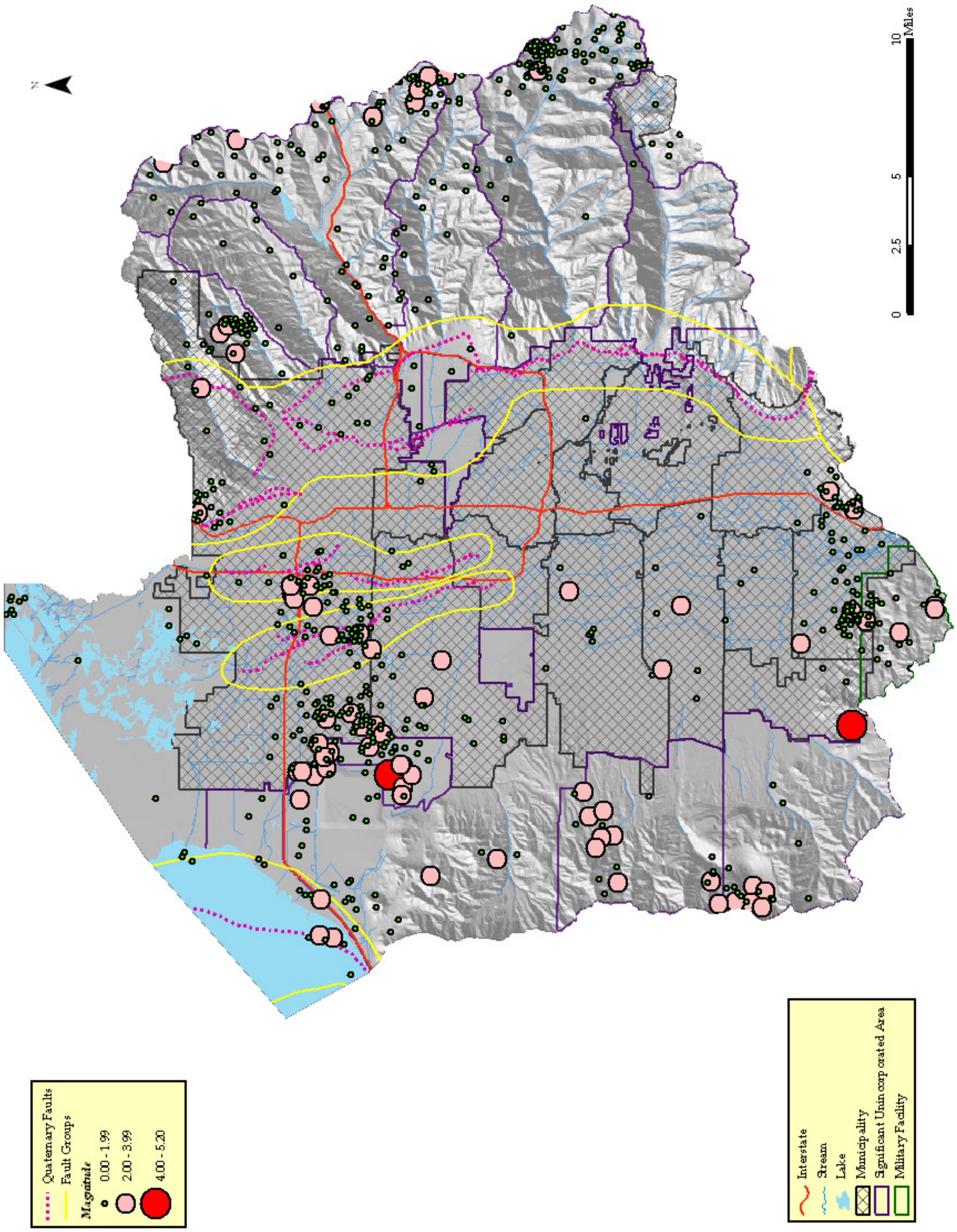
Table 11-6. Fire Following Event, Population Exposed, and Building Stock Exposed

Casualties

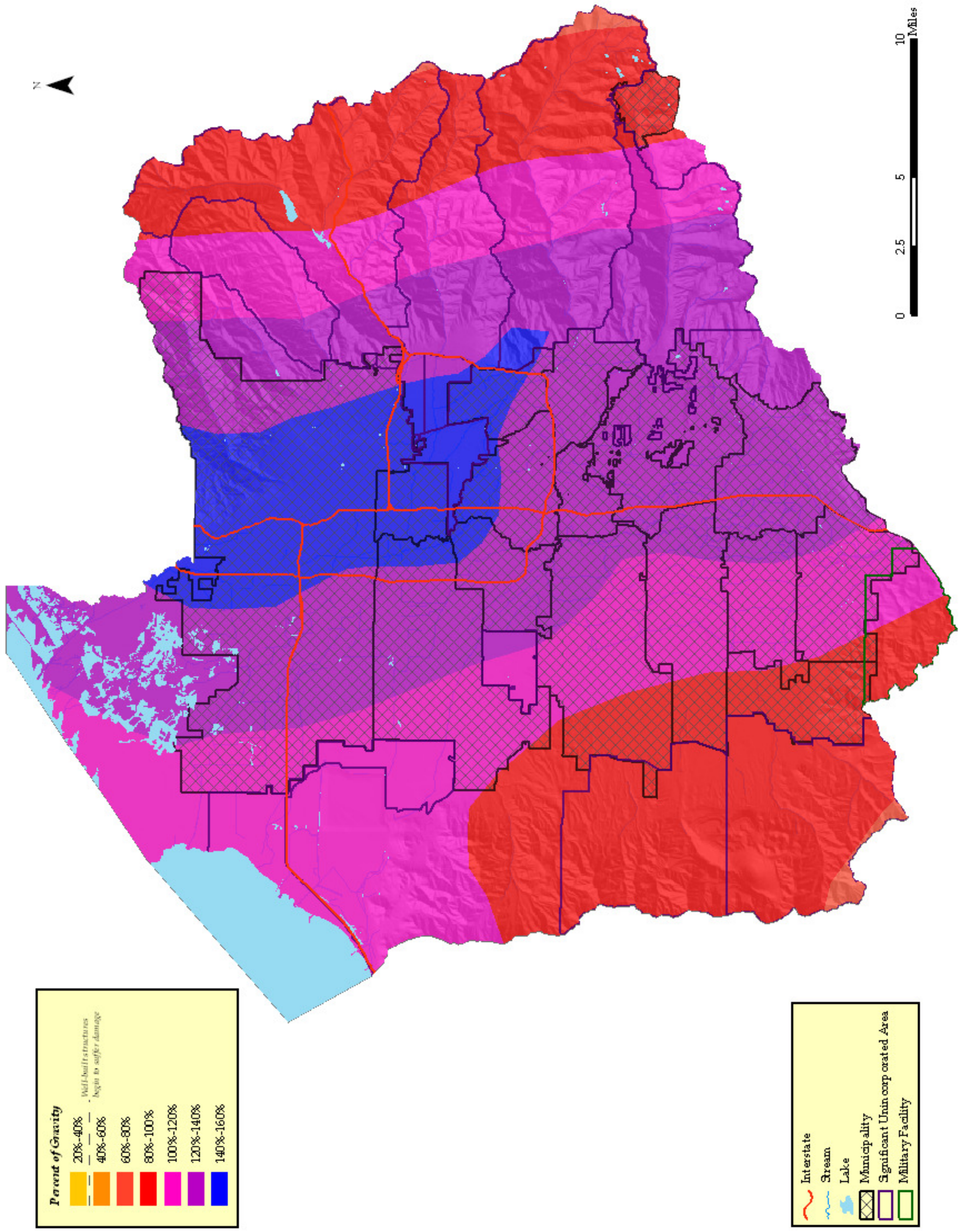
Table 11-7 estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons, the daytime scenario (2 p.m. local time) a commercial concentration, and the commute scenario (5 pm. local time) a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major), and fatalities.

Night Event	Salt Lake M5.9	2500-yr M7.1	Day Event	Salt Lake M5.9	2500-yr M7.1	Commute Event	Salt Lake M5.9	2500-yr M7.1
Minor	1,024	10,475	Minor	1,883	17,110	Minor	1,432	13,442
Major	219	3,224	Major	502	6,192	Major	369	4,688
Fatalities	44	758	Fatalities	122	1,742	Fatalities	87	1,258

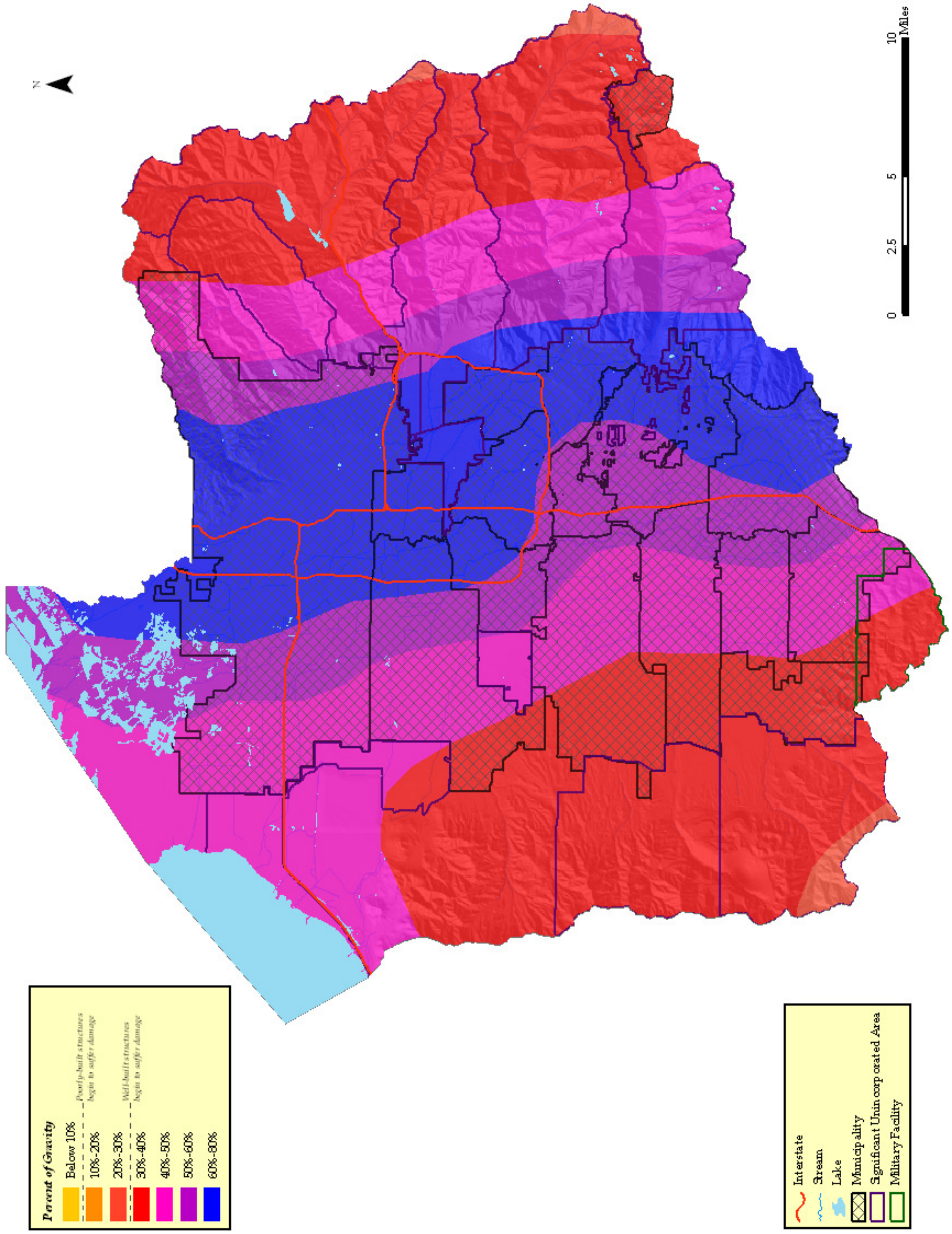
Table 11-7. Casualties



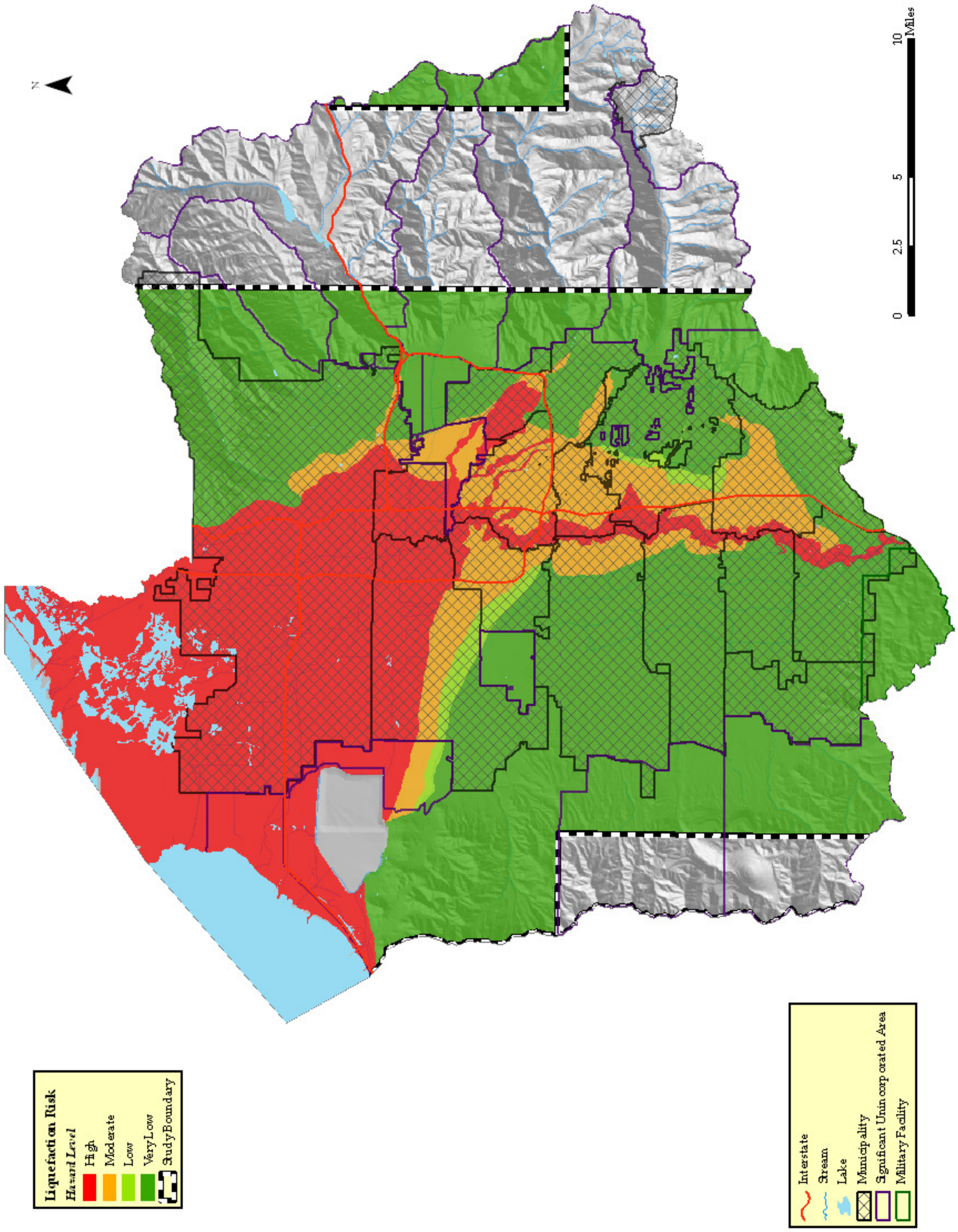
Map 11-2. Salt Lake County Earthquakes, 1962-2005 (UUSS 2007)



Map 11-3. 0.2-Second Spectral Acceleration, Salt Lake County (NSHMP 2002)



Map 11-4. 1.0-Second Spectral Acceleration, Salt Lake County (NSHMP 2002)



Map 11-5. Liquefaction Susceptibility, Salt Lake County (Christenson and Shaw 2008)

2. Wildland Fire

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
	X	***Critical (25-50%)***		*X*	***Likely***
		Limited (10-25%)			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Wildland-Urban Interface (WUI) zones near the foothills and in forested areas (see Map 11-6, page 199)				
Seasonal Pattern	June-October				
Conditions	Areas affected by drought; heavily overgrown and dry brush and debris; lightning and human triggers				
Duration	Days to months; depends on climate and fuel load as well as resources (financial, manpower) to extinguish the fire				
Secondary Hazards	Landslides, debris flows/flash floods, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by US Forest Service, FFSL, FEMA, AGRC, County Hazard Analysis Plans, and DHLS				

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 Range, Traverse Mountain and the Oquirrhs. These WUI areas are threatened most because of the amount of forested lands and the increasing population growth spreading into the foothills. Another concern is vegetation type in these areas such as sagebrush, mountain scrub oak, cheat grass, pinion and juniper trees, and rural and riparian vegetation. Sagebrush burns hot and fast, 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 population growth continues, pressure to develop in WUI areas is likely to increase the threats associated with fire. Mitigation measures will need to be recognized and enforced to reduce these threats.

Past wildfires in Salt Lake County have had a significant impact on watersheds, resulting in slope failure, debris flows and other forms of erosion. State and local agencies have worked together to enhance ordinances and other measures to protect County watersheds.

Vulnerability Assessment

Table 11-8 estimates infrastructure vulnerable to wildland fire in Salt Lake County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 11-9 and Table 11-10 estimate the total area, population and buildings vulnerable to wildland fire for individual cities and unincorporated areas.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	366.71 miles	$1,991,590,683
Highway Bridges	608 bridges	$1,298,659,176
Railway Segments	179.70 miles	$206,434,364
Railway Bridges	17 bridges	$2,275,560
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		$3,498,959,783

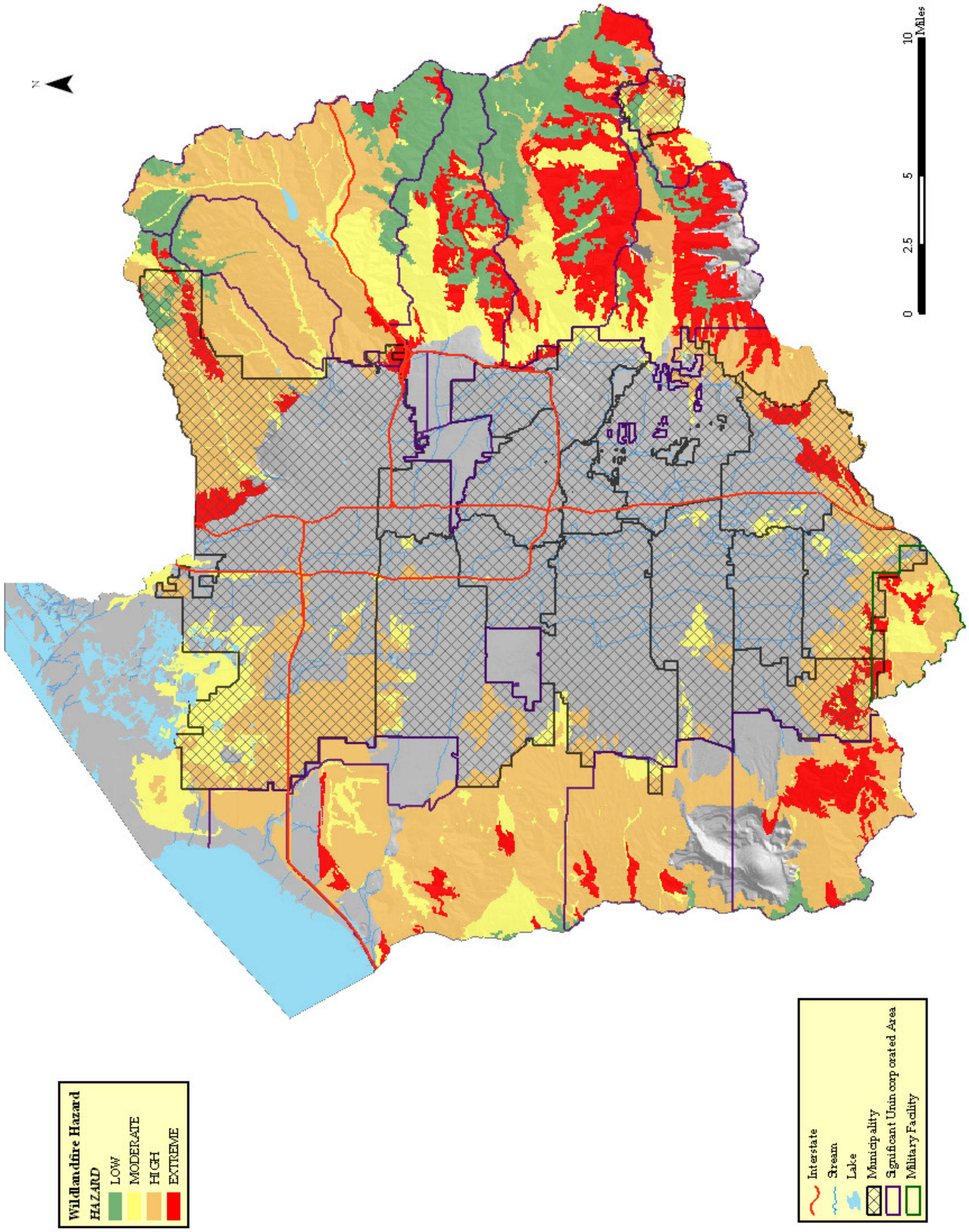
Table 11-8. Infrastructure Vulnerable to Wildland Fire, Salt Lake County

Incorporated Areas	Acres in Wildfire Risk Area	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Alta	2,030	723	348 $71,200,800	0
Bluffdale	5,227	584	100 $35,995,600	22 $52,329,256
Cottonwood Heights	5,763	213	67 $,13,708,200	9 $3,517,434
Draper	7,664	6,128	2,934 $599,061,540	113 $44,163,338
Herriman	8,212	1,385	908 $185,232,600	143 $55,888,140
Holladay	0	0	0	0
Kearns	0	0	0	0
Magna	4,064	170	48 $9,908,400	10 $4,188,691
Midvale	0	0	0	0
Murray	0	0	0	0
Riverton	247	1,502	429 $85,545,142	12 $8,018,261
Salt Lake City	10,783	1,435	410 $83,640,000	60 $209,789,232
Sandy City	1,463	789	228 $47,648,800	16 $529,697,373
South Jordan	2,800	0	0	0
South Salt Lake	0	0	0	0
Taylorsville	0	0	0	0
West Jordan	222	0	0	0
West Valley City	2,591	0	0	44 $525,835,874

Table 11-9. Vulnerability Assessment for Wildland Fire, Salt Lake County

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Big Cottonwood Canyon	35,274	603	71 $52,116,600	0 $0
Camp Williams	14,873	428	0 $0	0 $0
Canyon Rim	0	0	0 $0	0 $0
Copperton	0	0	0 $0	0 $0
East Millcreek	1,969	2,640	301 $240,080,600	9 $8,652,009
Emigration Canyon	11,979	3,764	1,457 $298,102,200	31 $13,809,838
Granite	0	0	0 $0	0 $0
Millcreek	0	0	0 $0	0 $0
Mount Olympus	19,692	2,671	559 $8,171,400	222 $73,649,211
Parley's Canyon	34,254	6,688	2,428 $496,768,800	1 $530,390
Sandy Hills	249.7	6,052	1,849 $378,305,400	48 $15,254,384
Southwest	3,568	931	1,395 $285,417,000	24 $10,841,802
Willow Canyon	66	132	22 $4,525,200	0 $0

Table 11-10. Vulnerability Assessment for Wildland Fire, Unincorporated Salt Lake County



Map 11-6. Wildfire Hazard Map, Salt Lake County (UDFFSL 2007)

3. Flood

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Largely in and along floodplains (See Map 11-7 and Map 11-8); debris flows could cause natural damming of water if nearby streams were to become blocked				
Seasonal Conditions	Spring, heavy rainfall, and spring snowmelt runoff.				
Conditions	Thunderstorms w/heavy rainfall, extended wet periods				
Duration	Flooding can last anywhere from hours to days and even months.				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
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 typically the result of excessive snowmelt runoff and/or heavy rainfall. Snowmelt flooding is usually the result of rapid melting of snowpack and occurs between Aril through June. Thunderstorms can produce high intensity, short duration heavy rainfall that occurs over a relatively small area in the summer months. However, flooding can occur from non-thunderstorm rainfall events. Refer to Maps 11-7 and 11-8 (pages 203 and 204).

September 1982 flooding in Big Cottonwood Canyon (Photo by David Carpenter.) (*Source*: http://www.utahweather.org/)

The major waterways in the County include the Jordan River, Big and Little Cottonwood Creeks, Parley's Creek, Emigration Creek, Red Butte Creek, City Creek, Lambs Creek, Dell Creek and Millcreek. All have the potential to flood. However, the major floods of 1983-84 and other flood events resulted in the incorporation of significant flood mitigation measures that greatly reduced the flood threat.

The flows of the Jordan River are controlled and the flood potential is reduced. Parley's 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 Creeks and Bell's Canyon have a number of smaller flood storage lakes and ponds providing some minimal flood protection. In Salt Lake City, Emigration Creek and Red Butte Creek come together at 700 East and 300 South and can be discharged in or bypass Liberty Park pond. Parley's Creek discharges to the 1300 South drain at State Street.

The potential for flooding is greatest for heavy rainfall events, usually from thunderstorms during peak flow times. Areas to monitor include 13th South between 700 East and State Street, 7th West and North Temple Streets. Retention ponds are also used to store runoff from commercial and residential development areas.

During the past 149 years, the Great Salt Lake has peaked three times above 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.

Great Salt Lake Flooding, Salt Air Resort (Photo courtesy of the National Weather Service.) *(Source*: http://www.utahweather.org/)

This picture of the Saltair Resort on the southeast shore of the Great Salt Lake was taken during the flood years of the 1980s. 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 are currently inoperable, but could be reactivated if necessary (Utah Department of Water Resources 2007b).

Vulnerability Assessment

The vulnerability assessment for flooding in Salt Lake County was obtained from HAZUS-MH**. Vulnerability was assessed for both 100-year (NFIP Zone A) and 500-year (NFIP Zone B or Zone X (shaded) flood events. Analysis was completed using Digital Flood Insurance Rate Maps (DFIRM). Only streams which contained detailed flood cross-section data could be used. Flooding from the Great Salt Lake was not included. Consequently, the results should be considered conservative. Total monetary losses include structures, contents and business interruption. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the* *<u>HAZUS-MH Technical Manual (Flood Model)</u>* *at www.fema.gov/hazus).*

	Acres Flooded	Population Displaced	Number of Structures in Floodplain	
			Residential Units (Total Losses)	Commercial/Industrial Units (Total Losses)
100-year Flood	2,588.7	13,777	2,255 $342,730,000	47 $331,750,000
500-year Flood	8,346.4	14,613	2,490 $409,820,000	47 $401,500,000

Table 11-11. Salt Lake County Flood Hazard

Agricultural Losses

Agricultural losses are listed in Table 11-12 (page 202). Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15th.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$45,134	$60,179	$49,078	$65,438
Corn Silage	$565,932	$754,577	$566,310	$820,518

Table 11-12. Agricultural Losses, April 15th Scenario

Vehicle Losses

Table 11-13 contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$8,934,176	$12,019,101
Nighttime Scenario	$16,956,505	$21,976,899

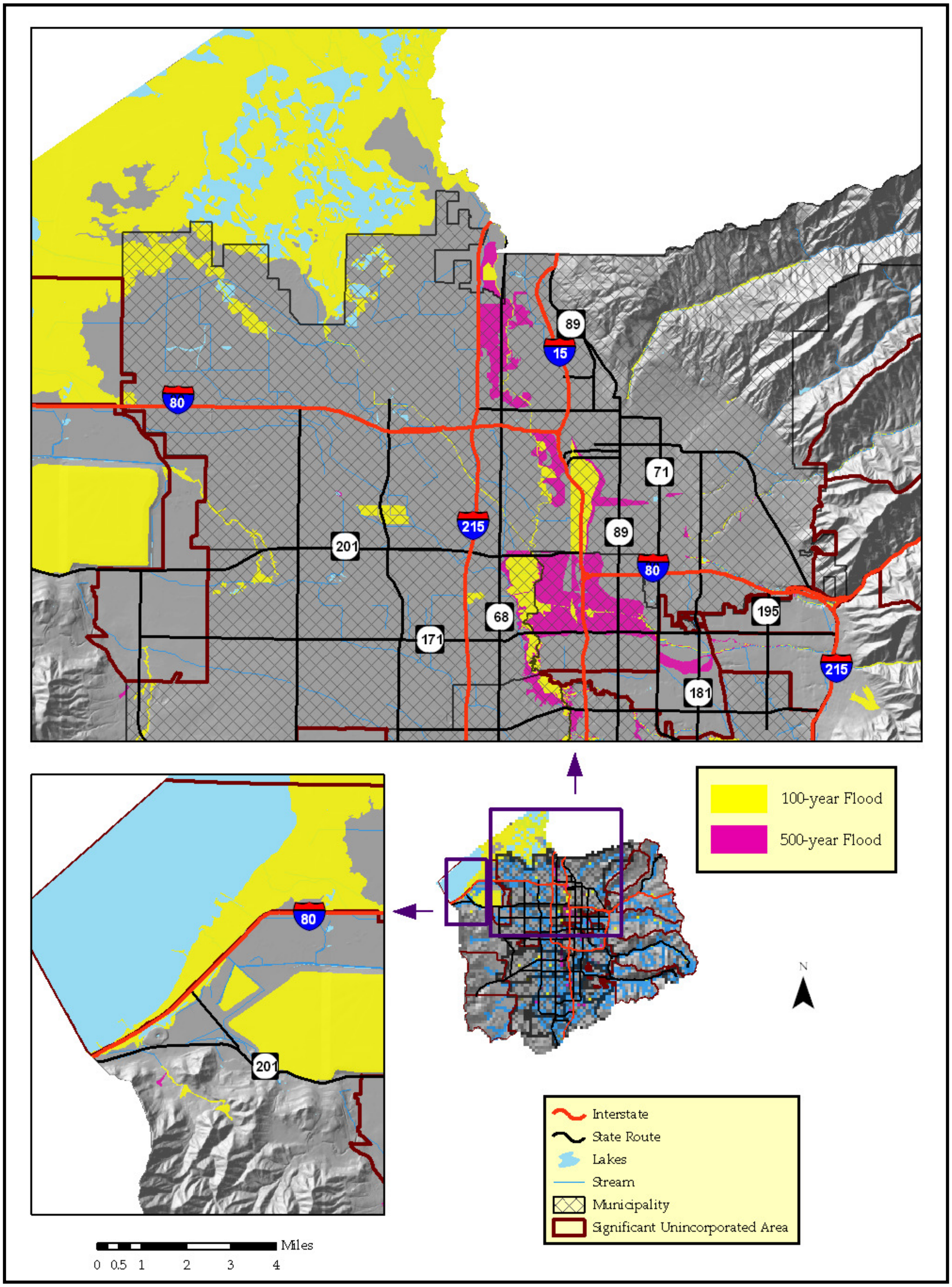
Table 11-13. Vehicle Losses

Debris Removal

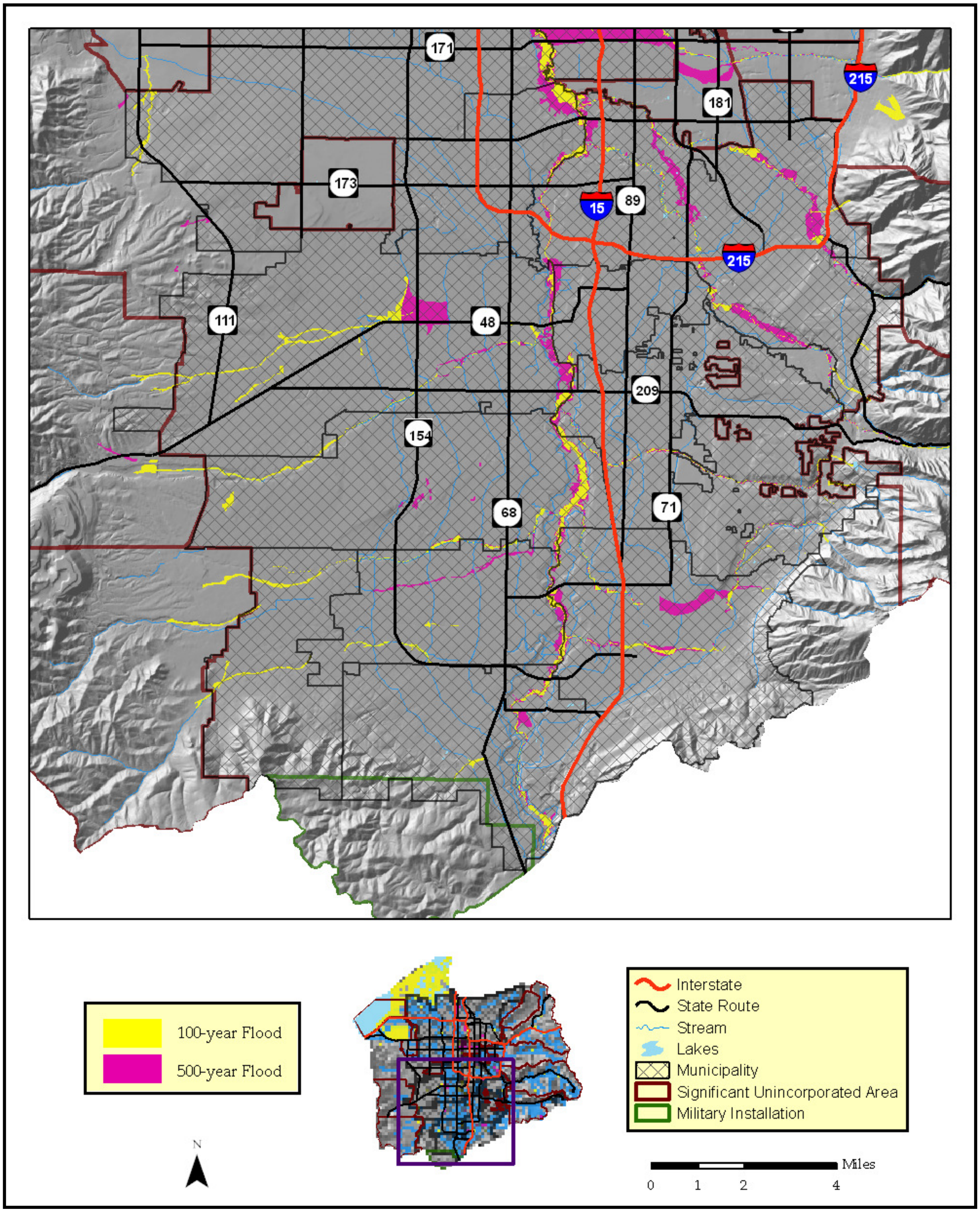
Table 11-14 shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	37,402 tons/1,497 loads	44,481 tons/1,780 loads
Structures	64,725 tons/2,589 loads	69,936 tons/ 2,798 loads
Foundations	61,660 tons/2,467 loads	66,747 tons/2,670 loads
Totals	**163,786 tons/6,553 loads**	**181,164 tons/7,248 loads**

Table 11-14. Debris Generation and Removal



Map 11-7. Flood Hazard Map, Northern Salt Lake County (FIMA 2002)



Map 11-8. Flood Hazard Map, Southern Salt Lake County (FIMA 2002)

4. Slope Failure

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)		X	*Likely*
	X	*Limited (10-25%)*			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Generally in canyon mouths and foothills; areas of recent wildfire activity (Map 11-9, page 208)				
Seasonal Pattern	Spring and summer months				
Conditions	Usually caused by the stress release of over-weighted soils or loosening of rock and debris by wind, water or ground shaking				
Duration	Landslides: hours to months Rock falls/debris flows: instantaneous				
Secondary Hazards	Flooding (natural dams), traffic accidents				
Analysis Used	Information and maps provided by UGS, DHLS, 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. 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 (refer to Map 11-9). As urbanization spreads into geologically unstable areas of the County, the risk to life and property increases.

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.

Subsidence is possible in City Creek, Emigration, Parley's, and Big Cottonwood Canyons due to the prevalence of dissolvable limestone. Subsidence can also occur in the Avenues area of Salt Lake City and in the Taylorsville-Kearns area due to collapsible soils that are compactable upon wetting (Mulvey 1992).

Vulnerability Assessment

Table 11-15 (below) estimates infrastructure vulnerable to landslides in Salt Lake County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 11-16 estimates the total area, population, and buildings vulnerable to landslides for individual cities. Table 11-17 examines the same for unincorporated areas.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	46.86 miles	$259,322,175
Highway Bridges	38 bridges	$33,527,413
Railway Segments	4.98 miles	$5,716,617
Railway Bridges	1 bridges	$23,520
Water Distribution Lines	609.38 miles	$19,621,849
Gas Lines	243.64 miles	$7,848,732
Sewer Lines	365.61 miles	$11,773,110
Total Estimated Infrastructure Replacement Cost		**$337,833,416**

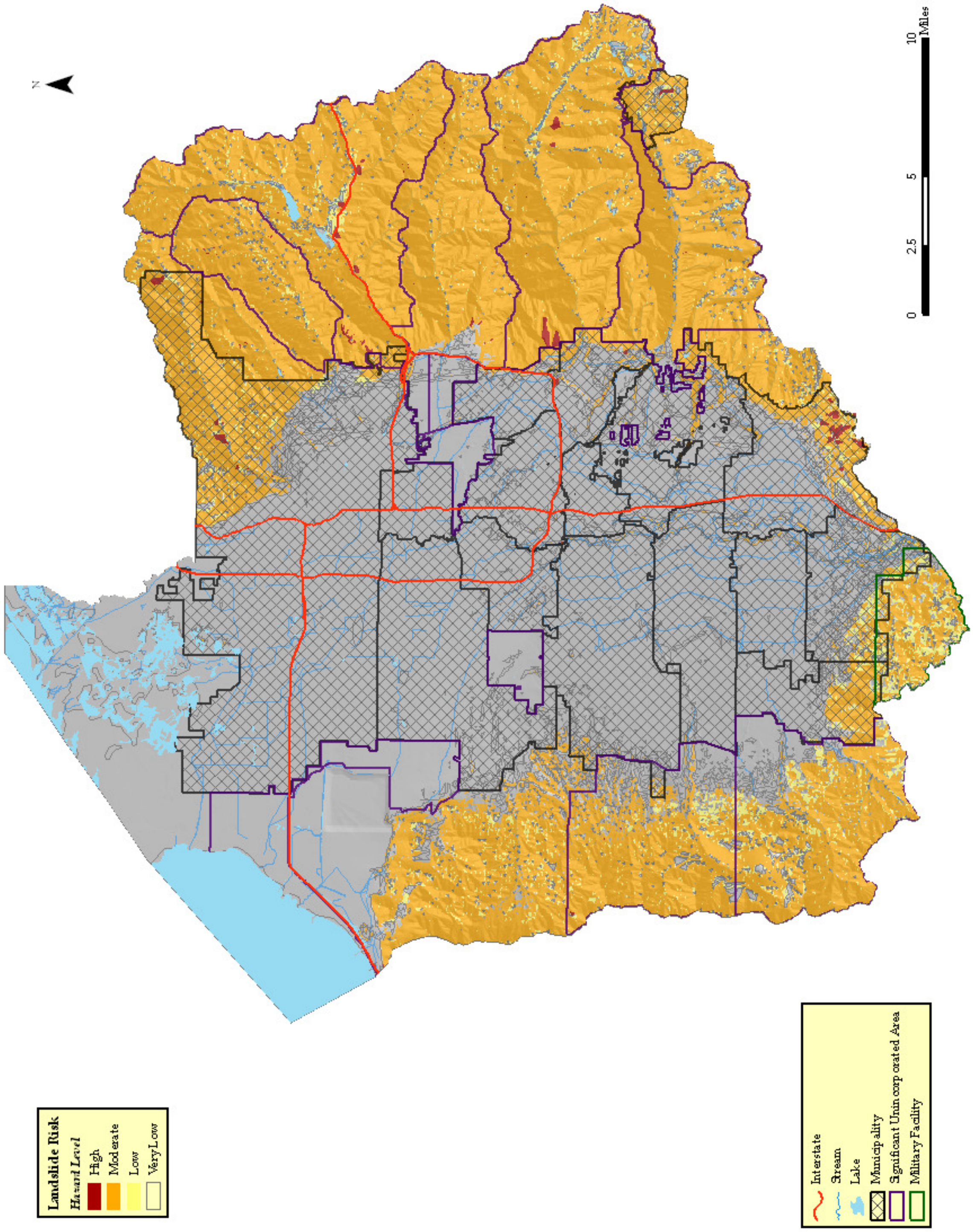
TabTable 11-15. Infrastructure Vulnerable to Landslides, Salt Lake County

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Alta	2,477	986	322 $65,881,200	0
Bluffdale	1,457	3,626	1,061 $217,080,600	1 $110,705
Cottonwood Heights	1,296	5,982	2,014 $412,064,400	93 $38,368,162
Draper	2,816	8,318	2,380 $486,948,000	26 $7,143,464
Herriman	2,508	4,139	1,242 $254,113,200	0
Holladay	397	1,721	506 $103,527,600	23 $3,371,052
Midvale	11	53	18 $3,682,800	0
Murray	35	258	88 $18,004,800	4 $2,407,223
Riverton	75	362	88 $18,004,800	2 $120,490
Salt Lake City	15,701	15,762	6,327 $1,294,504,200	176 $47,480,280
Sandy City	1,567	8,199	2,301 $470,784,600	77 $15,535,108
South Jordan	72	213	60 $12,276,000	0
South Salt Lake	0	0	0	0
Taylorsville	19	179	55 $11,253,000	2 $346,531
West Jordan	368	439	171 $34,986,600	0
West Valley City	65	59	17 $3,478,200	0

Table 11-16. Vulnerability Assessment for Landslides, Incorporated Salt Lake County

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Big Cottonwood Canyon	32,822	4,635	1,543 $315,697,800	0
Camp Williams	9,746	5,475.0	1,571 $321,426,600	2 $724,308
Canyon Rim	168	2,865	928 $189,868,800	0
Copperton	14,390	510	215 $43,989,000	1 $9,785
East Millcreek	18	162	57 $11,662,200	1 $27,753
Emigration Canyon	11,281	3,562	1,378 $281,938,800	25 $12,583,730
Granite	17,372	8,817	2,724 $557,330,400	6 $2,300,292
Kearns	10	109	31 $6,342,600	1 $85,797
Magna	40	254	157 $32,122,200	0
Millcreek	4	54	20 $4,092,000	0
Mount Olympus	18,263	5,226	1,706 $349,047,600	39 $9,634,013
Parley's Canyon	31,744	6,188	2,245 $459,327,000	1 $530,390
Sandy Hills	1	7	2 $409,200	0
Southwest	15,295	2,383	656 $134,217,600	7 $5,411,633
Willow Canyon	5	45	11 $2,250,600	1 $387,562

Table 11-17. Vulnerability Assessment for Landslides, Unincorporated Salt Lake County
(2006 socioeconomic projections)



Map 11-9. Salt Lake County Landslide Hazard (Giraud and Shaw 2007)

4. Dam Failure

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*			*Likely*
		Limited (10-25%)		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Dam locations are primarily in the eastern portion of the county (Map 11-10, page 213)				
Seasonal Conditions	*Rainy Day Failure:* Spring, late summer *Sunny Day Failure:* Anytime				
Conditions	*Rainy Day Failure* happens mainly during heavy precipitation events, can have some warning time. *Sunny Day Failure* can happen at anytime with no warning				
Duration	Hours or days - depends on spillway type and area, maximum cubic feet per second (cfs) discharge, overflow or breach type and dam type				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of BOR inundation maps and plans, FIS, Utah Division of Water Rights				

Description of Location and Extent

Twenty-seven "high-hazard" dams and other irrigation impoundments 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 twenty-six "moderate-hazard" dams and other irrigation impoundments; meaning if the dam were to fail it would have a low probability of causing loss of life but would cause appreciable property damage. One hundred and seven dams have a "low-hazard" threat; meaning 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, these dams should continue to be monitored. There are sixty-three additional water impoundments with no hazard rating whatsoever. Refer to Table 11-18 for a listing of the high and moderate hazard dams within the County.

The dam safety hazard is classified by the State Engineer. This classification is based upon the damage caused if the dam were to fail, not the dam's probability of failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Name	Rating	Name	Rating
Black Ridge Reservoir – Herriman Dam	High	Sandy City – Storm Mountain Detention Basin	High
Draper Pressure Irrigation Project	High	Twin Lakes (Salt Lake)	High
Ensign Downs Detention Basin (AKA Victory Road DB)	High	White Pine	High
Kennecott Mine – Bingham Creek	High	Barney's Wash Detention Basin (6400 West)	Mod
Lake Mary – Phoebe	High	Jordan Valley Water Purification Lower	Mod
Little Dell	High	Jordan Valley Water Purification Upper	Mod
Mountain Dell	High	Kennecott Mine – 4000 West Pond	Mod

Name	Rating	Name	Rating
Oquirrh Lake Dam - Kennecott Daybreak	High	Kennecott Mine – Small Reservoir	Mod
Point of the Mountain Raw Water Reservoir	High	Kennecott Smelter – Kessler Canyon #06	Mod
Red Butte Dam	High	Kennecott Smelter – Kessler Canyon #10	Mod
Red Pine	High	Kennecott Smelter – Kessler Canyon #11	Mod
Riverton City – 3200 West Pond	High	Kennecott Smelter – Tailings Pond	Mod
Riverton City – 4200 West Pond	High	Magna Water Company & Improvement District	Mod
Salt Lake County – Big Cottonwood (Spencer's)	High	Monroc	Mod
Salt Lake County – Creekside Park (Big Cottonwood)	High	Oakridge Development	Mod
Salt Lake County – Scott Ave	High	Riverton Dam (Formerly American Contract)	Mod
Salt Lake County – Sugarhouse	High	Salt Lake County – Wheeler Farm	Mod
Salt Lake County – Chandler Drive (#13)	High	Salt Lake County –Upper I-9	Mod
Salt Lake County – Federal Heights (#1A)	High	Sandy City – Alta Canyon	Mod
Salt Lake County – School Pond (#14)	High	Sandy City – Aspen Meadows	Mod
Salt Lake County – Shriners (#12)	High	Sandy City – Buttercup	Mod
Salt Lake County – Rotary Glen Park	High	Sandy City – Crescent Park	Mod
Sandy City – East Sandy Elementary	High	Sandy City – Falcon Detention Basin	Mod
Sandy City – Flat Iron Mesa	High	Sandy City – Willow Creek	Mod

Table 11-18. High and Moderate Hazard Dams, Salt Lake County *(Source: Utah Division of Water Rights) Mod = Moderate*

Vulnerability Assessment

Table 11-19 (below) estimates infrastructure vulnerable to dam failure in Salt Lake County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 11-20 estimates the total area, population and buildings vulnerable to dam failure for individual cities and Table 11-21 examines the same for unincorporated areas.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	49.35 miles	$270,712,431
Highway Bridges	141 bridges	$194,240,663
Railway Segments	18.68 miles	$21,462,350
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$486,415,444**

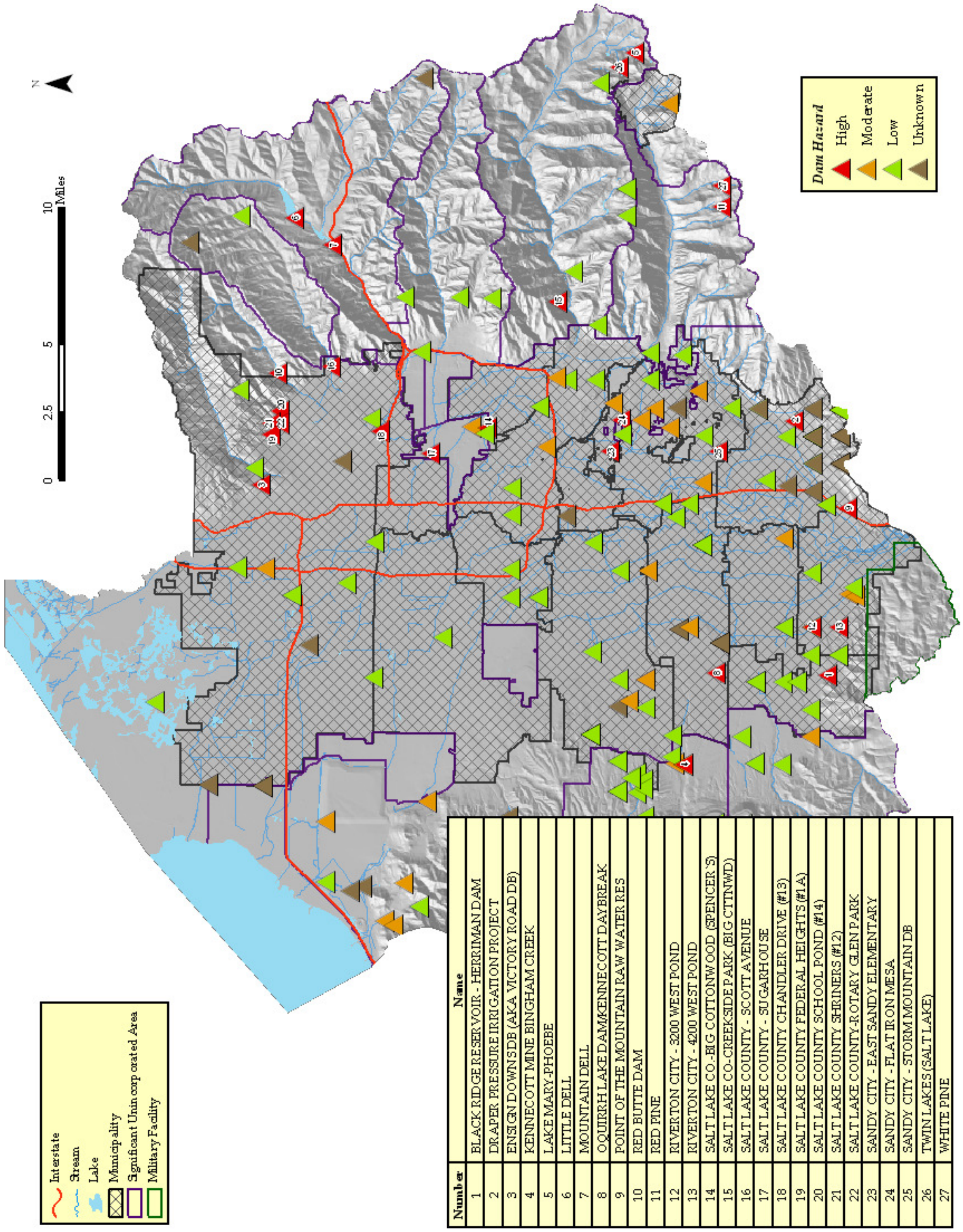
Table 11-19. Infrastructure Vulnerable to Dam Failure, Salt Lake County

Incorporated Areas	Acres Affected	Population Affected	Structures in Inundation Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Alta	0	0	0	0
Bluffdale	577	1,066	281 $57,492,600	9 $2,792,296
Cottonwood Heights	618	4,299	1,498 $306,490,800	170 $68,626,409
Draper	479	1,444	486 $99,435,600	52 $126,907,719
Herriman	0	0	0	0
Holladay	1,159	7,369	3,080 $630,168,000	371 $232,693,583
Midvale	323	3,714	1,546 $316,311,600	49 $33,150,823
Murray	1,066	7,423	3,324 $680,090,400	715 $550,016,335
Riverton	853	3,710	969 $198,257,400	28 $14,217,055
Salt Lake City	5,487	44,174	18,186 $3,720,855,600	2,259 $1,319,027,117
Sandy City	1,357	12,191	4,221 $863,616,600	442 $216,962,013
South Jordan	222	474	137 $28,030,300	1 $110,705
South Salt Lake	1,719	12,973	5,974 $1,222,280,400	1,344 $855,609,248
Taylorsville	1	60	32 $6,547,200	0
West Jordan	2,126	13,322	3,830 $783,618,000	313 $109,253,013
West Valley City	40	324	80 $16,368,000	16 $9,492,390

Table 11-20. Vulnerability Assessment for Dam Failure, Incorporated Salt Lake County

Unincorporated Areas	Acres Affected	Population Affected	Structures in Inundation Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Big Cottonwood Canyon	913	55	19 $3,887,400	0
Camp Williams	0	0	0	0
Canyon Rim	127	936	332 $67,927,200	0
Copperton	92	1	0	0
East Millcreek	0	0	0	0
Emigration Canyon	0	0	0	0
Granite	328	269	80 $16,368,000	1 $27,753
Kearns	0	0	0	0
Magna	0	0	0	0
Millcreek	640	6,428	3,153 $645,103,800	282 $180,987,936
Mount Olympus	27	45	13 $2,659,800	0
Parley's Canyon	708	146	44 $9,002,400	0
Sandy Hills	25	280	83 $16,981,800	1 $27,753
Southwest	0	0	0	0
Willow Canyon	0	0	0	0

Table 11-21. Vulnerability Assessment for Dam Failure, Unincorporated Salt Lake County



Map 11-10. Dam Hazard Map, Salt Lake County (Utah Division of Water Rights 2007)

5. Problem Soils

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)			*Likely*
	X	*Limited (10-25%)*		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Wasatch Mountains (Map 11-11, page 218)				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to Years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Problem soils are soils that present problems for engineered structures. Two types of problem soils are present in Salt Lake County – limestone and expansive soils. Both of these hazards are primarily found in the Wasatch Mountains in the eastern part of the County. See Map 11-11for more information on the locations of problem soils in Salt Lake County.

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way causing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Fortunately, many of the areas affected by karst structures in Salt Lake County are undeveloped.

Expansive soils can absorb large quantities of water. When a home or road is placed on top of these soils, normal evaporation cannot take place. The clay begins to absorb more water than is evaporated and expands, causing heaving. During especially dry periods, these soils can contract significantly causing subsidence and ground cracking. Residents already living in these areas should avoid excessive watering, make sure sufficient water drainage is in place around the home, and ensure plumbing and irrigation pipes and fixtures are well protected from breakage or leaks (Kaliser 1972).

Vulnerability Assessment

Table 11-22 (below) estimates infrastructure vulnerable to problem soils in Salt Lake County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 11-23 and Table 11-24 estimate the total area, population and buildings vulnerable to problem soils.

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	4.81 miles	$37,544,750
Highway Bridges	8 bridges	$10,166,037
Railway Segments	0 miles	$0
Railway Bridges	0 bridges	$0
Water Distribution Lines	75.86 miles	$2,441,550
Gas Lines	30.34 miles	$976,619
Sewer Lines	45.51 miles	$1,464,931
Total Estimated Infrastructure Replacement Cost		**$52,593,887**

Table 11-22. Infrastructure Vulnerable to Problem Soils, Salt Lake County

Incorporated Areas	Acres Affected	Population Affected	Structures in Hazard Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Alta	0	0	0	0
Bluffdale	0	0	0	0
Cottonwood Heights	0	0	0	0
Draper	0	0	0	0
Herriman	0	0	0	0
Holladay	0	0	0	0
Midvale	0	0	0	0
Murray	0	0	0	0
Riverton	0	0	0	0
Salt Lake City	3,783	1,707	634 $129,716,400	0
Sandy City	0	0	0	0
South Jordan	0	0	0	0
South Salt Lake	0	0	0	0
Taylorsville	0	0	0	0
West Jordan	0	0	0	0
West Valley City	0	0	0	0

Table 11-23. Vulnerability Assessment for Problem Soils, Incorporated Salt Lake County
(2006 socioeconomic projections)

Unincorporated Areas	Acres Affected	Population Affected	Structures in Hazard Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Big Cottonwood Canyon	8,574	41	16 $3,273,600	0
Camp Williams	0	0	0	0
Canyon Rim	0	0	0	0
Copperton	0	0	0	0
East Millcreek	0	0	0	0
Emigration Canyon	9,373	1,329	520 $106,392,000	20 $10,270,878
Granite	0	0	0	0
Kearns	0	0	0	0
Magna	0	0	0	0
Millcreek	0	0	0	0
Mount Olympus	15,714	516	175 $35,805,000	0
Parley's Canyon	19,814	1,447	557 $113,962,200	0
Sandy Hills	0	0	0	0
Southwest	0	0	0	0
Willow Canyon	0	0	0	0

Table 11-24. Vulnerability Assessment for Problem Soils, Unincorporated Salt Lake County *(2006 socioeconomic projections)*

Hazards and Future Development

Population Estimates									
County	2000 Pop (July 1)	2006 Pop (est.)	Absolute Change 2000-2006	% Change 2000-2006	AARC 2000-2006	Rank by 2000 Pop	Rank by Absolute Change	Rank by % Change	Rank by AARC
Salt Lake County	902,777	996,374	93,597	10.4%	1.7%	1	2	12	12
Population by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	941,172	1,104,356	1,389,252	1,665,238	1,966,372	2,207,282	2,429,057	2,654,682	1.3%
Salt Lake County	625,000	728,298	902,777	1,053,258	1,230,817	1,381,519	1,521,926	1,663,994	1.2%
Households by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	298,700	357,257	446,844	565,333	679,589	780,369	870,671	960,756	1.5%
Salt Lake County	201,742	240,367	297,064	362,825	429,889	493,268	551,047	608,614	1.5%

Table 11-25. Demographic and Economic Projections (UPEC 2007, 2008) All statistics are based on July 1 snapshot.

Salt Lake County development trends have recently slowed with many new developments stalled. Development that is still occurring will be in the southern and western portions of the County because housing and land values are slightly lower. Development is tending to occur on agricultural lands. The Wasatch Mountain Range and the Great Salt Lake restrain development in the northern and eastern reaches of Salt Lake County.

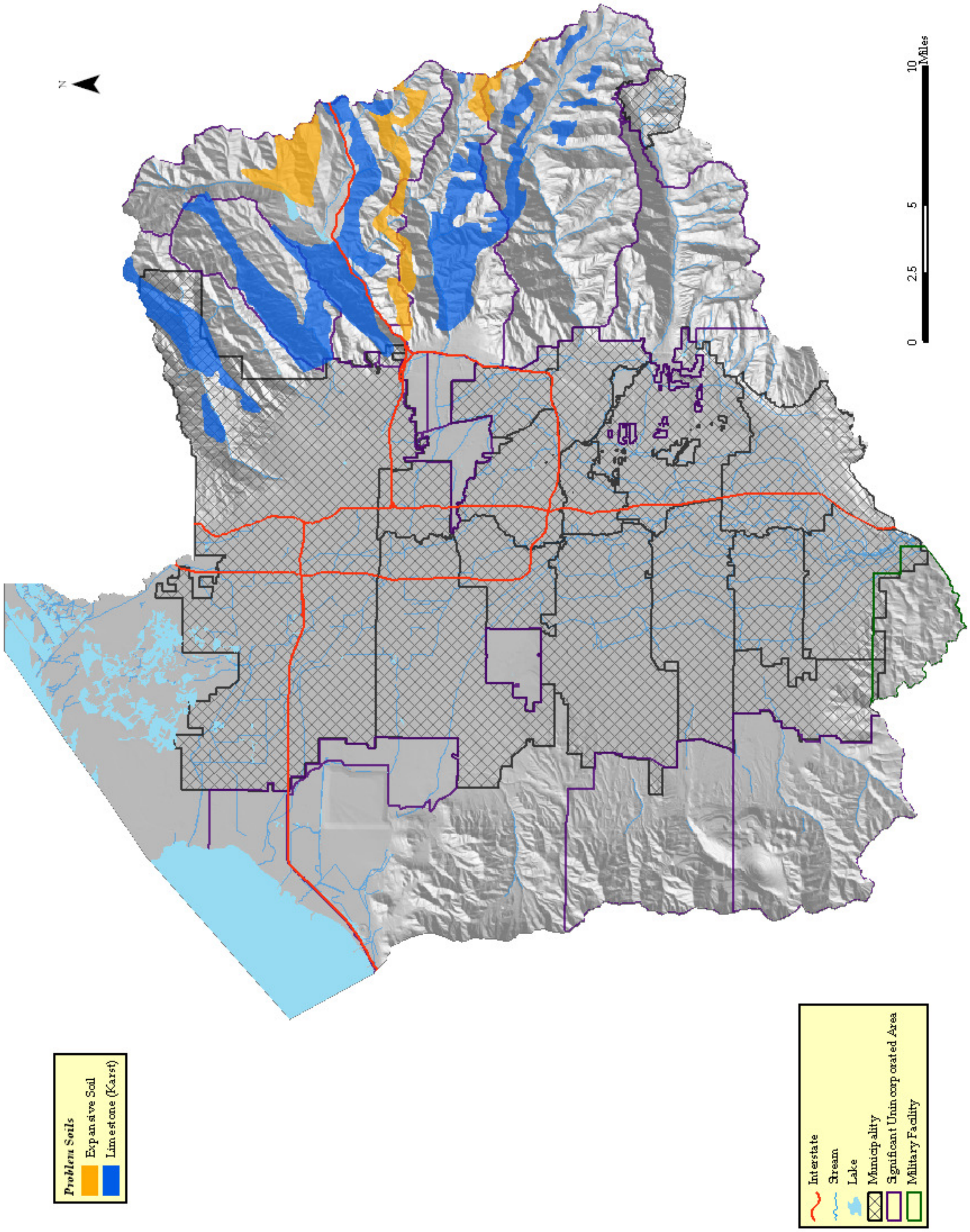
Those portions of the County near the Great Salt Lake and the Jordan River are subject to high liquefaction in the event of an earthquake and therefore pose a risk to incoming residents and new structures. Jurisdictions may mitigate the earthquake threat and its secondary risks through the use of zoning ordinances and building codes that will recognize the threat and reduce its impact. Examples of more appropriate forms of land use along fault lines include "farms, golf courses, parks, and undeveloped open space" (UGS 1996).

Flooding is also possible along the Jordan River. Many new homes have been built along the river's banks in areas that flooded in 1983-84. Zoning restrictions on building location and building codes preventing basements would be well-suited in these areas.

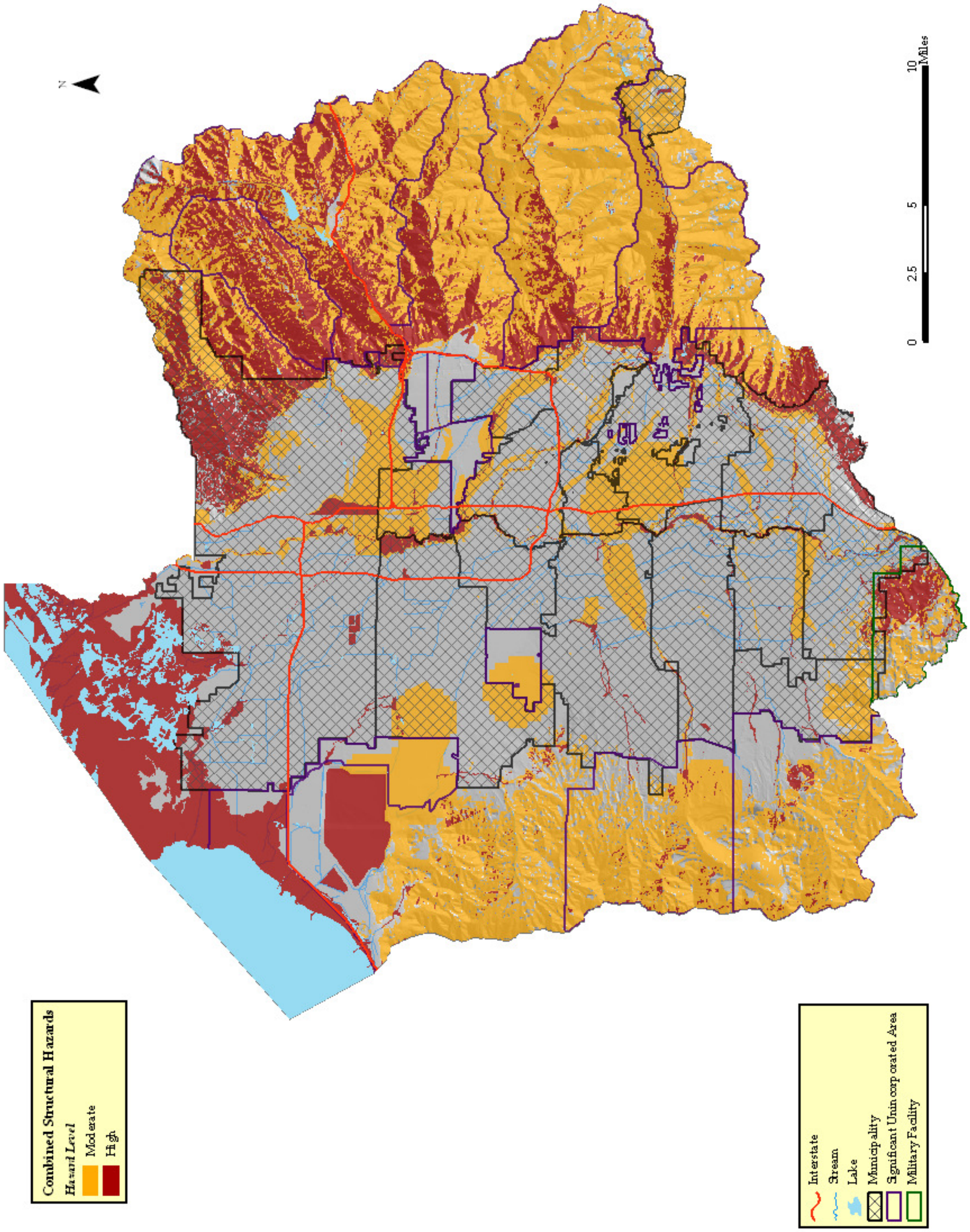
Wildfire risk is most severe in the foothills of the Wasatch Mountain Range. These areas, known as Wildland-Urban Interface (WUI) zones, are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. This threat may be mitigated by encouraging communities to become "Fire Wise Communities", continued use of building and zoning codes and increase the public's awareness.

Landslide/slope failure is another threat near the foothills of the Wasatch Mountains. Many new developments can be found near areas of current landslides. More detailed landslide studies and zoning appropriate for high hazard areas will decrease the likelihood of landslides injuring persons or damaging property.

Map 11-12 (page 219) shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, tornado, wildland fire and wind) in Salt Lake County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Map 11-11. Problem Soils Hazard Map, Salt Lake County (Mulvey 1992)



Map 11-12. Combined Hazards to Structures, Salt Lake County

Mitigation Strategies

The following mitigation strategies were formulated by the Salt Lake County Mitigation Strategies Working Group on November 20, 2007, at Holladay City Hall. The Working Group sought to refine and expand on efforts already in place. Additional information was provided in October, 2008 by the Central Utah Water Conservancy District in regards to the Red Butte Dam in Salt Lake County that was developed through the course of an ongoing Hazard Mitigation Planning effort, which began in July, 2007 and is scheduled to be completed in February, 2009. Information on Working Group members can be found in Part IV. "Emergency Services" for the purpose of this section is defined as County and City emergency management and may include relevant emergency response agencies.

All Hazards

Problem Identification: One of the pivotal aspects of disaster response is communication. Without effective communication, relief and rescue operations become chaotic and disorganized, as evidenced by the 2005 Hurricane Katrina event. During that event, communication systems often were inoperable, incompatible or merely went unused because of lack of training (Peterson 2005).

Goal 1 – Improve and maintain communications capabilities for emergency operations

Objective 1.1 (Priority HIGH): Improve communications capabilities

Action 1: Conduct an inventory and assessment of communications equipment and systems and identify needs.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services
Jurisdictions: Countywide

Action 2: Conduct training and awareness activities on communications equipments, tools, and systems.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services
Jurisdictions: Countywide

Action 3: Establish agreements to share communications equipment between agencies involved in emergency operations.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services
Jurisdictions: Countywide

Action 4: Establish notification capabilities and procedures for emergency personnel.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services
Jurisdictions:	Countywide

Objective 1.2 (Priority HIGH): Maintain communications capabilities for critical facilities

Action 1: Evaluate vulnerability of critical communications systems.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services
Jurisdictions:	Countywide

Action 2: Establish redundancy for dispatch centers and other critical communications systems.

Time Frame:	1-2 years
Funding:	State, Federal
Estimated Cost:	Unknown
Staff:	Emergency Services
Jurisdictions:	Countywide

Objective 1.3 (Priority HIGH): Conduct Communications Strategic Planning

Action 1: Establish a coordinating group to address long-term communication needs and implementation strategies.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services
Jurisdictions:	Countywide

Action 2: Acquire, upgrade, and/or integrate communications equipment and systems as determined by coordinating group.

Time Frame:	1-2 years
Funding:	Federal Grants
Estimated Cost:	$3,000,000.00
Staff:	Emergency Services
Jurisdictions:	Countywide

Problem Identification: Without sufficient knowledge of hazards affecting a jurisdiction, effective and efficient mitigating actions cannot be properly applied. Information on critical and high value infrastructure is also important. Advances in mapping technology and observational techniques have given a significantly clearer vision of hazards and vulnerability. This technology is only effective if utilized with up-to-date data.

Goal 2 – Improve awareness and analysis of hazards

Objective 2.1 (Priority MEDIUM): Improved quality and access to digital geographic (GIS) hazards data

Action 1: Establish a coordinating group to address geographic data issues.

Time Frame:	1-2 years
Funding:	State, Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City GIS, AGRC, UGS, DNR and Federal Forest Service
Jurisdictions:	Countywide

Action 2: Examine current data availability and sharing capabilities, evaluate needs, and identify shortcomings.

Time Frame:	1-2 years
Funding:	State, Local
Estimated Cost:	Minimal
Staff:	Emergency Services, coordinating group
Jurisdictions:	Countywide

Action 3: Update and expand data on hazards, critical facilities, and critical infrastructure according to assessed needs.

Time Frame:	3-5 years
Funding:	State, Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City GIS, Special Service Districts, State & Federal agencies
Jurisdictions:	Countywide

Action 4: Provide centralized access to geographic data to emergency planners and responders.

Time Frame:	Ongoing
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City GIS, Special Service Districts GIS
Jurisdictions:	Countywide

Objective 2.2 (Priority MEDIUM): Improve and expand hazard monitoring capabilities.

Action 1: Integrate existing hazard monitoring networks in emergency operations centers. Utilize sensors such as weather stations, stream gauges, seismograph stations, road conditions, etc.

Time Frame:	1-2 years
Funding:	State, Local
Estimated Cost:	Minimal

Staff: Emergency Services, various special service districts, state and federal monitoring entities
Jurisdictions: Countywide

Action 2: Identify and implement additional hazard monitoring capabilities.
Time Frame: 3-5 years
Funding: State, Local
Estimated Cost: Minimal
Staff: Emergency Services, various special service districts, state and federal monitoring entities
Jurisdictions: Countywide

Problem Identification: Certain infrastructure must be able to withstand the most extreme hazard event expected in order to provide coordinated response operations, shelter, and evacuation, if necessary. Some examples of critical infrastructure include police stations, fire stations, schools, water systems, emergency operations centers and major transportation routes.

Goal 3 – Ensure critical facilities can sustain operations for emergency response and recovery

Objective 3.1 (Priority HIGH): Prevent damage to critical facilities and infrastructure.

Action 1: Utilize GIS to identify facilities and infrastructure at risk.
Time Frame: 1-2 years
Funding: State, Local
Estimated Cost: Minimal
Staff: Emergency Services, County/City/Special Service District GIS
Jurisdictions: Countywide

Action 2: Assess critical facilities for hazard exposure, structural weaknesses, power, communications and equipment resources and redundancy, and adequate emergency procedures.
Time Frame: 2-3 years
Funding: State, Local
Estimated Cost: Minimal
Staff: Emergency Services, Public Works
Jurisdictions: Countywide

Action 3: Implement Improvements to address needs identified in assessment.
Time Frame: 3-5 years
Funding: State, Local
Estimated Cost: $1,000,000 Include possible structural improvements and equipment purchases
Staff: Emergency Services, County/City/Special Service District GIS
Jurisdictions: Countywide

Problem Identification: Hazardous events often overcome the resources of any one jurisdiction. An effective measure which ensures adequate response to a hazardous event is mutual-aid agreements specifying resources and assistance from adjoining jurisdictions or state and federal agencies.

Goal 4 – Improve response capabilities through mutual-aid agreements

Objective 4.1 (Priority MEDIUM): Utilize mutual-aid agreements in accordance with National Incident Management System (NIMS) requirements.

Action 1: Compile inventory of current mutual-aid agreements and memoranda of understanding (MOU) and identify deficiencies.

Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, County/City/Special Service District Attorney
Jurisdictions: Countywide

Action 2: Pursue and implement needed mutual-aid agreements.

Time Frame: 3-5 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, County/City/Special Service District Attorney
Jurisdictions: Countywide

Problem Identification: One of the most cost-effective means of mitigating hazards is through public education. This allows citizens to make informed choices to themselves mitigate hazards affecting them. Education can be especially effective when tied to grant programs.

Goal 5 – Increase citizen safety through improved hazard awareness

Objective 5.1 (Priority HIGH): Establish a comprehensive public education program.

Action 1: Provide education regarding all natural hazards through live trainings, as well as web-based, print and broadcast media.

Time Frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services, County/City Fire/Police, Special Service District, Building Code Enforcement.
Jurisdictions: Countywide

Action 2: Incorporate information about cascading effects of hazards in education programs.

Time Frame: Ongoing
Funding: Local
Estimated Cost: Minimal

Staff: Emergency Services, County/City Fire/Police, Special Service District, Building Code Enforcement.
Jurisdictions: Countywide

Action 3: Develop education programs to target specific groups including homeowners, developers, schools and people with special needs.
Time Frame: Ongoing
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, County/City Fire/Police, Special Service District, Building Code Enforcement
Jurisdictions: Countywide

Action 4: Utilize maps and similar products on County EM website and other media to educate public on areas at risk to hazards.
Time Frame: Ongoing
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, County/City/ Special Service District GIS
Jurisdictions: Countywide

Action 5: Coordinate with existing public education programs such as the American Red Cross, Utah Living with Fire, Be Ready Utah, the National Weather Service, etc.
Time Frame: Ongoing
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, various public education programs
Jurisdictions: Countywide

Problem Identification: Sometimes hazards require mandated mitigation in the form of ordinances, codes, laws or regulations. Zoning ordinances and building codes are the most common form of mitigation.

Goal 6 – Improve public safety through preventative regulations

Objective 6.1 (Priority HIGH): Minimize hazard impacts through the adoption of appropriate prevention measures.

Action 1: Establish and enforce appropriate planning, zoning, and building code ordinances.
Time Frame: 3-5 years
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services, County/City Councils, Building Code Enforcement, Planning/Engineering Departments
Jurisdictions: Countywide

Action 2: Ensure current hazard ordinances are available for viewing online.

Time Frame:	3-5 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City Councils, Building Code Enforcement, Planning/Engineering Departments
Jurisdictions:	Countywide

Dam Failure

Problem Identification: The failure of dams and irrigation impoundments will result in a severe impact on residents and infrastructure in Salt Lake County.

Goal 1 – Include dam failure inundation in future County and City planning efforts

Objective 1.1 (Priority MEDIUM): Review current State dam safety information on all identified high hazard dams in the County.

Action 1: Include dam inundation maps in current County, City and Special Service District Emergency Operations Plans.

Time Frame:	3-5 Years
Funding:	Undetermined
Estimated Cost:	$10,000
Staff:	Emergency Services
Jurisdictions:	Countywide

Action 2: Utilize inundation maps to identify potential evacuation areas and routes.

Time Frame:	3-5 Years
Funding:	Undetermined
Estimated Cost:	Unknown
Staff:	Emergency Services
Jurisdictions:	Countywide

Drought

Problem Identification: Because the Great Salt Lake Valley is a desert climate, there have always been periods of intermittent drought. Measures must be taken to conserve water and to address water shortages for both culinary and agricultural use.

Goal 1 – Reduce and prevent hardships associated with water shortages

Objective 1.1 (Priority HIGH): Limit unnecessary consumption of water throughout the County

Action 1: Continue to encourage water conservation utilizing and promoting outreach material from all water districts in the County.

Time Frame: Ongoing
Funding: Minimal
Estimated Cost: Undetermined
Staff: Public Works in coordination with water districts.
Jurisdictions: Countywide

Action 2: Emergency Managers will coordinate with local water districts/public utilities to support ongoing conservation efforts.
Time Frame: Ongoing
Funding: Minimal
Estimated Cost: Undetermined
Staff: Should coordinate with local water districts.
Jurisdictions: Countywide

Action 3: Investigate feasibility of implementing an incentive program to encourage the use of low-flow appliances and fixtures in homes and businesses.
Time Frame: 3-5 years
Funding: Unknown
Estimated Cost: Undetermined
Staff: Emergency Services, Water Conservation Districts
Jurisdictions: Countywide

Action 4: Implement water-saving devices and practices in public facilities.
Time Frame: 3-5 years
Funding: Local
Estimated Cost: Undetermined
Staff: Emergency Services, Public Works
Jurisdictions: Countywide

Action 5: Repair, maintain and improve water distribution infrastructure to prevent loss from leakage, breaks, etc.
Time Frame: Ongoing
Funding: Local
Estimated Cost: Undetermined
Staff: Public Works
Jurisdictions: Countywide

Action 6: Coordinate public safety water use, such as hydrant testing.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services
Jurisdictions: Countywide

Action 7: Provide information on landscaping alternatives for persons subject to green area requirements.
Time Frame: 1-2 years
Funding: Local

Estimated Cost: Minimal
Staff: Emergency Services, Water Conservation Districts
Jurisdictions: Countywide

Objective 1.2 (Priority HIGH): Address agricultural water shortages in the County

Action 1: Set up livestock water rotation in areas of agricultural use.
Time frame: Ongoing
Funding: Minimal
Estimated Cost: Undetermined
Staff: Emergency Services, USDA, UDAF
Jurisdictions: County agricultural communities

Objective 1.3 (Priority MEDIUM): Encourage development of secondary water systems

Action 1: Coordinate with water districts to plan for, develop and/or expand secondary water systems.
Time Frame: 3-5 years
Funding: Unknown
Estimated Cost: Undetermined
Staff: Emergency Services, Water Conservation Districts, Public Works
Jurisdictions: Countywide

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 large earthquakes. The major earthquake risk present throughout the Salt Lake County metropolitan area confronts planners with a variety of safety and economic issues that must always be considered prior to land use development.

Goal 1 – Reduce earthquakes losses to infrastructure

Objective 1.1 (Priority HIGH): Encourage retrofit and rehabilitation of highly susceptible infrastructure

Action 1: Identify structures at risk to earthquake damage.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services
Jurisdictions: Countywide

Action 2: Research feasibility of an incentive program for retrofitting privately-owned buildings, particularly unreinforced masonry.

Time Frame: 1-2 years
Funding: State, Federal
Estimated Cost: Unknown
Staff: Emergency Services
Jurisdictions: Countywide

Action 3: Complete seismic rehabilitation/retrofitting projects of public buildings at risk.
Time Frame: 1-2 years
Funding: State, Federal
Estimated Cost: Unknown
Staff: Emergency Services
Jurisdictions: Countywide

Objective 1.2 (Priority MEDIUM): Improve public education regarding earthquake risks to unreinforced masonry buildings

Action 1: Provide educational materials to unreinforced masonry home and business owners.
Time Frame: Ongoing
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services
Jurisdictions: Countywide

Objective 1.3 (Priority MEDIUM): Improve seismic hazard understanding and seismic resistance of Central Utah Water Conservancy District's (CUWCD) Red Butte Dam in Salt Lake County. Perform geotechnical assessment and review of Red Butte Dam to determine seismic hazard risk of slope failure on the outlet control structure and cyclic softening failure in the dam foundation soils. Perform a structural engineering analysis and design of nonstructural bracing/anchoring of piping and ancillary equipment in Red Butte Dam's flow control structure." Improve public education regarding earthquake risks to unreinforced masonry buildings

Action 1: Procure an Engineering Consultant to perform the nonstructural design and geotechnical assessment and review. CUWCD staff will procure contractor and/or install nonstructural bracing per consultant's design.
Time Frame: 1-3 years
Funding: FEMA PDM Grant and CUWCD funds
Estimated Cost: $75,000
Staff: CUCWD staff, engineering consultant contractor
Jurisdictions: Central Utah Water Conservancy District (CUWCD)

Flooding

Problem Identification: Although located in a semi-arid region, Salt Lake City is subject to flash flooding due to heavy rainfall and rapid snowmelt. The Jordan River's four major northern tributaries (City, Red Butte, Emigration and Parley's Creeks) are diverted into storm sewers beneath the city. These storm sewers have sufficient capacity to handle the excessive runoff, but must be continually maintained to prevent debris from accumulating.

Public works agencies have built debris basins, installed stream-bank protection, and regularly dredge stream channels to reduce flood hazards. The Federal Emergency Management Agency (FEMA) has rated floodplains 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). 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): Provide 100% availability of the National Flood Insurance Program (NFIP).

Action # 1: Assist cities with NFIP application.

Time Frame:	1 year
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, State Floodplain Manager
Jurisdictions:	Countywide

Action # 2: Encourage communities to actively participate in NFIP.

Time Frame:	1 year
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, FEMA, NWS
Jurisdictions:	Countywide

Objective 1.2 (Priority MEDIUM): Encourage appropriate flood control measures, particularly in new developments.

Action 1: Determine potential flood impacts and identify areas in need of additional flood control structures.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, State Floodplain Manager, Public Works, USACE
Jurisdictions:	Countywide

Action 2: Address identified problems through construction of debris basins, flood retention ponds, energy dissipaters or other flood control structures.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, State Floodplain Manager, Public Works, USACE
Jurisdictions:	Countywide

Objective 1.3 (Priority HIGH): Provide maintenance, repairs and improvements to drainage structures, storm water systems and flood control structures.

Action: Establish maintenance and repair programs to remove debris, improve resistance and otherwise maintain effectiveness of storm water and flood control systems.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, Public Works
Jurisdictions:	Countywide

Goal 2 – Reduce threat of unstable or inadequate flood control structures

Objective 2.1 (Priority HIGH): Reduce potential for failure of flood control structures.

Action 1: Identify and assess structures for deficiencies.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Minimal
Staff:	City Managers, County Emergency Services, Public Works
Jurisdictions:	Countywide

Action 2: Modify structures as needed to address deficiencies.

Time Frame:	2-3 years
Funding:	Local, grants
Estimated Cost:	Retrofit structural modifications are very expensive
Staff:	City Managers, County Emergency Services, Public Works
Jurisdictions:	Countywide

Severe Weather

Problem Identification: Severe weather over northern Utah can have a dramatic impact on regional commerce, transportation and daily activity and is 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 4,300 ft above mean sea level (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 precipitation.

Goal 1: Reduce threat of loss of life or property due to extreme weather events

Objective 1.1 (Priority LOW): Maintain status as a StormReady Community

Action 1: Maintain Hazardous Weather Operations Plan according to StormReady requirements.

Time Frame:	1-2 years
Funding:	Local
Estimated Cost:	Unknown

Staff: Emergency Services, NOAA National Weather Service (NWS)
Jurisdictions: Countywide

Action 2: Maintain contact with NWS prior to re-application in 2010.
Time Frame: 2 years
Funding: None
Estimated Cost: None
Staff: Emergency Services, NWS
Jurisdictions: Countywide

Objective 1.2 (Priority MEDIUM): Increase awareness of information services provided by NWS.

Action 1: Meet with NWS representative on an annual basis to receive information on new services and alerts available.
Time Frame: Annually
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, NWS
Jurisdictions: Countywide

Action 2: Assist NWS in making other agencies and departments aware of available resources.
Time Frame: Annually
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, NWS
Jurisdictions: Countywide

Objective 1.3 (Priority MEDIUM): Encourage safe practices in avalanche prone areas.

Action: Assist Forest Service Utah Avalanche Forecast Center (FSUAC) and other organizations in promoting avalanche hazard awareness for backcountry users.

Time Frame: Annually
Funding: Local
Estimated Cost: Minimal
Staff: Emergency Services, FSUAC, mountain resorts
Jurisdictions: Countywide

Objective 1.4 (Priority HIGH): Examine the vulnerability of patrons at large event venues to extreme weather events.

Action: Work with the NWS to develop large event venue weather safety and evacuation procedures.
Time Frame: 3-5 years
Funding: State, Federal
Estimated Cost: Unknown

Staff:	Emergency Services, Utah Division of Homeland Security, National Weather Service
Jurisdictions:	Countywide

Slope Failure

Problem Identification: Slope instability has not been a major problem in the Salt Lake area. Yet, 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 the unusually wet springs of 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 buildable 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 slope failure damage

Objective 1.1 (Priority MEDIUM): Reduce the threat of slope failures following wild fires.

Action 1: Develop protocol for working with State and Federal agencies in reducing the impact of post-fire debris flow hazard.

Time Frame:	3-5 years
Funding:	Federal Grants
Estimated Cost:	Unknown
Staff:	Emergency Services, National Weather Service, National Resource Conservation Service, United States Forest Service, and the Utah Geological Survey (UGS)
Jurisdictions:	County communities on Alluvial Fans

Objective 1.2 (Priority MEDIUM): Monitor historic landslide areas.

Action 1: Coordinate with Utah Geological Survey and other agencies to understand current slope failure threats/potential.

Time Frame:	1-2 years
Funding:	State and Federal Grants
Estimated Cost:	Unknown
Staff:	Emergency Services, UGS, United States Geological Survey
Jurisdictions:	County communities on Alluvial Fans

Objective 2.1 (Priority HIGH): Address landslide hazards in new sub-divisions.

Action 1: Utilize recommendations provided by State Geologic Hazards Working Group to address land-use and planning for new developments.

Time Frame:	3-5 years
Funding:	Local and Federal Grants
Estimated Cost:	Minimal
Staff:	Emergency Services, Planning Department, UGS
Jurisdictions:	County communities on Alluvial Fans

Wildland Fire

Problem Identification: Utah's typical fire season is the dry period from May through October. Lightning causes the largest numbers of wildfires.
Recent large western states wildfires; the 1991 Oakland Hills fires, 1994 Tyee fire in Washington, the 1993 and 2007 Southern California fire sieges are examples of the growing fire threat which occurs in the Wildland/Urban Interface (WUI). The WUI 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 the Affleck Park day use picnic area, 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 5,500 acres were burned. Fortunately, no one was injured and no structures were lost.

Goal 1 – Community education on wildfire hazard

Objective 1.1 (Priority HIGH): Reduce risk from wild fire through education programs

Action 1: Increase public awareness through "Fire Wise" program.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City Fire, FFSL, State Fire Marshall
Jurisdictions:	Identified WUI communities

Action 2: Educate homeowners on the need to create defensible space near structures in WUI.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services, County/City Fire, FFSL, State Fire Marshall
Jurisdictions:	Identified WUI communities

Goal 2 – Improve safety from wildfire hazards through planning, protective actions and improved fire response capabilities

Objective 2.1 (Priority HIGH): Assist homeowners with creating defensible space near structures in WUI areas.

Action 1: Designate and promote county-wide annual initiative for clearing fuels.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Unknown
Staff:	Emergency Services, County/City Fire, Public Works
Jurisdiction:	Identified WUI communities

Action 2: Provide waste removal, such as chipping of green waste by Public Works, following designated fuel clearing day/week.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Unknown
Staff:	Emergency Services, Public Works
Jurisdictions:	Identified WUI communities

Objective 2.2 (Priority HIGH): Improve evacuation capabilities for WUI areas.

Action 1: Work with experts and communities to develop or update evacuation plans.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Minimal
Staff:	Emergency Services, Planning Departments
Jurisdictions:	Identified WUI communities

Action 2: Evaluate transportation network and address needed improvements to facilitate evacuation and emergency response.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Unknown
Staff:	Emergency Services, Planning Departments
Jurisdictions:	Identified WUI communities

Objective 2.3 (Priority HIGH): Improve addressing system in WUI areas to facilitate emergency response.

Action 1: Identify all facilities, businesses, and residences, particularly in the canyons, and assign addresses according to current county addressing standards.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Unknown
Staff:	Emergency Services, city and county recorders
Jurisdictions:	Countywide

Action 2: Incorporate improved addresses in fire-dispatch and other databases.
Time frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services, County/City Fire
Jurisdictions: Countywide

Objective 2.4 (Priority HIGH): Complete wildfire protection projects
Action 1: Reduce fuels around publicly owned structures.
Time frame: Ongoing
Funding: Local, grants
Estimated Cost: Unknown
Staff: Emergency Services, Public Works
Jurisdictions: Identified WUI communities

Action 2: Implement fire breaks and other protective measures.
Time frame: Ongoing
Funding: Local, grants
Estimated Cost: Unknown
Staff: Emergency Services, Public Works, state and federal agencies
Jurisdictions: Identified WUI communities

Action 3: Assess existing water flow capabilities, both public and private, and address deficiencies.
Time frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services, County/City Fire
Jurisdictions: Identified WUI communities

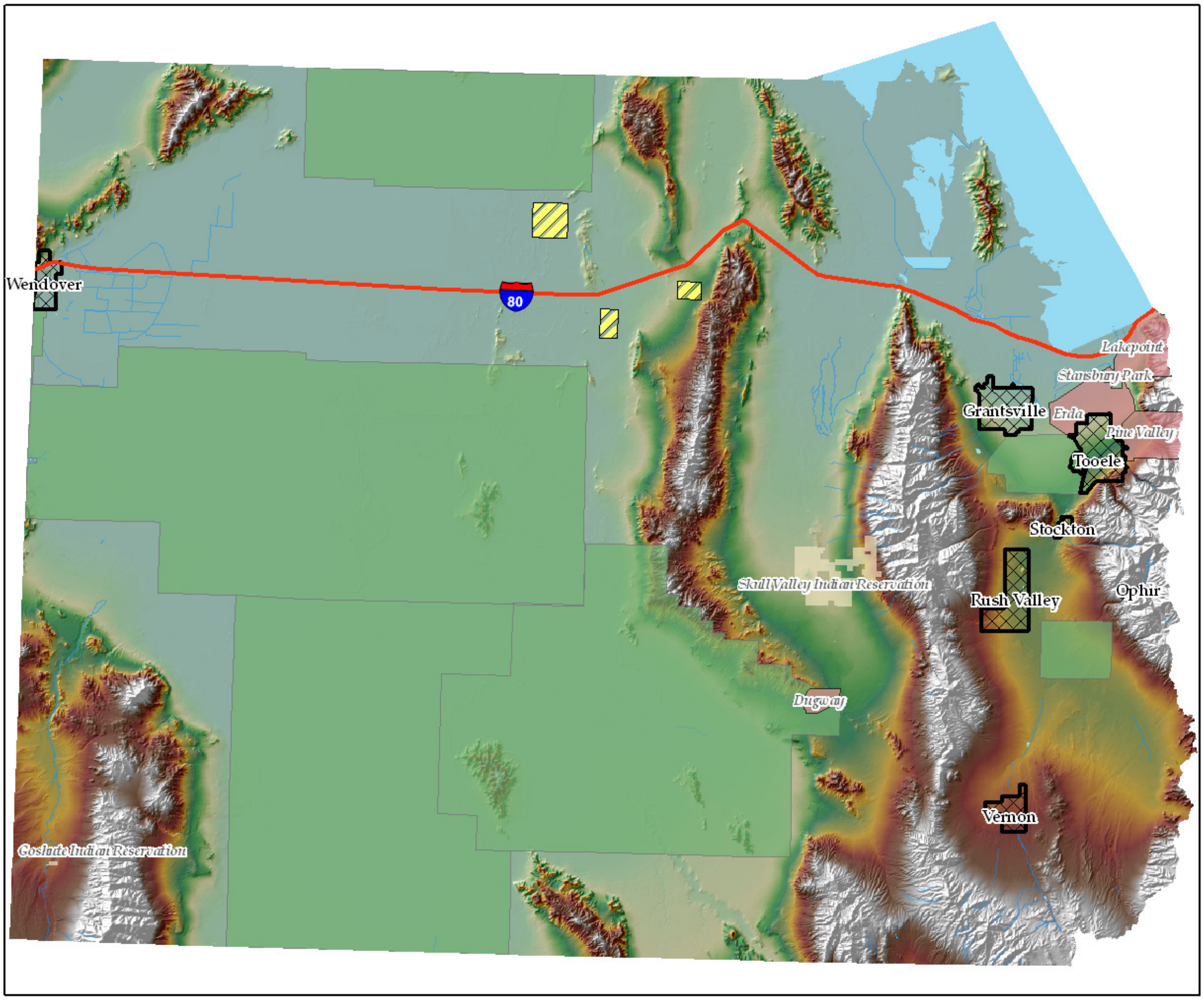
Action 4: Assist communities in developing Community Wildfire Protection Plans or similar plans.
Time frame: Ongoing
Funding: State and Federal Grants
Estimated Cost: Unknown
Staff: Emergency Services
Jurisdictions: Countywide

Objective 2.5 (Priority HIGH): Encourage proper development practices in the WUI.

Action 1: Adopt the Utah Wildland-Urban Interface Code (Code addresses proper road accessibility, availability of water flow for fire response, etc.)
Time frame: Ongoing
Funding: Local
Estimated Cost: Unknown
Staff: Emergency Services, City and County Councils
Jurisdictions: Countywide

Action 2: Define wildland-urban interface and develop digital maps of the WUI.

Time frame:	Ongoing
Funding:	Local
Estimated Cost:	Unknown
Staff:	Emergency Services, AGRC
Jurisdictions:	Countywide



Map 12-1. Tooele County

Part XII. Tooele County

Tooele County is the second largest county in Utah in land area, with 6,923 square miles. Salt Lake and Utah Counties bound the county to the east, Juab County to the south, 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***, ***Ophir***, ***Rush Valley***, ***Stockton***, ***Tooele City***, ***Vernon***, and ***Wendover***) and nine unincorporated areas (***Burmeister***, ***English Village***, ***Erda***, ***Ibapah***, ***Lakepoint***, ***Loftgreen***, ***Pine Canyon***, and ***Stansbury Park***). Percent of land ownership is 78.5% Federal, 5.9% State, 0.3% Native American, 11.2% Private and Local Government and 4.1% water.

Tooele County migration patterns show that most of the 1980's are characterized by out-migration. However, beginning in 1996, an in-migration trend began due to cheaper housing in the county. 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 to serve the increasing numbers of residences in the county. Tooele County is projected to almost double its population to 112,722 by 2030 (UPEC 2008). A significant portion of this increase is expected to commute to Salt Lake County for work. Recent census data show that approximately 40 percent of Tooele County's work force commutes to Salt Lake County. The 2005 numbers for persons per square mile within the county was 7.5, most of which are located in the eastern portion of the county.

Construction activity in the county exploded in 1996 and steadily increased through the end of the millennium. Housing growth slowed slightly in the early part of this decade, but had been regaining momentum as of 2005 with 738 new permitted dwellings (BEBR 2007). The recent economic slowdown in Utah has largely been driven by reductions in new construction.

In 2005, the average monthly wage in the county was $2,942, 7.5% higher than the state average of $2,736 (BEA 2007). Total personal income in millions in 2005 was $492 million (BEA 2007). The 2005 per capita income was $22,442 (UDWS 2006). Employment in Tooele County is based on three main types of industry: *government* (23.8%), *trade/transportation/utilities* (14.9%), and *professional and business services* (14.0%). Other important sources of employment in the county are *manufacturing* (8.6%), *education and health services* (8.0%), *leisure and hospitality* (7.4%), and *construction* (6.3%). Some of the largest employers include Tooele County School District, Dugway Proving Grounds, EG&G Defense Materials, Detroit Diesel, U.S. Magnesium, Wal-Mart, Tooele County, and the Tooele Valley Regional Medical Center (UDWS 2007b).

Hazard History

Identifying past hazard events is the key to predicting where future events could occur. The SHELDUS database was used to assess significant historical disasters causing greater than $50,000 in damages per event. Some disasters involved multiple counties of which the damages were not limited to an individual county. These damages were split evenly amongst the involved counties resulting in partial injuries and fatalities. As this database is monetarily-based, the number of injuries and fatalities for each hazard may be underestimated for each hazard here. All damages are computed in 2005 dollars (refer to figures 12-1 and 12-2).

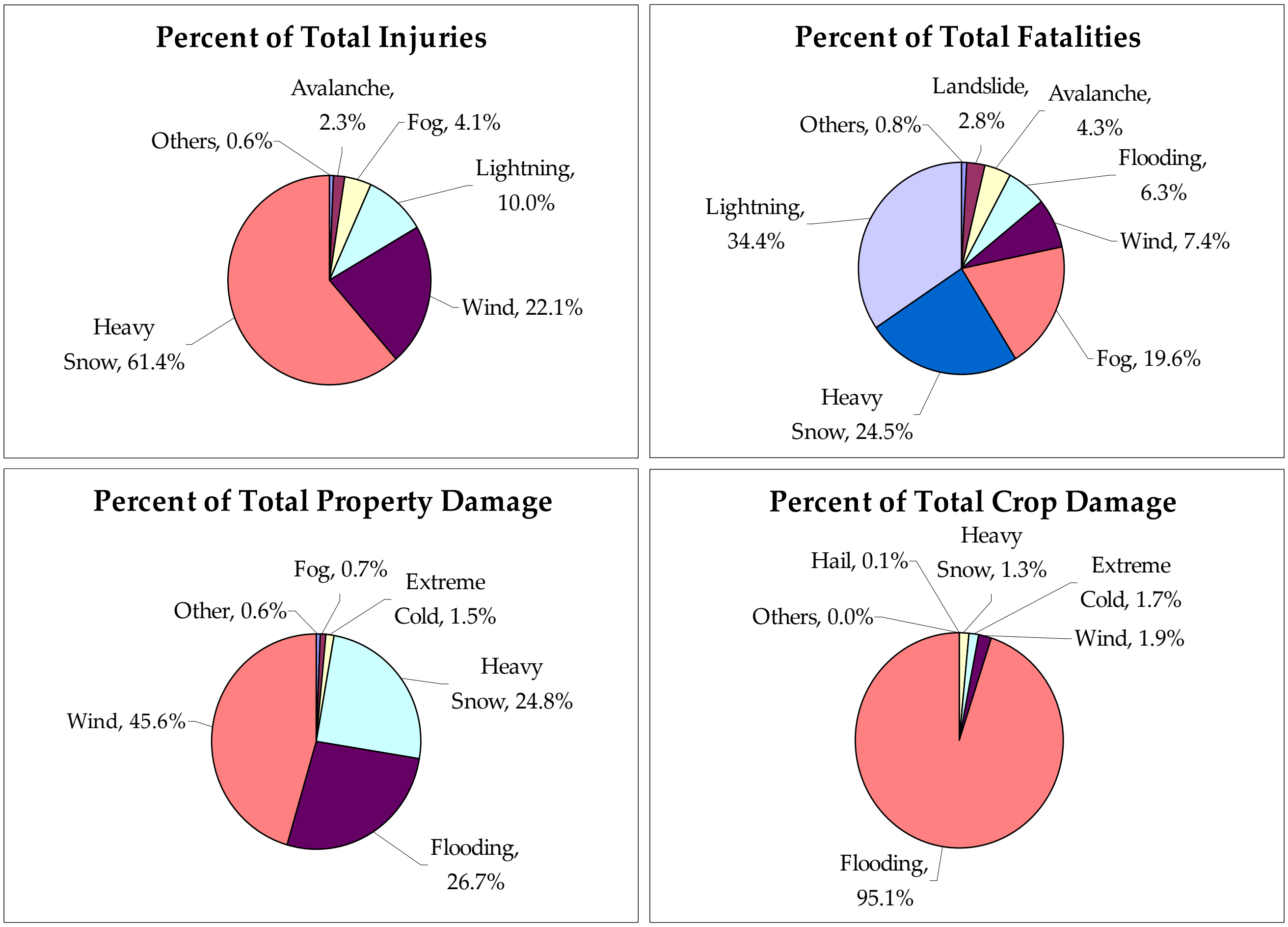


Figure 12-1. Major Disaster Event Averages 1962-2005, Tooele County, Percentages (HVRI 2007)

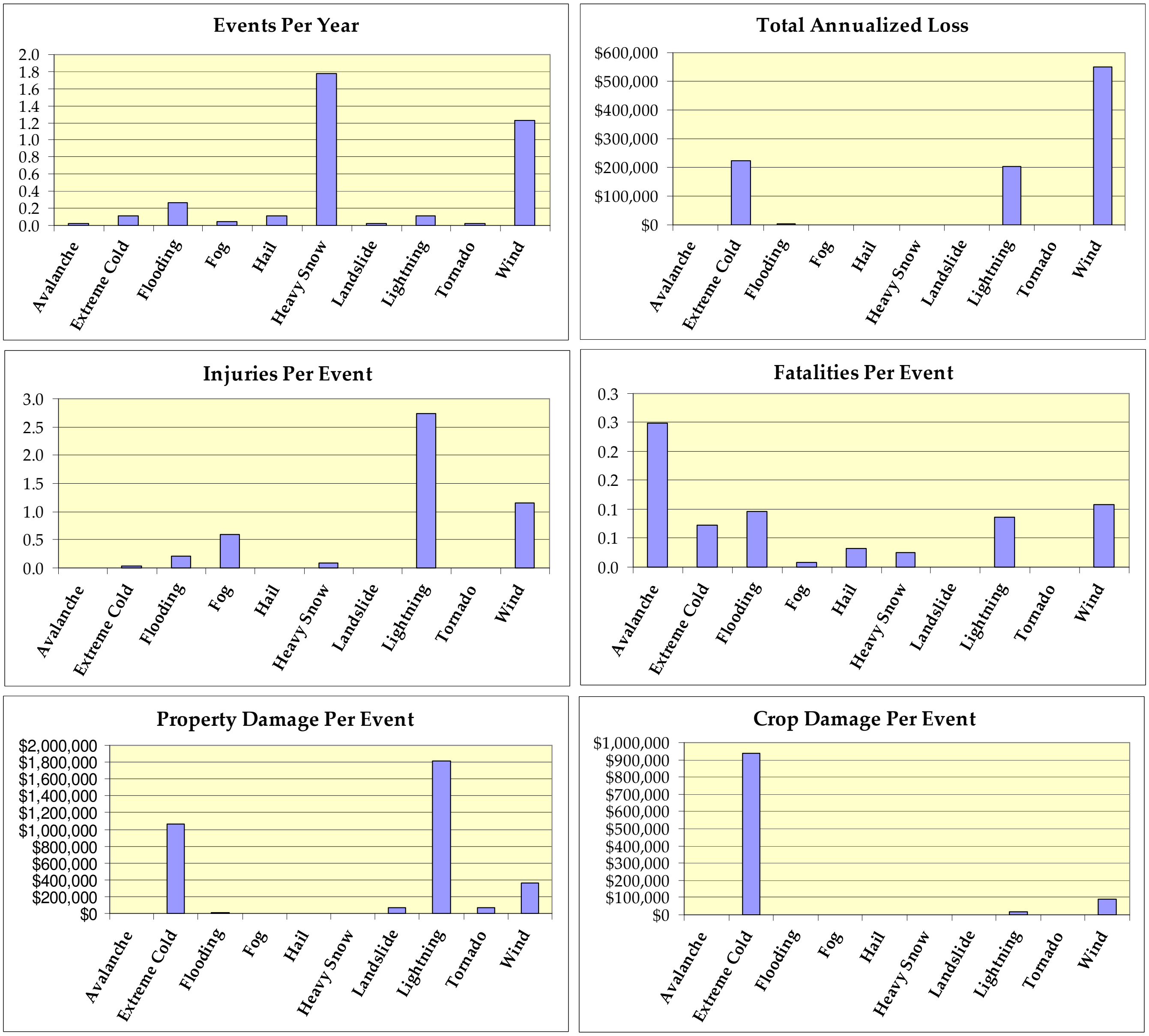


Figure 12-2. Major Disaster Event Annual and Per Event Averages 1962-2005, Tooele County, Counts (HVRI 2007)

Risk Assessment

The risk assessment process revealed the following for Drought, Earthquake, Flood, Infestation, Landslide/Slope Failure, Severe Weather and Wildland Fire. Drought, Infestation and Severe Weather are considered to be regional hazards and can be found in Part XIII. Refer to Part VII for an explanation of the risk assessment methodology. According to this data, there are a total of 54 identified critical facilities within Tooele County. For the complete list refer to Appendix D.

Number of Structures with Moderate or Greater Vulnerability (% of Total)								
Critical Facilities	**Total**	***Dam Failure***	***Flood***	***Ground Shaking***	***Liquefaction***	***Problem Soils***	***Slope Failure***	***Wildfire***
Amateur Radio Repeaters	**14**	0 (0%)	0 (0%)	14 (100%)	1 (7%)	0 (0%)	11 (79%)	14 (100%)
Public Safety Repeaters	**50**	0 (0%)	0 (0%)	50 (100%)	0 (0%)	0 (0%)	33 (66%)	50 (100%)
Fire Stations	**5**	2 (40%)	0 (0%)	5 (100%)	1 (20%)	0 (0%)	0 (0%)	0 (0%)
Hospitals	**1**	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Oil Facilities	**1**	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Police Stations	**4**	3 (75%)	0 (0%)	4 (100%)	1 (25%)	0 (0%)	0 (0%)	0 (0%)
Schools	**26**	10 (38%)	1 (4%)	26 (100%)	4 (17%)	1 (4%)	1 (4%)	0 (0%)
Water Treatment Facilities	**4**	2 (50%)	4 (100%)	4 (100%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)

Table 12-1. Critical Facilities Vulnerability Matrix for Local Hazards, Tooele County NA=Not Applicable

Name	Fault Type	Length (km)	Time of most recent deformation	Recurrence Interval

1. Earthquake

Hazard Profile

Potential Magnitude	X	*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*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.				
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 and 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.				
Secondary Hazards	Fire, landslide, rock falls, avalanche, flooding				
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DHLS, AGRC.				

Description of Location and Extent

The primary earthquake threat to Tooele County is from the Wasatch Fault Zone. The Wasatch Fault Zone is an active fault zone that can produce a large 7.3-7.5 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 1,200-2,600 years. Previous major earthquakes on the five central segments range from 620 to 2,120 years ago.

The Oquirrh Fault Zone is the other primary threat for earthquakes affecting the County. The fault has an approximate recurrence interval of 20,000 years. Earthquakes up to Richter magnitude 7.0 are possible within the Oquirrh Fault Zone, but given its recurrence interval, earthquakes of this magnitude are not probable. Smaller earthquakes are more likely along this fault with Richter magnitudes around 6.0.

Map 12-2 (page 246) show the positions of historic earthquakes relative to fault groups. It is notable that no earthquake greater than 3.0 in Richter magnitude has occurred in the county in the past 45 years. Many of the recorded seismic events on the map are the result of mining operations and not true earthquakes.

Cedar Mountains faults (East Side)	Normal	5	<1,600,000 years ago	Unknown
Deep Creek faults	Normal	10	<1,600,000 years ago	Unknown
Deep Creek Range (Northwest Side) faults	Normal	11	<130,000 years ago	Unknown
Lookout Pass fault	Normal	4	<1,600,000 years ago	Unknown
Oquirrh fault zone	Normal	21	4,800-7,900 years ago	20,000 years
Saint John Station fault zone	Normal	5	<130,000 years ago	Unknown
Sheeprock fault zone	Normal	7	<1,600,000 years ago	Unknown
Silver Island Mountains (Westside) fault	Normal	6	<1,600,000 years ago	Unknown
Silver Island Mountains (Southside) fault	Normal	2	<15,000 years ago	Unknown
Simpson Mountains faults	Normal	11	<750,000 years ago	Unknown
Skull Valley faults (Mid-Valley)	Normal	55	<15,000 years ago	Unknown
Southern Oquirrh Mountains fault zone	Normal	24	4,400-4,800 years ago	20,000 years
Stansbury fault zone	Normal	50	6000-10,000 years ago	Unknown
Topliff Hill fault zone	Normal	20	<130,000 years ago	Unknown
Vernon Hills fault zone	Normal	3	<130,000 years ago	Unknown
Puddle Valley fault zone	Normal	7	<15,000 years ago	Unknown

Table 12-2. Quaternary Faults, Tooele County

One of the better measures of earthquake destruction potential is spectral acceleration. 0.2 spectral acceleration represents the frequency at which the most potential damage can occur in one- and two-story buildings, while 1.0 spectral acceleration represents the frequency at which taller buildings potentially will see greater damage. The potential forces exerted on buildings are shown as a percentage of the force of gravity with 100% equaling one times the force of gravity (Map 12-3, page 247).

Portions of Tooele County are located atop an ancient Lake Bonneville, the bed of 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 significant impact on populated areas of northeastern Tooele County. For a further explanation of the liquefaction threat, see Map 12-4 (page 248). See also regional hazards identification section for further explanation of liquefaction.

Vulnerability Assessment

An earthquake vulnerability assessment for Tooele County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH)**. The following numbers were based on a probabilistic 2500-year event with a Richter magnitude of 7.1 as well as an arbitrary 5.9 event located in close proximity to the county's most populated areas. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VII or the HAZUS-MH Technical Manual (Earthquake Model) at www.fema.gov/hazus).*

Building Damage

HAZUS-MH classifies building damage into five states: none, slight, moderate, extensive and complete. Table 12-3 lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage during either an arbitrary Richter magnitude 5.9 (M5.9) or a probabilistic Richter magnitude 7.1 (M7.1) earthquake. Also listed are the estimated monetary losses to structures, contents/inventory and income.

Category	Number of Structures with > 50% Damage		Category	Estimated Losses	
	Tooele M5.9	2500-yr M7.1		Tooele M5.9	2500-yr M7.1
Residential	4,698	4,898	Structural Losses	$18,419,000	$56,606,250
Commercial	54	109	Non-Structural Losses	$66,291,000	$192,654,880
Industrial	12	29	Content Losses	$23,865,000	$59,805,880
Government	4	9	Inventory Losses	$673,000	$2,235,650
Education	1	4	Income & Relocation Losses	$18,145,000	$49,560,420
Totals	**4,769**	**5,049**	**Totals**	**$127,393,000**	**$360,863,080**

Table 12-3. Building Damage Counts and Estimated Losses

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in Table 12-4. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage >50%		Estimated Losses	
		Tooele M5.9	2500-yr M7.1	Tooele M5.9	2500-yr M7.1
Waste Water Facilities	3	1	2	$14,367,000	$51,777,000
Waste Water Pipelines	6,485 km	265 leaks/breaks	3,710 leaks/breaks	$952,000	$13,356,000
Potable Water Pipelines	10,808 km	333 leaks/breaks	4,691 leaks/breaks	$1,204,000	$16,887,000
Natural Gas Pipelines	4,323 km	257 leaks/breaks	3,966 leaks/breaks	$1,018,000	$14,277,000
Communication Facilities	4	0	2	$16,000	$86,000
Highway Bridges	54	1	20	$295,000	$10,002,000
Railway Bridges	1	0	0	$0	$0
Airport Facilities	4	4	0	$1,129,000	$4,228,000
Total Losses				**$18,981,000**	**$110,613,000**

Table 12-4. Damage to Transportation and Utilities

Debris Removal

Table 12-5 shows how much debris would be generated by the scenario 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 at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	Tooele M5.9	2500-yr M7.1
Brick, Wood & Others	24,000 tons / 960 loads	68,000 tons / 2,720 loads
Concrete & Steel	41,000 tons / 1,640 loads	132,000 tons / 5,280 loads

Table 12-5. Debris Generated/Number of Loads

Fire Following

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and estimated winds to calculate the estimated area that would be burned following an earthquake. Table 12-6 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Tooele M5.9	2500-yr M7.1
Ignitions	1	3
Persons Exposed	49	64
Value Exposed	$2,365,000	$3,114,000

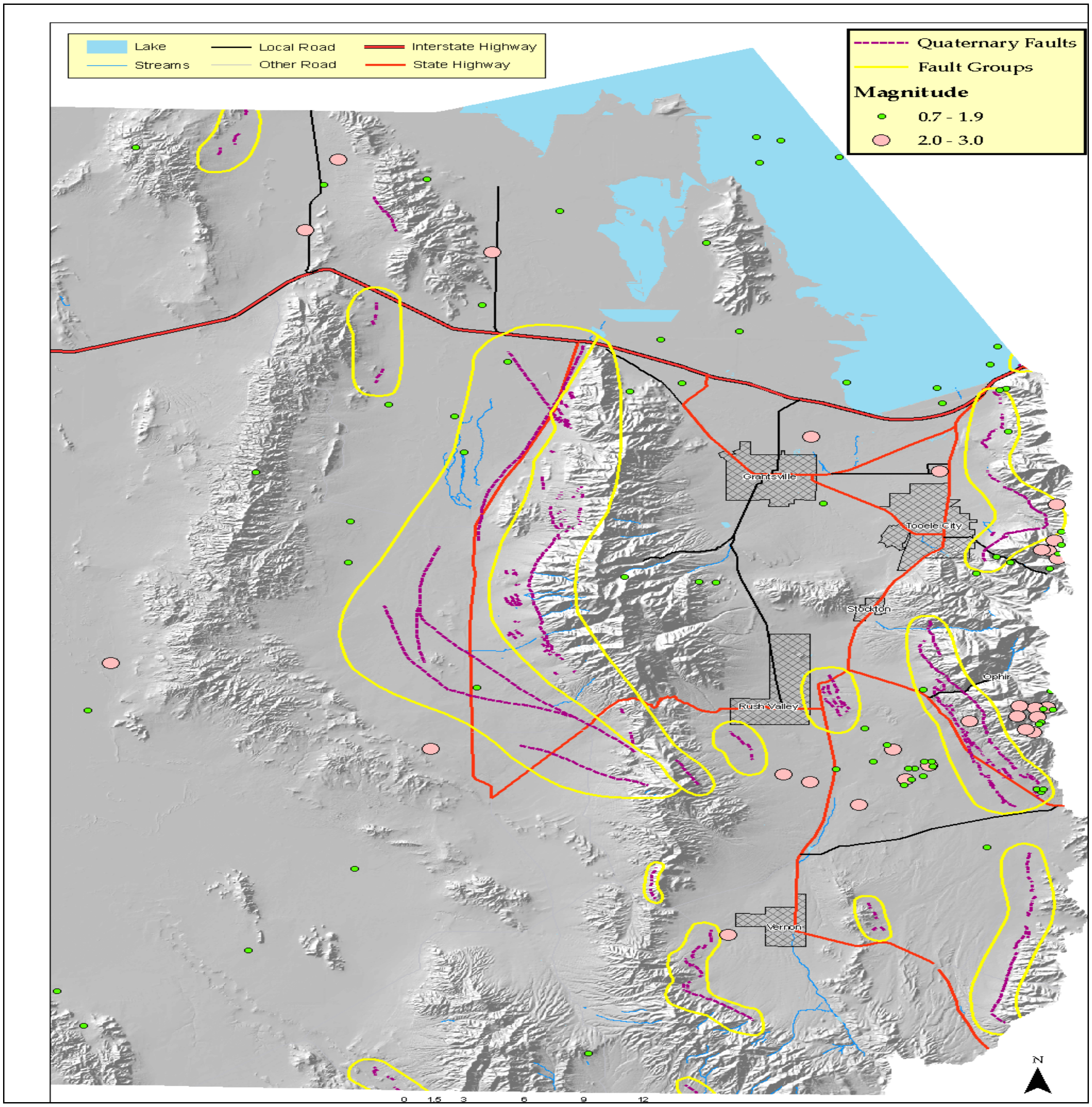
Table 12-6. Fire Following Event, Population Exposed, and Building Stock Exposed

Casualties

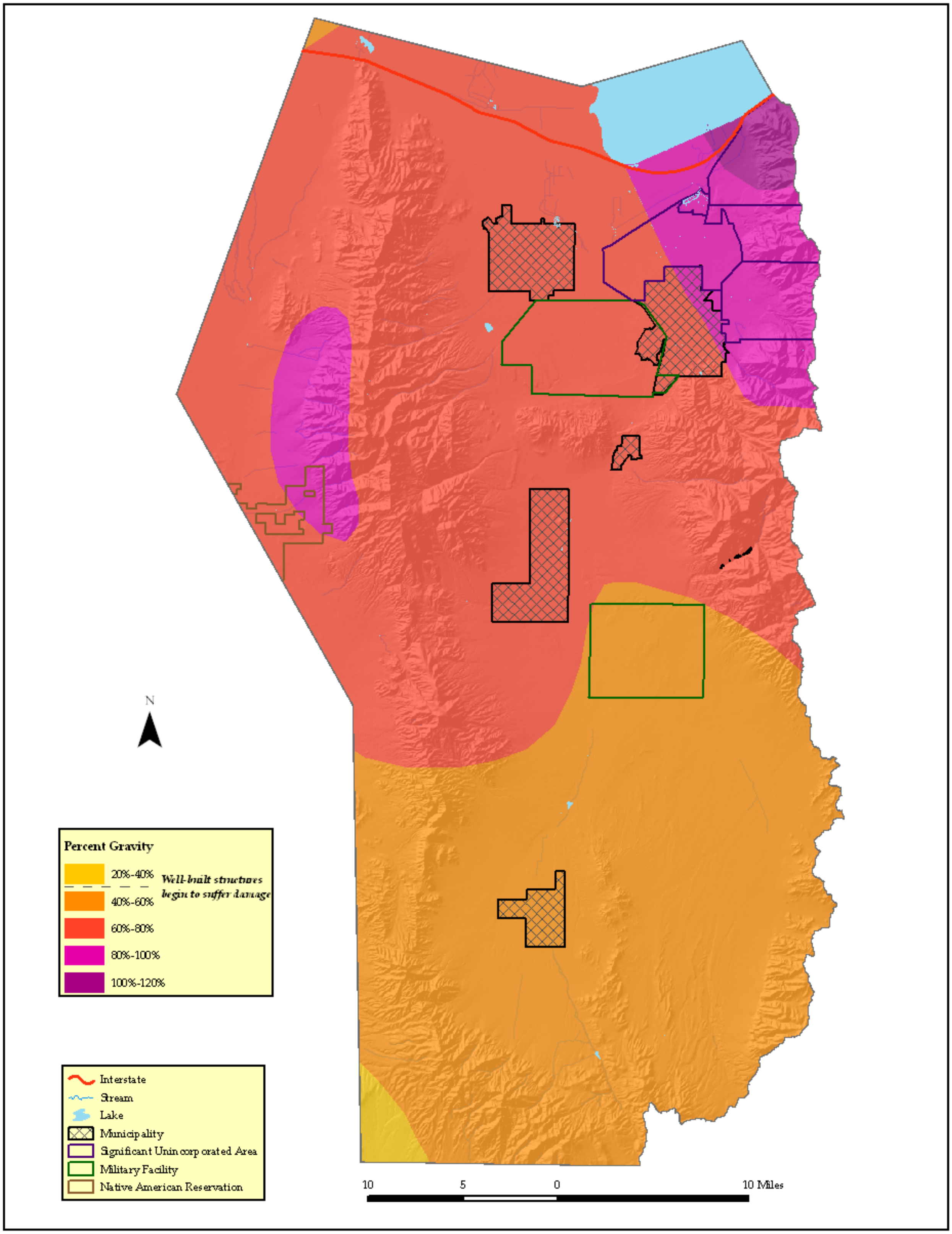
Table 12-7 estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons, the daytime scenario (2 p.m. local time) a commercial concentration, and the commute scenario (5 pm. local time) a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major) and fatalities.

Night Event	Tooele 5.9	2500-yr 7.1	Day Event	Tooele 5.9	2500-yr 7.1	Commute Event	Tooele 5.9	2500-yr 7.1
Minor	52	184	**Minor**	58	209	**Minor**	49	179
Major	11	50	**Major**	16	67	**Major**	13	56
Fatalities	2	11	**Fatalities**	4	18	**Fatalities**	3	14

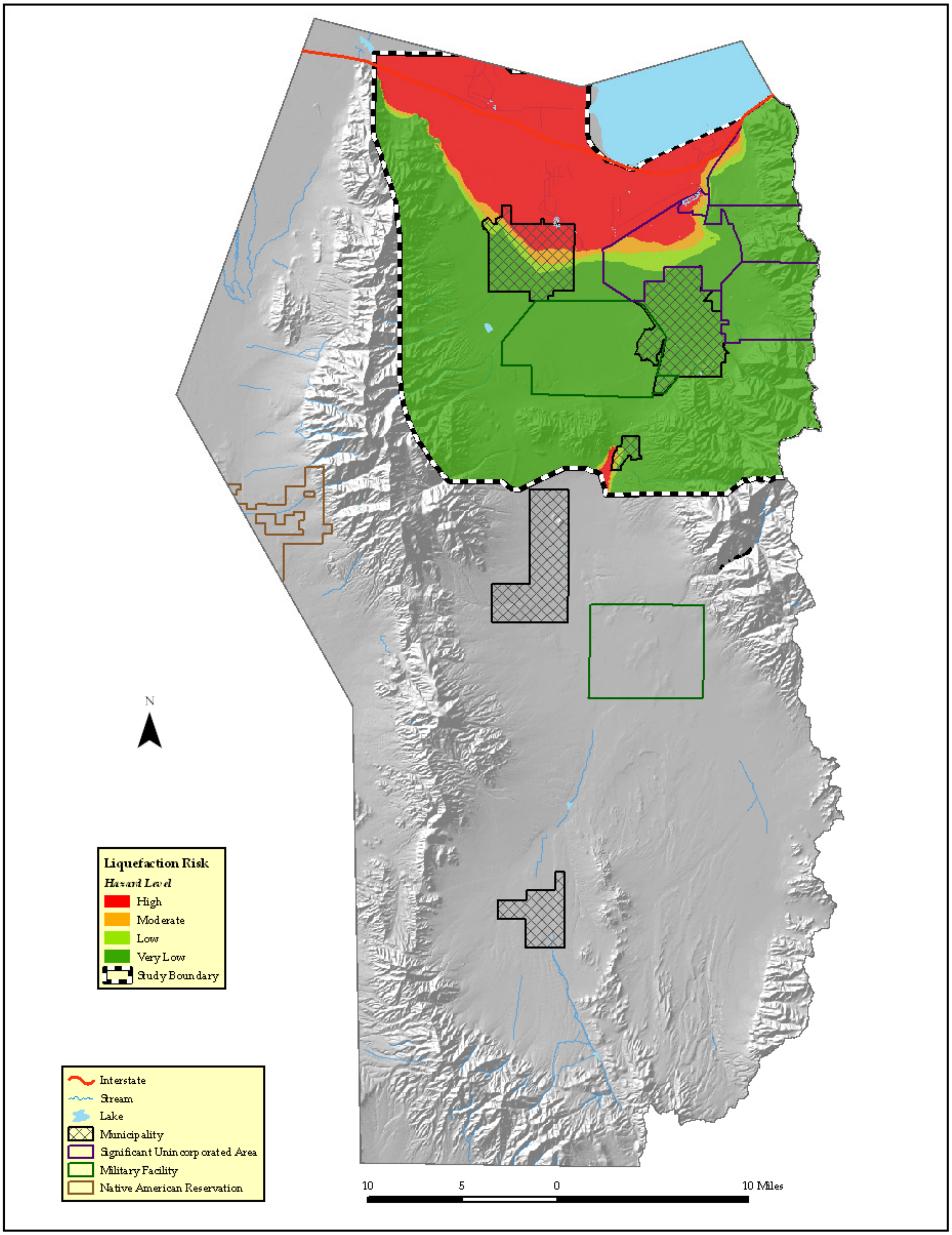
Table 12-7. Casualties



Map 12-2. Historical Earthquake Epicenters, Eastern Tooele County (Source: UUSS)



Map 12-3 Ground Shaking Potential, Eastern Tooele County (Source: National Seismic Hazards Mapping Program)



Map 12-4 Liquefaction Potential, Eastern Tooele County (UUSS)

Wildland Fire

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Wildland-Urban Interface (WUI) zones near the foothills and in forested areas. See Map 12-5 (page 252).				
Seasonal Pattern	Summer months				
Conditions	Areas affected by drought and/or heavily overgrown; 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.				
Secondary Hazards	Landslides, debris flows, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by U.S. Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and the DHLS				

Description of Location and Extent

Potential wildfire hazard within Tooele County is growing as population growth is spreading into the wildland-urban interface (WUI). Over the past 10 years urban sprawl has encroached upon forested foothill areas and wildland areas threatening life and property.

The wildfire threat in Tooele County in the past has had a significant effect on the watersheds, including landslides, debris flows and other forms of erosion. Federal, state and local agencies have worked together to enforce ordinances and other programs such as re-vegetation zones to protect watersheds.

Wildland fire risk for Tooele County can be found in Map 12-5 (page 252). The map layers were provided by the Utah Division of Forestry, Fire, and State Lands and show four categories of wildfire risk (Extreme, High, Medium and Low). These ratings cover all of Tooele County and are based on the type and density of vegetation in each area as well as vulnerable population. Additional factors that influence wildfires (weather conditions, wind speed and direction) are not considered in this risk assessment.

The entire county is at moderate or greater risk for wildfires. Areas potentially affected include: Loftgreen, Vernon, Ophir, Deseret Chemical Depot, Rush Valley, Terra, Dugway Proving Grounds, Skull Valley Reservation, Stockton, Tooele Army Depot, Pine Canyon, Grantsville and Erda.

Development has been advancing further and further into the WUI, with many of the most vulnerable homes also the most costly to replace. Without effective fuel reduction measures and sufficient defensible space, these areas are likely to see considerable losses.

Vulnerability Assessment

Table 12-8 (below) estimates the total area, population, and buildings vulnerable to wildland fire for individual cities and unincorporated areas. Table 12-9 (next page) estimates infrastructure vulnerable to wildland fire in Tooele County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software.

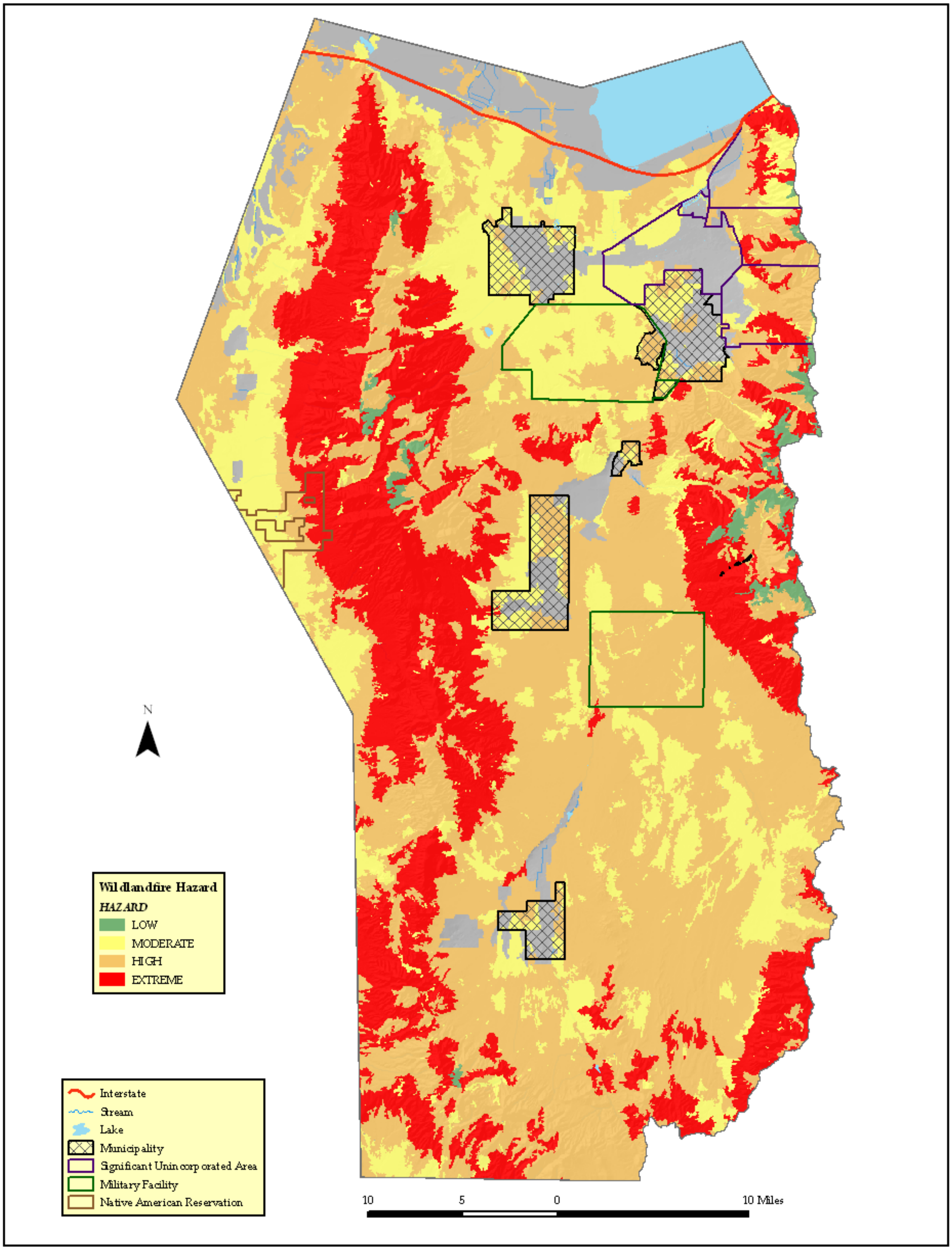
Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Grantsville	1,593	88	45 $6,421,250	0 $0
Ophir	37	0	0 $0	0 $0
Rush Valley	4,562	55	37 $3,879,050	0 $0
Stockton	585	162	75 $10,013,750	2 $1,559,791
Tooele	6,572	2,798	1,807 $309,160,550	34 $87,870,040
Vernon	14,801	28	7 $10,851,450	0 $0
Wendover	0	0	0 $0	0 $0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Deseret Chemical Depot	3,286	0	1 $148,650	0 $0
Dugway Proper	3,316	0	0 $0	0 $0
Erda	14,224	0	35 $2,232,750	2 $1,600,000
Goshute Reservation	150	59	12 $1,768,935	0 $0
Lakepoint	13,052	0	0 $0	0 $0
Pine Canyon	12,560	29	42 $6,243,800	0 $0
Skull Valley Reservation	15,445	87	20 $3,017,595	0 $0
Tooele Army Depot	42,496	0	0 $0	0 $0
Stansbury Park	0	0	0 $0	0 $0

Table 12-8. Vulnerability Assessment for Wildland Fire, Tooele County

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	179.20 miles	$998,352,407
Highway Bridges	54 bridges	$68,781,340
Railway Segments	237.14 miles	$272,415,587
Railway Bridges	1 bridge	$44,100
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$1,339,593,434**

TabTable 12-9. Infrastructure Vulnerable to Wildland Fire, Tooele County



Map 12-5. Wildfire Hazard, Eastern Tooele County (UDFFSL 2007)

3. Slope Failure

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)		*X*	***Likely***
	X	***Limited (10-25%)***			***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Generally, landslides, debris flows, and rock falls occur in canyon mouths and foothill areas. Areas of recent wildfire activity also pose landslide danger. See Map 12-6.				
Seasonal Pattern	Spring and summer months				
Conditions	Usually caused by the stress release of over-weighted soils and or loosening of rock and debris by wind, water, or ground shaking.				
Duration	Landslides generally last hours or days, but some can last weeks. Rock falls and debris flows are instantaneous.				
Seasonal Hazards	Flooding (natural dams), traffic accidents				
Analysis Used	Information and maps provided by UGS, DHLS, AGRC				

Description of Location and Extent

Slope failure in Tooele County comes primarily in the form of debris flows. The County has a high wildfire hazard. These wildfires denude slopes of anchoring vegetation. Heavy rainstorms following these wildfires fall on the denuded slopes and loosen the soils. These factors can combine to form a wall of water, rocks, and mud which smash into nearby homes. Many of these debris flows occur in canyon mouths forming alluvial fans.

Recent debris flows in Tooele County include Flux (1983-84), South Mountain (1983-84), Stockton (1983-84), Bingham (1993-1994), Lake Point (1983-84, 2000), and Grantsville (2007) (UGS Survey Notes 35-1, UGS Open File Report 318). Most of these debris flows have caused less than $50,000 in damages.

There are only a few areas with landslide risk in Tooele County. On the west side of the Stansbury Mountains, near the Skull Valley Native American Reservation, a small area of landslides can be found in Deadman Canyon and Barlow Hollow. Another small area of landslides is located in Ophir Canyon near the town of Ophir. These landslide areas affect little or no population. For more information on the landslide hazard in Tooele County, please see Map 12-6 (page 255).

Vulnerability Analysis

Table 12-10 estimates the total area, population, and buildings vulnerable to landslides for individual cities and unincorporated areas. Table 12-11 (next page) estimates infrastructure vulnerable to landslides in Tooele County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software.

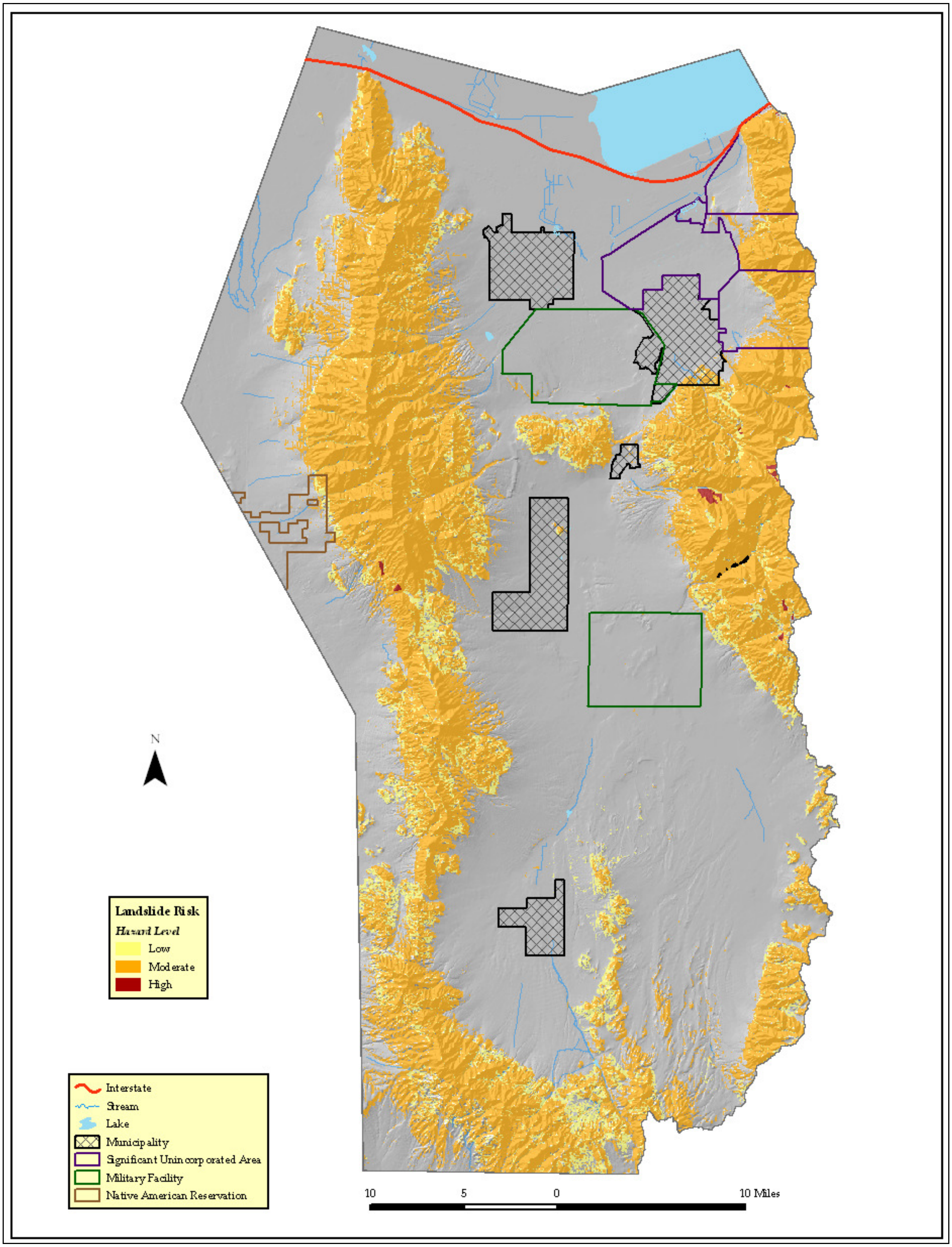
Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Grantsville	0	0	0 $0	0 $0
Ophir	34	144	55 $8,175,750	0 $0
Rush Valley	75	1	0	0
Stockton	89	64	24 $3,567,600	1 $68,622
Tooele	729	343	123 $18,283,950	0 $0
Vernon	0	0	0	0
Wendover	541	204	50 $7,447,365	0 $0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Deseret Chemical Depot	0	0	0	0
Dugway Proper	195	162	20 $2,973,000	0 $0
Erda	28	4	1 $148,650	0 $0
Goshute Reservation	0	0	0 $0	0 $0
Lakepoint	7,935	96	33 $4,905,450	0 $0
Pine Canyon	5,364	170	79 $11,743,350	0 $0
Skull Valley Reservation	625	22	5 $0	0 $0
Tooele Army Depot	0	0	0	0
Stansbury Park	0	0	0	0

Table 12-10. Vulnerability Assessment for Landslides, Tooele County

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	4.30 miles	$22,191,835
Highway Bridges	5 bridges	$4,565,620
Railway Segments	4.80 miles	$5,507,886
Railway Bridges	0 bridges	$0
Water Distribution Lines	982.89 miles	$31,636,250
Gas Lines	393.14 miles	$12,654,475
Sewer Lines	589.68 miles	$18,981,731
Total Estimated Infrastructure Replacement Cost		**$95,537,797**

TabTable 12-11. Infrastructure Vulnerable to Landslides, Tooele County



Map 12-6. Landslide Susceptibility, Eastern Tooele County (Source: USGS)

4. Flood

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
	X	***Limited (10-25%)***		*X*	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	Canyons, alluvial fans, Great Salt Lake (See Map 12-7, page 258)				
Frequency	Spring, late summer				
Conditions	Cloudburst storms, rapid snowmelt, extended wet periods				
Duration	Flooding can last anywhere from hours to days and even months.				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of FIRM, flood insurance studies, debris flow maps				

Description of Location and Extent

Flooding in Tooele County is associated primarily with heavy rainfall from cloudburst storms and from lake flooding around the Great Salt Lake. Stream flooding is limited due to the desert climate. Most streams in the County are intermittent. Intermittent stream water usually flows only after intense, short-duration rain events. Some areas in the eastern portions of the County do see sustained flows from spring and summer snowmelt.

Current flood insurance rate maps (FIRMS) exist only for the communities of Tooele City, Rush Valley, Stockton and Wendover. These maps haven't been updated in several years making the accuracy of the data suspect given the significant amount of recent development in the County. Floodplain information from these maps can be found in Map 12-7. Much of the flood hazards present in the maps are in the form of alluvial fans/debris flows. These flood events occur with the aforementioned short duration, heavy rainfall events. These flood events can be compounded if the heavy precipitation event causes rapid snowmelt during the spring months.

Lake flooding can occur along the Great Salt Lake (GSL) and in the West Desert. During the flood event of 1983-1984, much of the area near Lake Point was flooded by the GSL. The operation of the west desert pumping station, resulted in an inundation of a large area of the west desert. During periods of excessive precipitation, areas of the west desert and Bonneville Speedway are often underwater.

Vulnerability Assessment

The vulnerability assessment for flooding in Tooele County was obtained from HAZUS-MH**. Data was taken from Flood Insurance Rate Maps (FIRM) or Digital Flood Insurance Rate Maps (DFIRM). Only streams which contained detailed flood cross-section data could be used. Vulnerability was assessed for 100-year (NFIP Zone A) floods only in Tooele City. Cross-sections not were available at the 500-year elevation. As well, flooding from the Great Salt Lake was not included. Consequently, the results should be considered conservative. Total monetary losses include structures, contents and business interruption. (**For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VII or the HAZUS-MH Technical Manual (Flood Model) at www.fema.gov/hazus .)

	Acres Flooded	Population Displaced	Number of Structures with at Least Moderate Damage	
			Residential Units **(Total Losses)**	*Commercial/Industrial Units* **(Total Losses)**
100-year Flood	71.3	153	9 **$2,280,000**	0 **$750,000**
500-year Flood				

Table 12-12. Tooele City Flood Hazard

Agricultural Losses

Agricultural losses are listed in Table 12-13. Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15th.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$1,014	$1,352		

Table 12-13. Agricultural Losses, April 15th Scenario

Vehicle Losses

Table 12-14 contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$72,344	
Nighttime Scenario	$168,241	

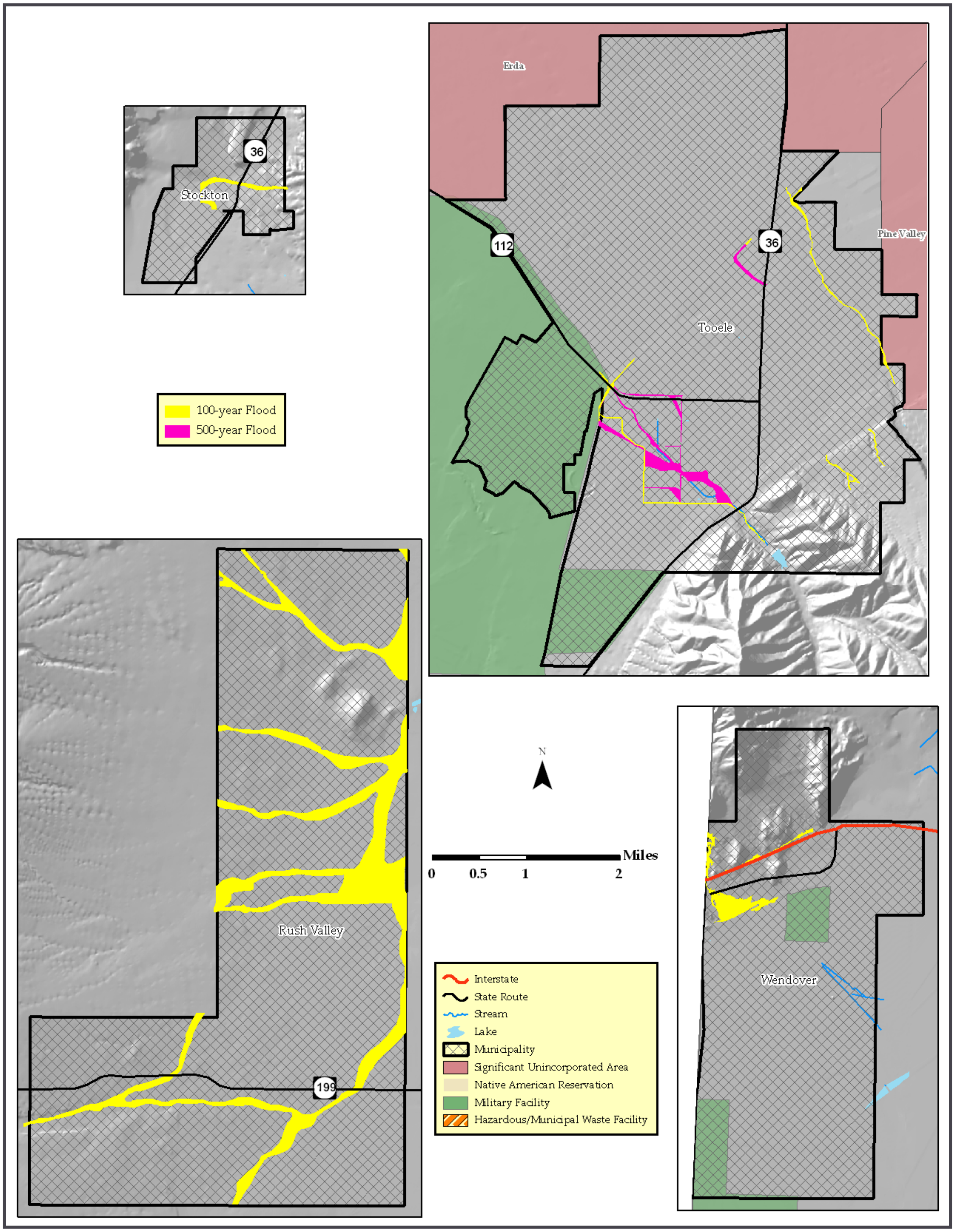
Table 12-14. Vehicle Losses

Debris Removal

Table 12-15 shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	225 tons/9 loads	
Structures	114 tons/5 loads	
Foundations	128 tons/6 loads	
Totals	**467 tons/20 loads**	

Table 12-15. Debris Generation and Removal



Map 12-7. 100-year and 500-Year Floodplains, Tooele County (NFIP 1990b)

4. Dam Failure

Hazard Profile

Potential Magnitude			Probability		
		Catastrophic (>50%)			*Highly Likely*
	X	*Critical (25-50%)*			*Likely*
		Limited (10-25%)		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	See Map 12-8 (page 261)				
Frequency	*Rainy Day Failure:* Spring, Late Summer *Sunny Day Failure:* Anytime				
Conditions	*Rainy-day failure* happens mainly during heavy precipitation events, and can have some warning time. *Sunny day failure* happens with no warning at all, usually from sudden structural failure.				
Duration	Hours - Days				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of BOR inundation maps and plans, FIS, and the Utah Division of Water Rights				

Description of Location and Extent

Sixty-nine (69) dams are located in Tooele County, two (2) 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. Four (4) dams are listed as a moderate hazard threat meaning if they fail they have a low probability of causing loss of life. Both threats would cause appreciable property damage and mitigation efforts should be developed and pursued. Fifty-eight (58) dams have a low hazard threat, meaning 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. No hazard rating is provided for five (5) dams.

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.

Name	Rating	Name	Rating
Grantsville	High	G & L Ranch 87R114	Moderate
Settlement Canyon	High	Grantsville Regulating Pond	Moderate
Buzianis DB	Moderate	Vernon	Moderate

Table 12-16. High and Moderate Hazard Dams, Tooele County (Utah Division of Water Rights 2007)

Vulnerability Assessment

Table 12-17 (below) estimates the total area, population and buildings vulnerable to dam failure for individual cities and unincorporated areas. Table 12-18 (next page) estimates infrastructure vulnerable to dam failure in Tooele County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH loss estimation software.

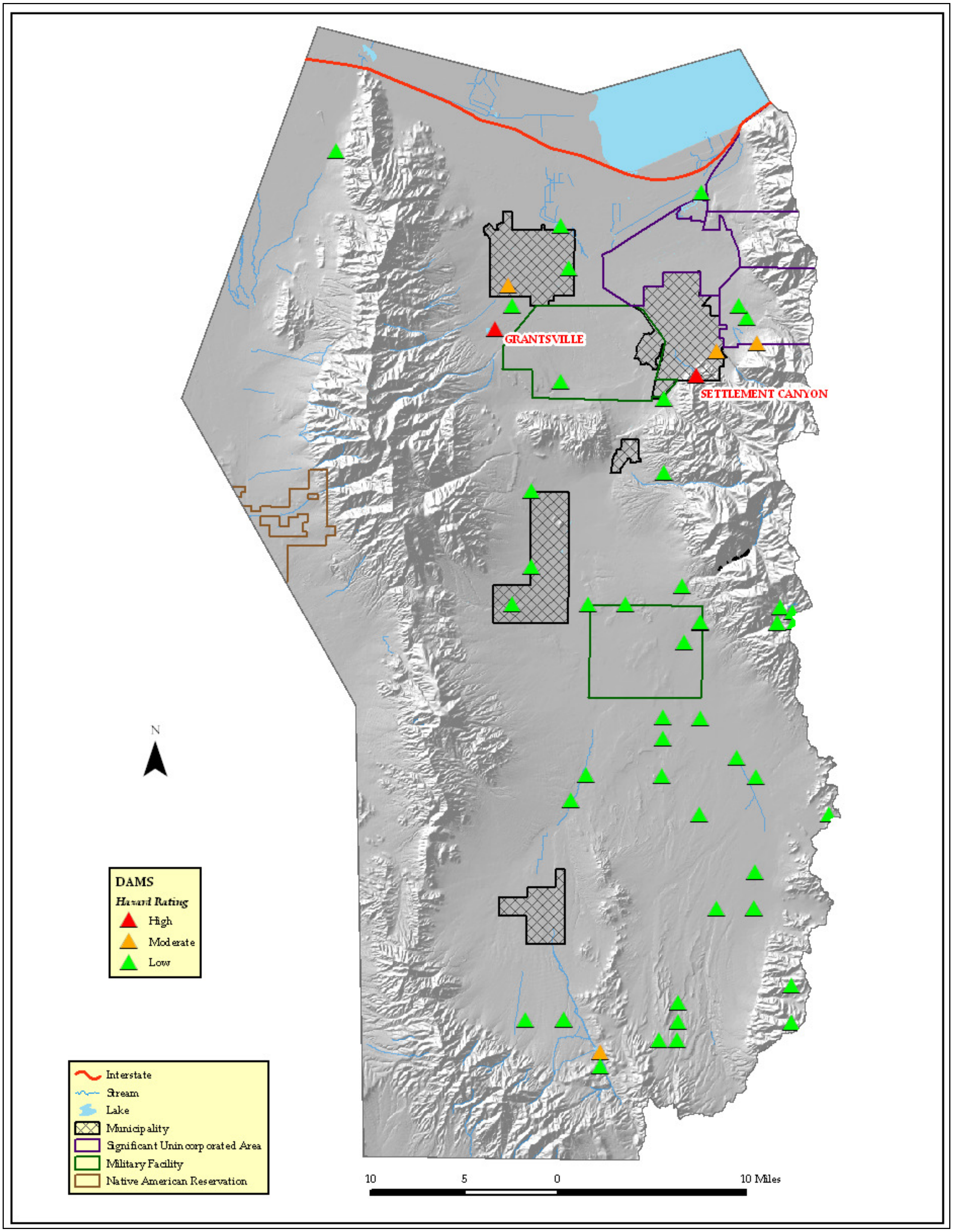
Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Grantsville	2,538	1,457	*504* $74,919,600	*22* $5,917,650
Ophir	0	0	*0*	*0*
Rush Valley	0	0	*0*	*0*
Stockton	0	0	*0*	*0*
Tooele	9,253	15,944	*5,335* $793,047,750	*449* $270,466,412
Vernon	268	11	*4* $594,600	*0* $0
Wendover	0	0	*0*	*0*

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Deseret Chemical Depot	0	0	*0* $0	*0* $0
Dugway Proper	0	0	*0* $0	*0* $0
Erda	6,661	3,259	*964* $143,298,600	*5* $1,976,328
Goshute Reservation	0	0	*0*	*0*
Lakepoint	0	0	*0*	*0*
Pine Canyon	0	0	*0*	*0*
Skull Valley Reservation	0	0	*0*	*0*
Tooele Army Depot	5,742	1,862	*560* $83,244,000	*84* $39,441,047
Stansbury Park	0	0	*00*	*0*

Table 12-17. Vulnerability Assessment for Dam Failure, Tooele County

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	20.36 miles	$104,368,536
Highway Bridges	1 bridge	$2,547,463
Railway Segments	23.67 miles	$27,185,660
Railway Bridges	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$134,101,659**

TabTable 12-18. Infrastructure Vulnerable to Dam Failure, Tooele County



Map 12-8. Dams and Associated Risk Levels, Eastern Tooele County (Utah Division of Water Rights 2007)

5. Problem Soils

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)			*Likely*
	X	*Limited (10-25%)*		X	*Possible*
		Negligible (< 10%)			*Unlikely*
Location	See Map 12-9 (page 264)				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Problem soils are soils that present problems for buildings and other engineered structures. Four types of problems soils are present in Tooele County – limestone (karst), gypsum dunes, silica dunes and oolitic dunes. See Map 12-9 for more information on the locations of problem soils in Tooele County.

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way causing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Ophir is the only area affected by karst structures in Tooele County and is sparsely populated.

Three types of dunes exist in Tooele County: gypsum, silica and oolitic. All three have the potential to cause problems. These problems center mainly on their inability to adequately filter wastewater and clog septic systems (Mulvey 1992). Fortunately, most of these problem soils are located in the central and western portions of the County do not affect any populated areas.

Vulnerability Assessment

Table 12-19 (page 261) estimates the total area, population, and buildings vulnerable to problem soils for individual cities and unincorporated areas. Table 12-20 estimates infrastructure vulnerable to problem soils in Tooele County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software.

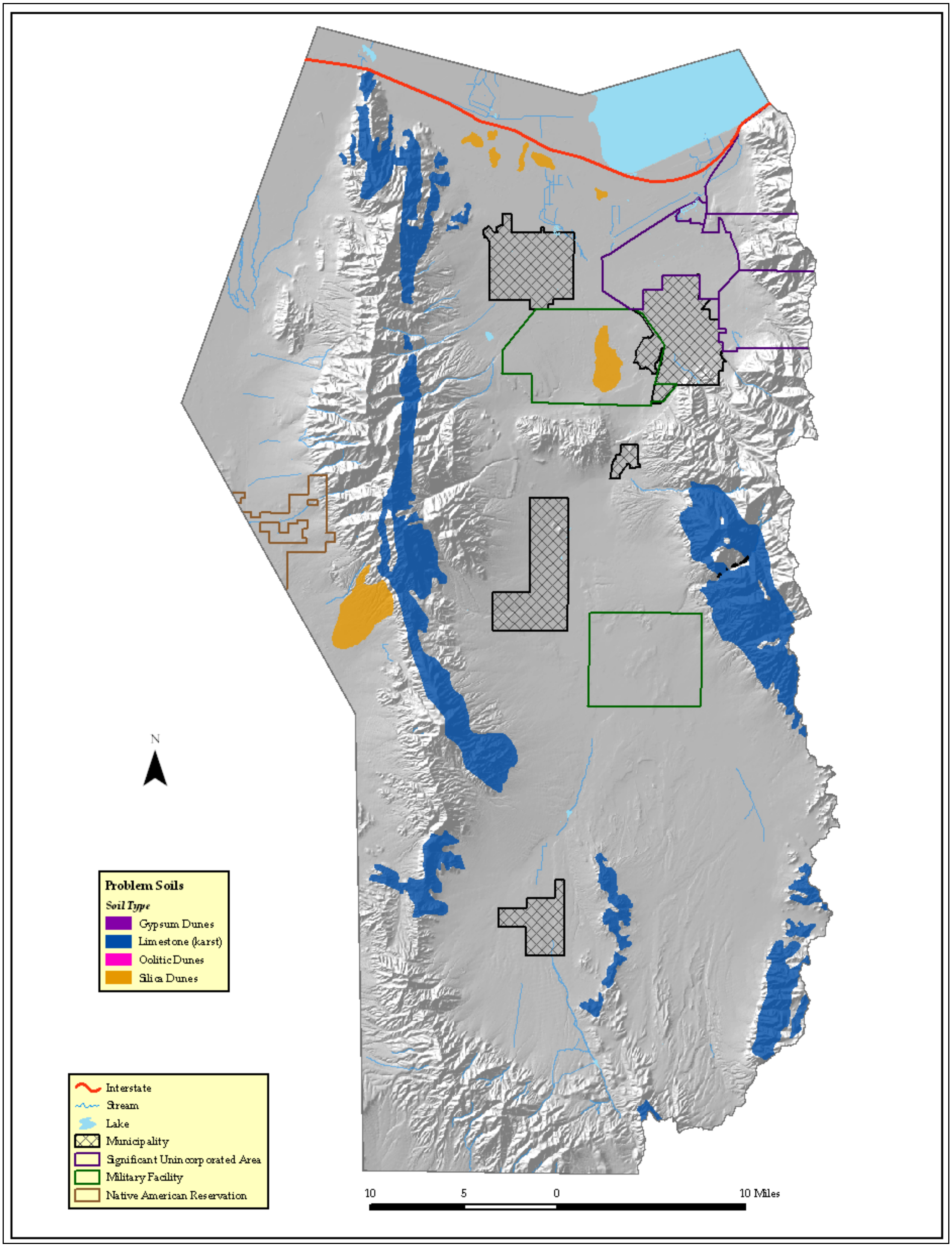
Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Grantsville	0	0	0 $0	0 $0
Ophir	66	79	30 $4,459,500	0 $0
Rush Valley	0	0	0 $0	0 $0
Stockton	0	0	0 $0	0 $0
Tooele	0	0	0 $0	0 $0
Vernon	0	0	0 $0	0 $0
Wendover	0	0	0 $0	0 $0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Deseret Chemical Depot	1,131	0	0 $0	0 $0
Dugway Proper	0	0	0 $0	0 $0
Erda	0	0	0 $0	0 $0
Goshute Reservation	0	0	0 $0	0 $0
Lakepoint	0	0	0 $0	0 $0
Pine Canyon	0	0	0 $0	0 $0
Skull Valley Reservation	0	0	0 $0	0 $0
Tooele Army Depot	2,255	0	0 $0	3 $2,627,261
Stansbury Park	0	0	0 $0	0 $0

Table 12-19. Vulnerability Assessment for Problem Soils, Tooele County

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	11.94 miles	$73,491,301
Highway Bridges	0 bridges	$0
Railway Segments	12.26 miles	$14,078,115
Railway Bridges	0 bridges	$0
Water Distribution Lines	480.86 miles	$15,477,370
Gas Lines	192.34 miles	$6,190,937
Sewer Lines	288.52 miles	$9,286,413
Total Estimated Infrastructure Replacement Cost		**$118,524,136**

TabTable 12-20. Infrastructure Vulnerable to Problem Soils, Tooele County



Map 12-9. Problem Soils, Eastern Tooele County (Source: Utah Geological Survey)

Hazards and Future Development

Population Estimates									
County	2000 Pop (July 1)	2006 Pop (est.)	Absolute Change 2000-2006	% Change 2000-2006	AARC 2000-2006	Rank by 2000 Pop	Rank by Absolute Change	Rank by % Change	Rank by AARC
Tooele County	41,549	54,375	12,826	30.9%	4.6%	8	7	3	3
Population by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	941,172	1,104,356	1,389,252	1,665,238	1,966,372	2,207,282	2,429,057	2,654,682	1.3%
Tooele County	26,033	26,601	41,549	67,150	95,696	112,722	130,092	148,486	2.6%
Households by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	298,700	357,257	446,844	565,333	679,589	780,369	870,671	960,756	1.5%
Tooele County	7,966	8,581	12,931	21,700	31,754	38,441	45,331	52,477	2.9%

Table 11-21. Demographic and Economic Projections (UPEC 2007, 2008) All statistics are based on July 1 snapshot. AARC = Average Annual Rate of Change)

Tooele County development trends have recently slowed with some new developments stalled. Development that is still occurring is in the northeastern portions of the County because housing and land values are slightly lower than nearby Salt Lake County. Development is occurring mostly on land formerly used for agriculture. The Oquirrh and Stansbury mountain ranges and the Great Salt Lake restrain development in the Tooele and Rush valleys. Hazardous waste disposal and federal lands restrict development in the central portion of the County. The western end of the County is salt flats and federal lands with the exception of the Wendover area on the Nevada-Utah border.

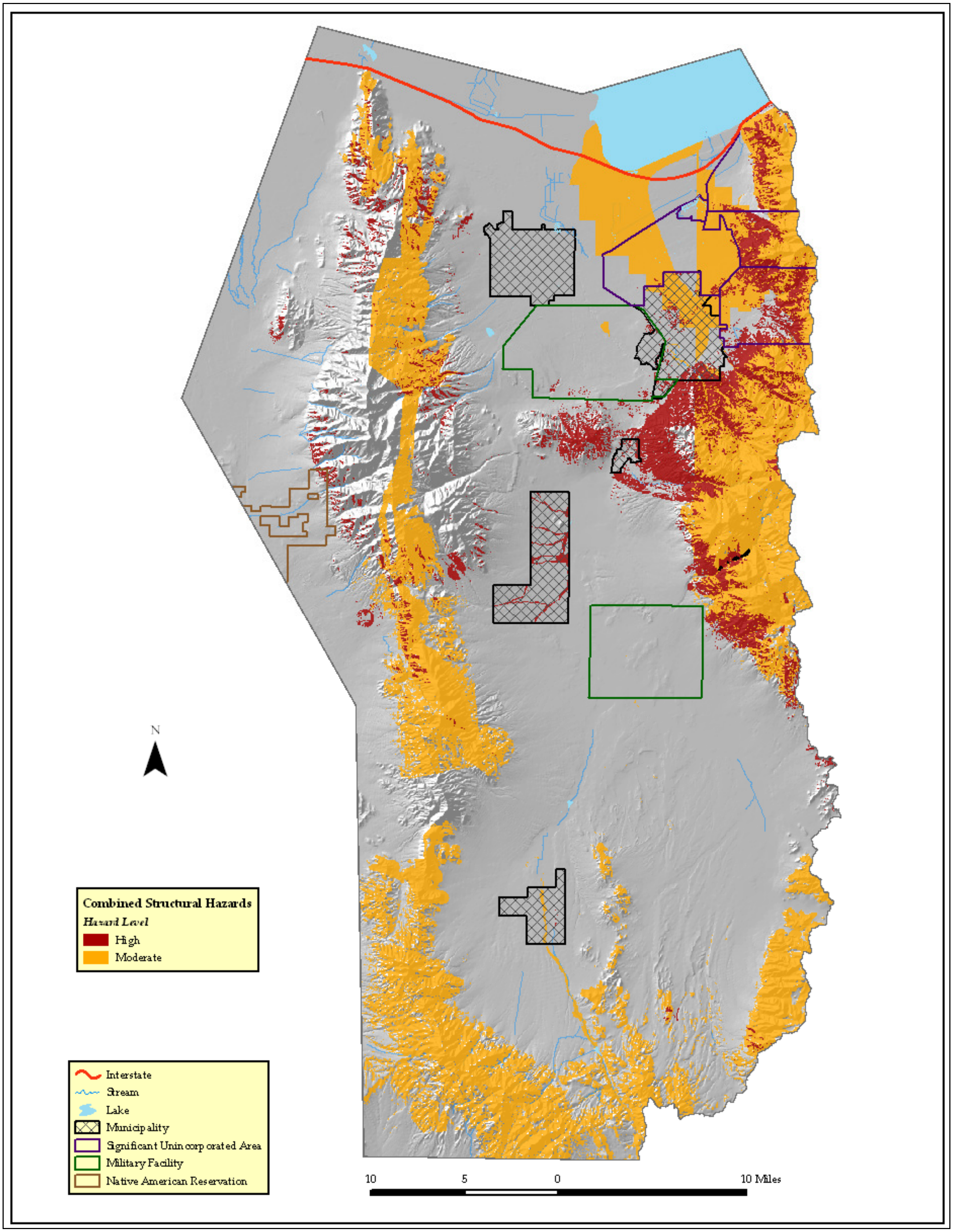
Those portions of the County that are near the Great Salt Lake are subject to high liquefaction in the event of an earthquake and therefore pose a risk to residents and structures. The County and municipalities can mitigate the earthquake threat and its secondary risks through the continued use of zoning ordinances and building codes. Examples of appropriate forms of land use along fault lines include "farms, golf courses, parks, and undeveloped open space" (UGS 1996).

Flooding is also of concern along canyon mouths, in alluvial fans and near the Great Salt Lake. Zoning restrictions on building location and building codes restricting basements would be well-suited in these areas.

Wildfire risk is most severe in the foothills. These areas, known as Wildland-Urban Interface (WUI) zones, are most vulnerable due to the amount and types of vegetation and structures that act as fuel to a burning fire. This threat may be mitigated by encouraging communities to become "Fire Wise Communities", continued use of building and zoning codes and increase the public's awareness.

Landslide/slope failure is another threat found near the foothills. Current development is not located near these areas. When future development does move into landslide-prone areas, more detailed landslide studies and zoning appropriate for high hazard areas will decrease the likelihood of landslides damaging persons and property.

Map 12-10 (next page) shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, tornado, wildland fire and wind) in Tooele County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Map 12-10. Combined Structural Hazards, Eastern Tooele County

Mitigation Strategies

The following mitigation strategies were formulated by the Tooele County Mitigation Strategies Working Group on October 11, 2007, at the Tooele County Courthouse. The Working Group sought to refine and expand on efforts already in place. Information on Working Group members can be found in Part IV.

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.

Goal # 1 – *Include dam failure inundation in future County planning efforts*

Objective #1 (Priority MEDIUM): Review current State Dam Safety information on all identified high hazard dams in Tooele County.

Action: Review dam failure inundation maps and Emergency Action Plans (EAPs) on high risk dams. If outdated work with irrigation companies and Utah Division of Water Rights, Dam Safety Section, to request updates to the EAPs and dam failure inundation maps, to be used for emergency and land use planning and incorporation in current County and City Emergency Operations Plans, as appropriate.

Time Frame: 1-2 years

Funding: Undetermined

Estimated Cost: $5,000.00

Staff: Irrigation companies together with Tooele County Emergency Management, Tooele County Engineering, and the Utah Division of Water Rights

Drought

Problem Identification: Utah is the second driest state in the country. Tooele County has endured intermittent drought periods since 1999.

Goal #1 – *Identify all available ground water sources and quantify potential flows.*

Objective #1 (Priority: HIGH): Project how much growth the valley can sustain, where it can best sustain the growth and develop a groundwater management plan.

Action 1: Finalize the Tooele Valley Water Study and compile a groundwater management plan.

Time frame: Immediate

Funding:	Tooele County, Tooele City, Stockton City, Stansbury Park, Kennecott Mining, Uintah Land, Grantsville City, Utah Division of Water Resources, Utah Division of Water Rights
Estimated cost:	$200,000
Staff:	Tooele County Engineering, USGS and other county entities as listed above

Action 2: Offer incentives if a developer's plans include water conservation measures (xeriscaping) in the CCR's for the new communities (especially pertaining to common properties such a condominiums and town homes).

Time frame:	1-2 years
Funding:	Unknown
Estimated cost:	Unknown
Staff:	Tooele County Engineering

Problem Identification: Tooele County has endured more than seven years of drought conditions. Actions must be taken to conserve water and address water shortages for both culinary and agricultural use.

Goal 2 – *Develop a drought management plan.*

Objective #2.1 (Priority HIGH): Take actions to maintain adequate culinary water supplies.

Action 1: Water reservoirs have insufficient storage capacity. Dredge reservoirs for increased capacity.

Time Frame:	Immediate
Funding:	Minimal
Estimated Cost:	Undetermined
Staff:	City/County Public Works, water treatment personnel, water districts

Action 2: Store water when there is surplus. Increase storage capacity through expansion.

Time Frame:	Ongoing
Funding:	Undetermined
Estimated Cost:	Undetermined
Staff:	City/County Public Works, water treatment personnel, water districts

Action 3: Manage surface and subsurface supplies as one. Implement redistribution and/or interconnections between reservoir drainage areas and surface/subsurface storage or wells.

Time Frame:	3 – 5 years
Funding:	Undetermined
Estimated Cost:	Undetermined
Staff:	City/County Public Works, irrigation companies and water treatment personnel, water districts

Objective #2.2 (Priority HIGH): Limit unnecessary consumption of water throughout the County.

Action: Actively encourage water conservation through the development and distribution of outreach materials to each community.

Time Frame: Immediate/Ongoing
Funding: Undetermined
Estimated Cost: $5,000
Staff: County Emergency Management, municipalities, water districts, USU Extension, Health Department
Jurisdictions: Countywide

Objective #2.3 (Priority MEDIUM): Address agricultural water shortages in the county.

Action: In areas of agricultural use, livestock water rotation should be set-up. Develop and distribute educational materials to ranchers and farmers in rural areas.

Time Frame: Ongoing
Funding: County, State and irrigation companies
Estimated Cost: $5,000
Staff: County Emergency Management, USU Extension, water districts, irrigation companies
Jurisdictions: Countywide

Objective #2.4 (Priority MEDIUM): Encourage the development of secondary water systems.

Action: Coordinate with irrigation companies to develop a secondary water system and water distribution plan for drought.

Time Frame: 3 – 5 years
Funding: Undetermined
Estimated Cost: Undetermined
Staff: City/County Engineering and Public Works, Health Department, irrigation companies, water treatment personnel, water districts
Jurisdictions: Countywide

Earthquake

Problem Identification: Tooele County is a seismically active area with continuously recorded earthquake activity, with several active faults near population centers. Within the over 6,300 square mile area of Tooele County are six separate mountain ranges and the partial boundaries of several others. All of these north-south trending mountain blocks are bounded on at least one side by a zone of geologically recent faulting. Tooele Valley contains two major fault zones, the Oquirrh Marginal Fault on the east and the Six Mile Creek Fault between Marshall and Interstate 80. A sixteen-inch natural gas line crosses the fault in Middle Canyon and a portion of Tooele City's culinary water supply is located west of the fault in Middle Canyon. Rupture of the ground along the Oquirrh Marginal Fault may cause severe damage to these facilities and others which lie on or adjacent to the fault. In Rush Valley, seven potentially active fault zones have been identified from South Mountain on the north to the Sheeprock and Tintic ranges to the south. Tooele County is also adjacent to the Wasatch and Magna fault zones to the east, and may experience significant shaking and liquefaction from an event centered on one of these or other county fault zones.

Goal 1 – Protection of life and property before, during or after a major disaster and emergency response.

Objective #1.1 (Priority HIGH): Find sources of revenue to assist the county and its municipalities in maintaining the current communication and warning system capability.

Action:	Find and apply for federal /state grants to maintain communication system currently in place.	
	Time Frame:	Ongoing
	Funding:	Federal/state grants
	Estimated Cost:	$1,000,000 annually
	Staff:	Tooele County Emergency Management
	Jurisdictions:	Countywide

Objective #1.2 (Priority HIGH): Provide Tooele County residents a secondary access/evacuation route

Action:	Construct a "Midvalley Highway" to support SR-36 with an access/ evacuation route.	
	Time Frame:	2-5 years
	Funding:	Federal/state grants, Utah Department of Transportation (UDOT), municipalities, developers
	Estimated Cost:	$20,000,000
	Staff:	UDOT, County Engineering, County Emergency Management, contractors

Objective #1.3 (Priority HIGH): Establish/improve building and zoning codes to protect citizens from the effects of damaging earthquakes

Action:	Create and/or improve natural hazard ordinances including codes for liquefaction. Make these easily accessible and downloadable on the County website and linked to the Emergency Management website.	
	Time Frame:	Ongoing
	Funding:	County Engineering, County Emergency Management
	Estimated Cost:	Unknown
	Staff:	County Engineering, County Emergency Management

Problem Identification: Citizens and community leaders alike lack sufficient knowledge to make effective decisions to protect themselves from the earthquake hazard.

Goal 2 – *Countywide earthquake safety education and hazard information*

Objective#2.1 (Priority HIGH): Identify what damage could occur and where it could occur in an earthquake

Action: Collect and model data on a Richter Magnitude 5+ and 7+ earthquakes using HAZUS. Update current earthquake maps and incorporate into County GIS System.

Time Frame: Ongoing
Funding: State and local partnership
Estimated Cost: Unknown
Staff: State Division of Homeland Security, County Emergency Management, countywide jurisdictions, County GIS, UGS

Objective #2.2 (Priority HIGH): Improve public education regarding earthquake risks

Action: Provide information on earthquake effects to government officials, planners, homeowners, and developers.

Time Frame: Ongoing
Funding: County Engineering, County Emergency Management
Estimated Cost: Unknown
Staff: County Engineering, County Emergency Management

Flood

Problem Identification: Although Tooele County is located in a semi-arid region, it is subject to severe cloudbursts and spring snowmelt flooding and mudslides. Additional to the 1983-84 widespread floods in Northern Utah counties due to melted record setting mountain snow pack, Tooele County suffered flooding in 1996, 2005, and 2007 in Tooele City, Stansbury Park, Stockton, Grantsville and Hickman Canyon.

The Flood Insurance Rate Maps (FIRM) for Tooele County are fast becoming outdated with the influx of new development, and do not incorporate recent flood events.

Goal 1 – *Provide current FIRMS to planners, engineers and public works departments.*

Objective #1 (Priority HIGH): Use FIRM maps to establish floodplain baselines for construction.

Action 1: Maps are currently being updated and digitized for Tooele City, Bates, Middle and Settlement Canyons and Stansbury Park. The new FIRMs will not be effective until 2009.

Time Frame: 1-2 years

Funding: FEMA and the State of Utah
Estimated Cost: Unknown
Staff: Utah Division of Homeland Security (DHLS), FEMA, subcontractors

Action 2: Request flood maps and/or updates for Grantsville City, Hickman Canyon and the South Rim development in Stockton.

Time Frame: 2-3 years
Funding: FEMA, State, federal grants, increased building permit fees
Estimated Cost: Unknown
Staff: DHLS, FEMA, subcontractors

Action 3: Work in cooperation with local communities located within recognized flood plains to obtain a ranking <10 in the Community Ranking System (CRS) and make federally backed flood insurance policies available for properties at a discounted rate through the National Flood Insurance Program (NFIP).
Time Frame: 2 – 5 years
Funding: Federal/State grants, County Emergency Management, water districts, developers
Estimated Cost: Unknown
Staff: County Emergency Management, municipalities, water districts, FEMA, DHLS

<u>Problem Identification:</u> Streams and storm water drainage require regular maintenance in order to transport water effectively and prevent flooding. New development also causes changes through stream bed alteration and increased impervious surfaces.

Goal 2 – *Develop a drainage master plan for all areas where there is a history of flooding and/or new development and rapid population growth.*

Objective #2.1 (Priority HIGH): Improve drainage channels to avoid future flooding.

Action 1: Develop a drainage master plan; design and construct improved drainage channels, and detention ponds in appropriate areas of the County to include: Bates Canyon, Pine Canyon, Middle Canyon, Settlement Canyon, North and South Willow.
Time Frame: 2-5 years
Funding: Federal and State grants, municipalities, developers
Estimated Cost: $300,000
Staff: DHLS, Utah Division of Water Resources, Tooele County, municipalities

Action 2: Develop a Surface Water Management Plan, design/construct storm water routes or channels to direct flows, and storm drain spot improvements according to the recently conducted Stansbury Park Storm Drainage Study.

Time Frame: Immediate
Funding: Federal /State grants, County and developers
Estimated cost: Unknown
Staff: Tooele County, Stansbury Park Improvement District

Action 3: Upgrade all culverts along SR36 to handle a 100-year storm event.

Time Frame: 1-2 years
Funding: Federal/state grants, County, developers
Estimated costs: Unknown
Staff: Public works

Action 4: Improve brush and debris removal from major drainages near county roadways and populated areas such as Middle, Settlement, South Willow and Ophir Canyons.

Time Frame: Ongoing
Funding: County municipalities, public works
Estimated cost: Minimal
Staff: County Roads Department, County Sheriff's detainee work crews.

Objective #2.2 (Priority HIGH): Look at Stansbury Park and Erda water table levels to determine where the water table has been and could come back to, to establish limits and develop guidelines for construction and the enactment of county ordinances regarding same.

Action 1: Enact construction ordinances for areas with historically high water tables to avoid the potential for future flooding.

Time frame: Immediate
Funding: Tooele County
Estimated Cost: Undetermined
Staff: Tooele County Engineering

Problem Identification: There is a lack of digitized data on flood events. This data needs to be incorporated into WebEOC®. As the world's first web-based emergency management communications system, WebEOC® provides cost-effective, real-time information sharing. By linking local, state, national, and even worldwide sources together, WebEOC® helps to facilitate decision-making in emergency situations or during major events.

Goal 3 – *Tooele County should track flood events*

Objective #3 (Priority MEDIUM): Record flood events

Action 1: Map (GPS) flood events, record flow levels, and incorporate data on flood events into WebEOC.

Time Frame: Ongoing

Funding: Federal/State grants, County Emergency Management, County Information Technology
Estimated Cost: Undetermined
Staff: County Emergency Management, County Information Technology

Problem Identification: Tooele County's population is rapidly growing and baseline data must be established to create and/or update construction ordinances based on FEMA flood elevations. Currently there are insufficient floodplain management ordinances.

Goal 4 – Enact floodplain development regulations.

Objective #3 (Priority HIGH): Establish ordinances with mandatory setbacks from 100-year and 500-year floodplains.

Action 1: Establish ordinance for mandatory setbacks.
Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: County Emergency Management, County/City Councils

Infestation

Problem Identification: Grasshoppers, Mormon crickets, and other types of insects negatively impact agriculture and landscaping within the County.

Goal 1 – Prevent/reduce insect infestation hazard

Objective #1 (Priority MEDIUM): Establish continuous funding sources for countywide insect control.

Action: Find grants and other funding sources to maintain insect control/containment
Time Frame: On going
Funding: Local
Estimated Cost: Minimal
Staff: U.S. Department of Agriculture (USDA) (APHIS), Utah Department Agriculture and Food (UDAF), USU Extension and local governments

Objective #2 (Priority MEDIUM): Utilize historical data to forecast infestation cycles and monitor pest populations to implement early prevention strategies.

Action 1: 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: Municipal funds
Estimated Cost: Unknown
Staff: USDA APHIS, UDAF, USU Extension and local governments

Action 2: 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

Severe Weather

Problem Identification: Severe weather-related incidents result in a large number of disaster declarations and emergency response needs.

Goal 1 – *Disseminate severe weather information to citizens in a timely manner*

Objective #1 (Priority MEDIUM): Educate more citizens about recognizing and knowing the dangers of severe weather hazards to encourage a more widespread and rapid response.

Action 1: Increase Weather Spotter training

Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Minimal
Staff: County Emergency Management, National Weather Service

Action 2: Increase Amateur Radio Operator Involvement in weather observations

Time Frame: Ongoing
Funding: Unknown
Estimated Cost: Minimal
Staff: HAM Radio Club, County Emergency Management

Action 3: Install more electronic sign boards for alerting public of severe weather condition, especially along the Interstate 80 corridor.

Time Frame: Ongoing
Funding: UDOT
Estimated Cost: Unknown
Staff: Tooele County Emergency Management, Utah Department of Public Safety, UDOT

Wildland Fire

Problem Identification: Severe drought continues to maximize the potential for Urban-Wildland Interface (WUI) fires in areas of southeast Tooele, Little Mountain, South Mountain, Terra, Skull Valley, Dugway Proving Grounds, South Willow Canyon, western Grantsville, Lakepoint and east Erda.

Goal 1 – *Reduce the amount of fuels that can impact residential homes in the WUI areas*

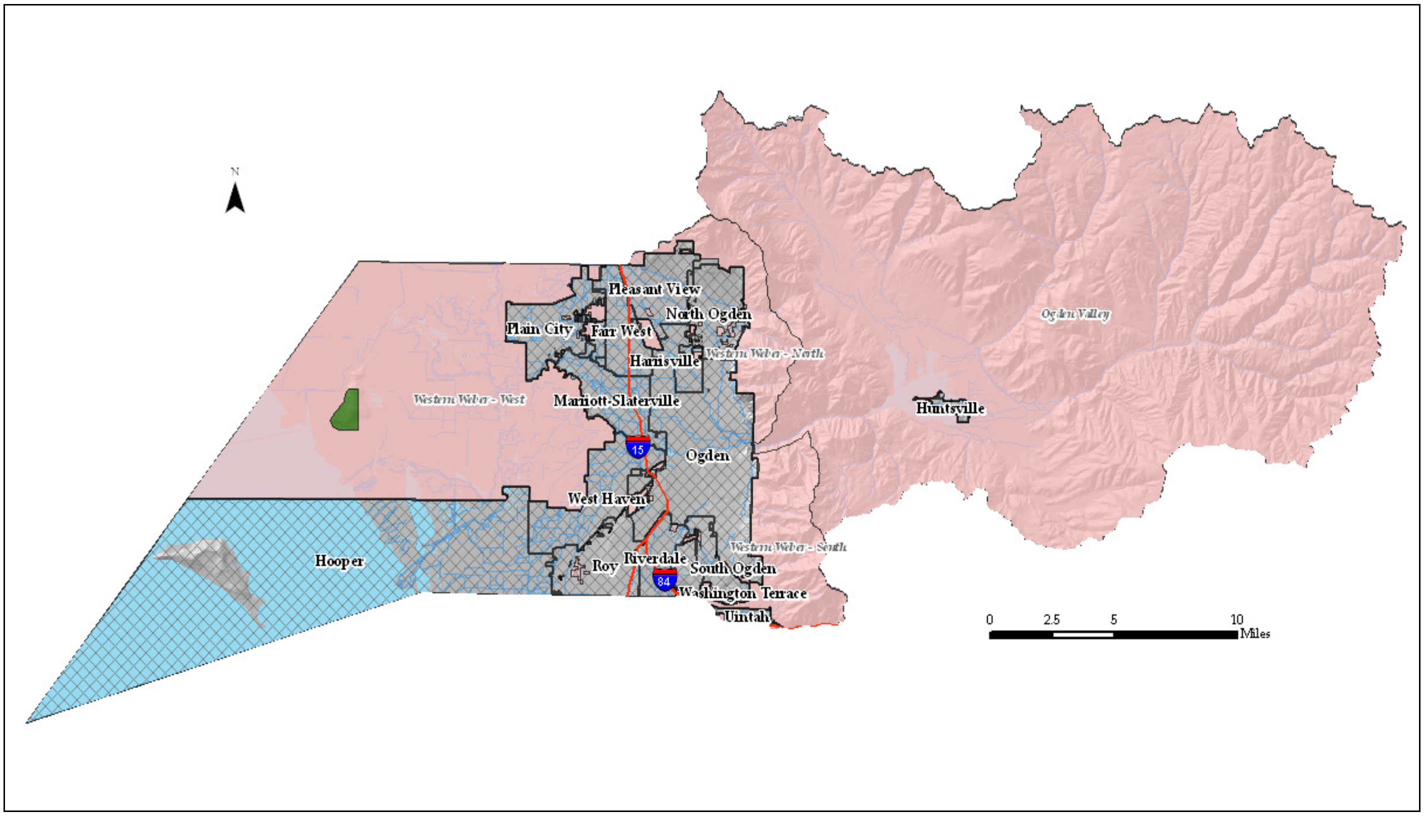
Objective #1 (Priority HIGH): Study these areas to determine which fire resistant natural vegetation can be used.

Action 1:	Develop and distribute outreach documents specific to fire resistant vegetation		
	Time Frame:	Ongoing	
	Funding:	State/County	
	Estimated Cost:	$5,000.00	
	Staff:	County Emergency Management, USFS, UDAF, County Extension Office	

Action 2:	Take action through physical inspection to enforce codes currently in place		
	Time Frame:	Ongoing	
	Funding:	County	
	Estimated Cost:	Undetermined	
	Staff:	County Emergency Management, County/City Fire, County/City Police	

Action 3:	Explain wildfire risk to people seeking building permits and realtors showing homes in risk prone areas, discourage building above 5577 feet above sea level (WUI areas), and provide a copy of the code and outreach documents.		
	Time Frame:	Ongoing	
	Funding:	Local	
	Estimated Cost:	Undetermined	
	Staff:	County/City Fire, County/City Engineering	

Action 4:	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:	Local	
	Estimated Cost:	Minimal	
	Staff:	County GIS, County Emergency Management	



Map 13-1. Weber County

Part XIII. Weber County

Weber County includes fifteen municipalities: Farr West, Harrisville, Hooper, Huntsville, Marriott-Slaterville, North Ogden, Ogden, Plain City, Pleasant View, Riverdale, Roy, South Ogden, Uintah, Washington Terrace and West Haven. Ogden, Utah's sixth largest city, is the county seat for Weber County and a transportation hub for northern Utah. Seven unincorporated communities can also be found in Weber County: Eden, Liberty, Nordic Valley, Taylor, Warren, West Warren and West Weber. Weber County encompasses 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%. Much 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.

Weber County experienced a growth of population of approximately 1.5% per year between 2000 and 2006, 1% below the state average (Utah Population Estimates Committee). Growth appears to be slowing as Weber County grew by only 1% in 2006 primarily due to negative net migration (UPEC 2007). Weber County is projected to almost double in population by the year 2050 (UPEC 2008).

The Weber County job market slowed in the early part of the decade due to a nationwide recession, but now appears to be recovering. The recession of 2008 will likely result in a major economic downturn for the entire region. The 2006 jobless rate was 3.3% for the county, down from a peak of 6.5% in 2003 (UDWS 2006). Unemployment has waned despite increasing population growth rates.

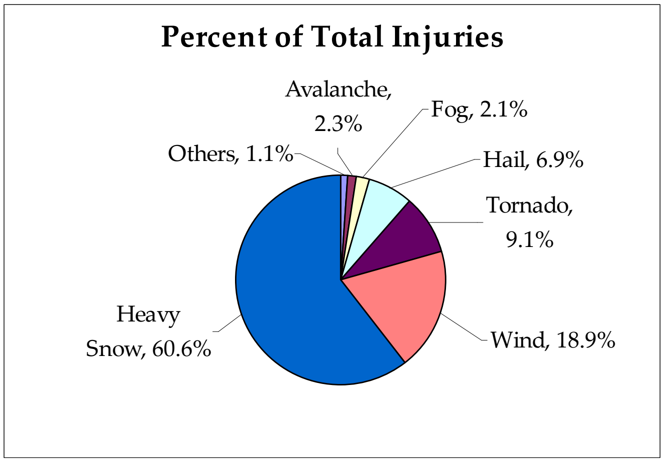
Twenty percent of private sector jobs are in the “goods producing” industry of construction and manufacturing, while eighty percent of all other workers are in the “service industries” of transportation, trade, finances, services and government (UDWS 2006). Per capita income in 2005 was $29,688 and the average monthly non-farm wage for 2005 was $2,474 (UDWS 2006). Weber County’s largest employers are identified in Table 13-1.

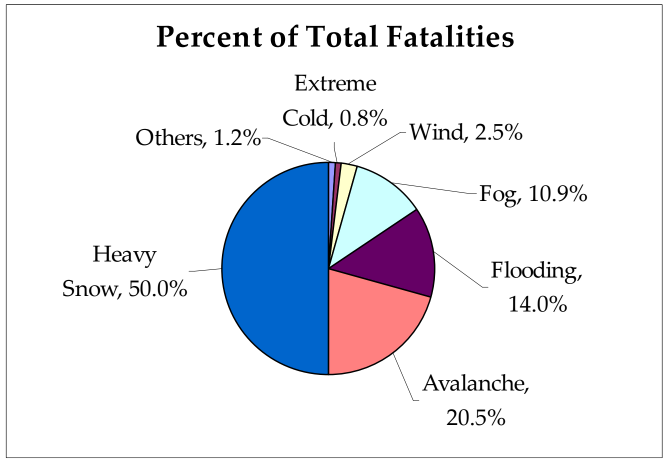
Company	Industry	Employment
Internal Revenue Service	Federal Government	5,000-6,999
Weber School District	Public Education	3,000-3,999
Weber State University	Higher Education	2,000-2,999
Autoliv	Motor Vehicle Equipment	2,000-2,999
McKay-Dee Hospital Center	Health Care	2,000-2,999
Fresenius USA Mfg. Inc.	Medical Instrument Manufacturing	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

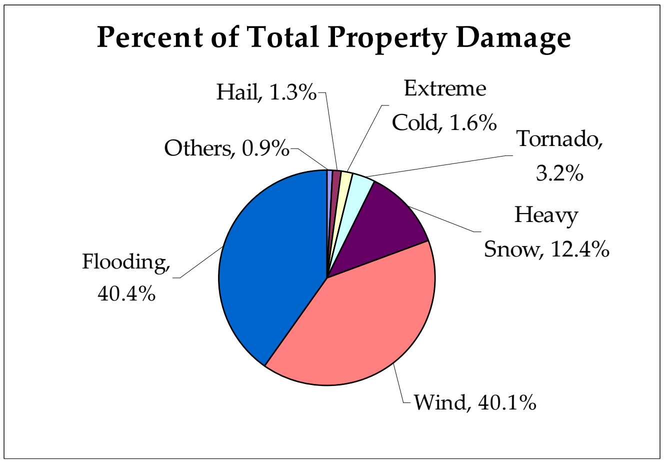
Table 13-1. Largest Employers, Weber County (UDWS 2006)

Hazard History

Identifying past hazard events provides a starting point for predicting where future events could potentially occur. The following historical hazard event statistics were consolidated from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) of the Hazards and Vulnerability Research Institute. This database records reported natural hazard events which cause greater than $50,000 in damages. Monetary figures are in 2005 dollars (Figures 13-1 and 13-2).







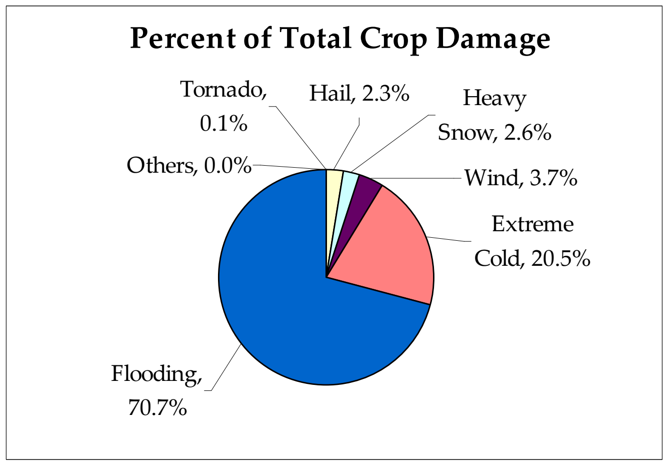


Figure 13-1. Major Disaster Event Averages 1962-2005, Weber County (HVRI 2007)

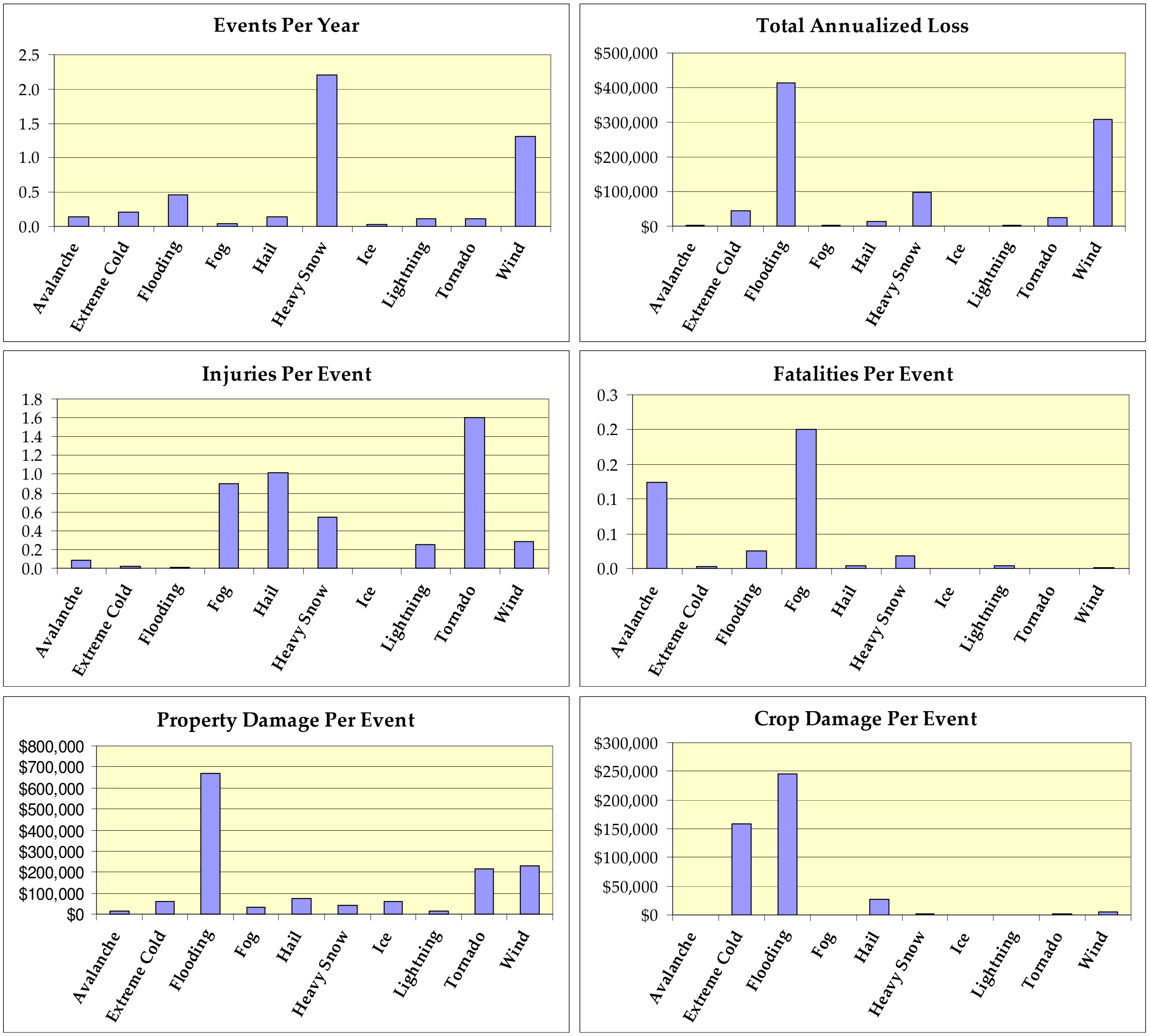


Figure 13-2. Major Disaster Average Annual and Per Event Statistics 1962-2005, Weber County (HVRI 2007)

Risk Assessment

The risk assessment process revealed the following for Dam Failure, Earthquake, Flood, Landslide/Slope Failure, Liquefaction, and Wildland Fire. Drought, Infestation, Radon and Severe Weather are considered to be regional hazards and can be found in Part VIII. Refer to Part VII for an explanation of the risk assessment methodology. According to this data, there are a total of 140 identified critical facilities within Weber County. For the complete list refer to Appendix D.

Number of Structures with Moderate or Greater Vulnerability (% of Total)								
Critical Facilities	**Total**	***Dam Failure***	***Flood***	***Earthquake***	***Liquefaction***	***Problem Soils***	***Slope Failure***	***Wildfire***
Amateur Radio Repeaters	**4**	0 (0%)	0 (0%)	4 (100%)	1 (25%)	0 (0%)	4 (100%)	0 (0%)
Public Safety Repeaters	**10**	0 (0%)	0 (0%)	10 (100%)	0 (0%)	0 (0%)	0 (0%)	5 (50%)
Electric Generation Facilities	**3**	3 (100%)	3 (100%)	3 (100%)	1 (33%)	3 (100%)	3 (100%)	3 (100%)
Emergency Operations Centers	**22**	8 (36%)	6 (27%)	22 (100%)	8 (36%)	8 (36%)	1 (1%)	0 (0%)
Fire Stations	**20**	6 (29%)	0 (0%)	20 (100%)	12 (60%)	0 (0%)	0(0%)	0 (0%)
Hospitals	**2**	0 (0%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (%)
Police Stations	**10**	3 (50%)	6 (36%)	10 (100%)	6 (36%)	6 (36%)	0 (0%)	0 (0%)
Schools	**68**	13 (19%)	8 (12%)	68 (100%)	40 (59%)	10 (15%)	3 (1%)	2 (1%)
Water Treatment Facilities	**2**	2 (100%)	2 (100%)	2 (100%)	1 (50%)	2 (100%)	0 (50%)	1 (50%)

Table 13-2. Critical Facilities Vulnerability Matrix for Local Hazards, Weber County NA=Not Applicable

1. Earthquake

Hazard Profile

Potential Magnitude	X	*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	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.				
Seasonal Pattern	There is no seasonal pattern for earthquakes. They can occur at any time of the year or day during any or all weather conditions.				
Conditions	Liquefaction potential within high ground water table areas. Soil that is comprised of old lakebed sediments.				
Duration	Actual ground shaking will be under one minute, aftershocks can occur for weeks or even months.				
Secondary Hazards	Fire, landslide, rock falls, avalanche, flooding, hazmat spills, building collapse, loss of utilities				
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, DHLS, AGRC.				

Description of Location and Extent

In northern Utah, the Wasatch Fault Zone is an active fault zone that can produce a large 7.3-75 Richter magnitude earthquake on average every 300-400 years. The Weber Segment of the Wasatch Fault Zone includes the area along the eastern edge of the valley between North Salt Lake and 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 (UGS 2002). The Weber segment of the Wasatch Fault could potentially 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 along the Cache fault produced a 5.7 Richter magnitude earthquake. Others include a 6.0 earthquake in the Pocatello Valley along the Hansel Valley Fault in 1975, another on the same fault in 1934 with a magnitude of 6.6, and yet another in 1909 with a 6.0 magnitude. For locations of all earthquakes centered within Weber County since 1962, see Map 13-2 (page 286).

One of the better measures of earthquake destruction potential is spectral acceleration. 0.2 spectral acceleration represents the frequency at which the most potential damage can occur in one- and two-story buildings, while 1.0 spectral acceleration represents the frequency at which taller buildings potentially will see greater damage. Maps 13-3 (page 287) and 13-4 (page 288) respectively show 0.2 and 1.0 spectral acceleration for a 2500-year event in Weber County. The potential forces exerted on buildings are shown as a percentage of the force of gravity with 100% equaling one times the force of gravity.

Western Weber County is located atop the ancient Lake Bonneville lake bed, 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 this portion of the county than the surrounding areas. For a further explanation of liquefaction, see Map 13-5 (page 289). See also the regional hazard identification section for further explanation of liquefaction.

Name	Fault Type	Length (km)	Time of Most Recent Deformation	Recurrence Interval
Bear River Range faults	Normal	63 km	1320-3420 years ago	1,000-100,000 years
East Great Salt Lake fault, Fremont Island section	Normal	103 km	2939-3385 years ago	4,200 years
Ogden Valley fault, Northeastern Marginal section	Normal	13 km	< 1,600,000 years ago	Unknown
Ogden Valley fault, North Fork section	Normal	26 km	< 750,000 years ago	Unknown
Ogden Valley fault, Southwestern Marginal section	Normal	18 km	< 750,000 years ago	Unknown
Wasatch fault, Brigham City section	Normal	37 km	2100±800 cal yr B.P	1300 years
Wasatch fault, Weber section	Normal	56 km	950±450 cal yr B.P.	1400 years

Table 13-3. Weber County Quaternary Faults (UGS 2002, Lund 2005) cal yr B.P. = calendar years before present

Vulnerability Assessment

Vulnerability to earthquake in Weber County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH)**. The following numbers were based on a probabilistic 2500-year event with a Richter magnitude of 7.1 as well as an arbitrary 5.9 event located in close proximity to the county's most populated areas. These locations and magnitudes were chosen for their likelihood and proximity respectively. Default HAZUS-MH inventory for all infrastructure was used. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH MR2, please see Part VI or the HAZUS-MH Technical Manual (Earthquake Model) at www.fema.gov/hazus*).

Building Damage

HAZUS-MH classifies building damage into five levels: none, slight, moderate, extensive and complete. Table 13-4 lists the number of buildings by occupancy estimated to sustain moderate to complete levels of damage. Also listed are the estimated monetary losses to structures, contents/inventory, and income.

Category	Number of Structures with > 50% Damage		Category	Estimated Losses	
	Weber M5.9	2500-yr M7.1		Weber M5.9	2500-yr M7.1
Residential	9,628	36,944	Structural Losses	$121,246,000	$606,962,750
Commercial	402	921	Non-Structural Losses	$427,644,000	$2,131,644,450
Industrial	94	233	Content Losses	$160,762,000	$683,297,620
Government	36	78	Inventory Losses	$5,829,000	$30,625,560
Education	15	35	Income and Relocation Losses	$134,323,000	$537,906,150
Totals	**10,175**	**38,211**	**Totals**	**$849,804,000**	**$3,990,436,530**

Table 13-4. Building Damage Counts and Estimated Losses

Transportation and Utilities Damage

Damages to transportation and utility infrastructure are in Table 13-5. Infrastructure sustaining moderate or worse damage and estimated monetary losses are both shown.

Category	Total	At Least Moderate Damage >50%		Estimated Losses	
		Weber M5.9	2500-yr M7.1	Weber M5.9	2500-yr M7.1
Waste Water Facilities	2	1	2	$18,503,000	$62,682,000
Waste Water Pipelines	1,561 km	248 leaks/breaks	4,095 leaks/breaks	$888,000	$14,740,000
Potable Water Facilities	1	0	1	$1,460,000	$11,423,000
Potable Water Pipelines	2,601 km	312 leaks/breaks	5,177 leaks/breaks	$1,123,000	$18,637,000
Natural Gas Pipelines	1,040 km	264 leaks/breaks	4,377 leaks/breaks	$950,000	$15,757,000
Electrical Power Facilities	1	0	1	$1,401,000	$28,244,000
Communication Facilities	12	4	10	$110,000	$398,000
Highway Bridges	141	17	100	$6,188,000	$52,408,000
Railway Bridges	5	0	3	$7,000	$161,000
Railway Facilities	1	1	1	$597,000	$1,043,000
Bus Facilities	2	1	2	$587,000	$1,055,000
Airport Facilities	1	0	1	$1,262,000	$2,637,000
Total Losses				**$33,076,000**	**$209,185,000**

Table 13-5. Damage to Transportation and Utilities

Debris Removal

Table 13-6 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 at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	Weber M5.9	2500-yr M7.1
Brick, Wood & Others	145,000 tons / 5,800 loads	654,000 tons / 26,160 loads
Concrete & Steel	287,000 tons / 11,480 loads	1,401,000 tons / 56,040 loads

Table 13-6. Debris Generated/Number of Loads

Earthquake Caused Fires

Multiple ignitions and broken water mains following an earthquake can make firefighting nearly impossible. HAZUS-MH uses estimated building damages, loss of transportation infrastructure and predictable winds to calculate the estimated area that would be burned following an earthquake. Table 13-7 provides estimates of ignitions, people at risk and the building stock exposed to fires following an earthquake.

Category	Number of Structures	
	Weber M5.9	2500-yr M7.1
Ignitions	11	14
Persons Exposed	146	239
Value Exposed	$7,290,000	$14,462,000

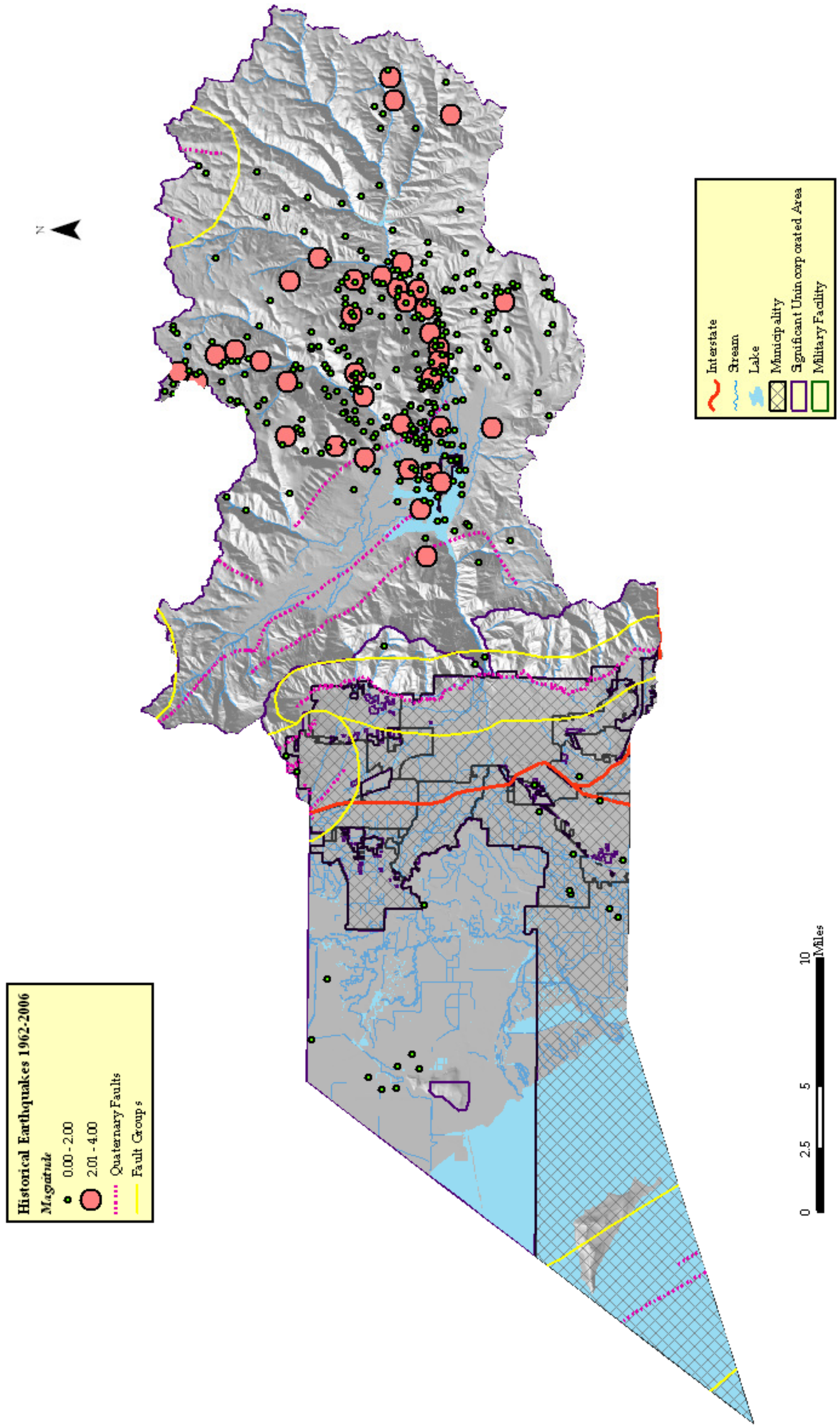
Table 13-7. Fire Following Event, Population Exposed, and Building Stock Exposed

Casualties

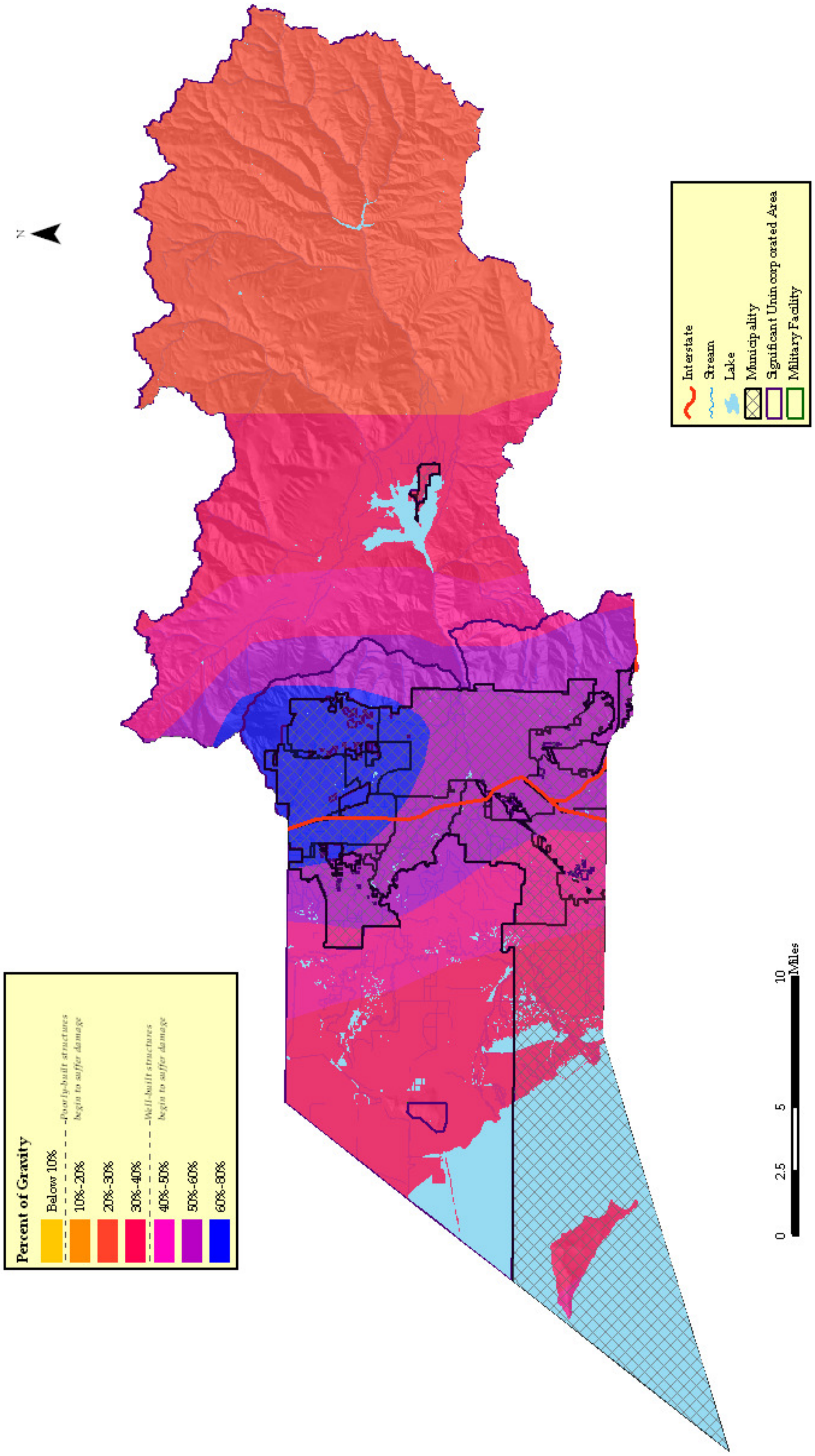
Table 13-8 estimates casualties likely to occur during each earthquake scenario. The nighttime scenario (2 a.m. local time) assumes a primarily residential concentration of persons, the daytime scenario (2 p.m. local time) a commercial concentration, and the commute scenario (5 pm. Local time) a concentration of persons on commuting routes. Categories of casualties include those not requiring hospitalization (minor), those requiring treatment at a medical facility (major), and fatalities.

Night Event	Weber M5.9	2500-yr M7.1	Day Event	Weber M5.9	2500-yr M7.1	Commute Event	Weber M5.9	2500-yr M7.1
Minor	294	2,076	**Minor**	434	2,797	**Minor**	349	2,313
Major	67	636	**Major**	119	996	**Major**	93	793
Fatalities	14	150	**Fatalities**	29	276	**Fatalities**	22	210

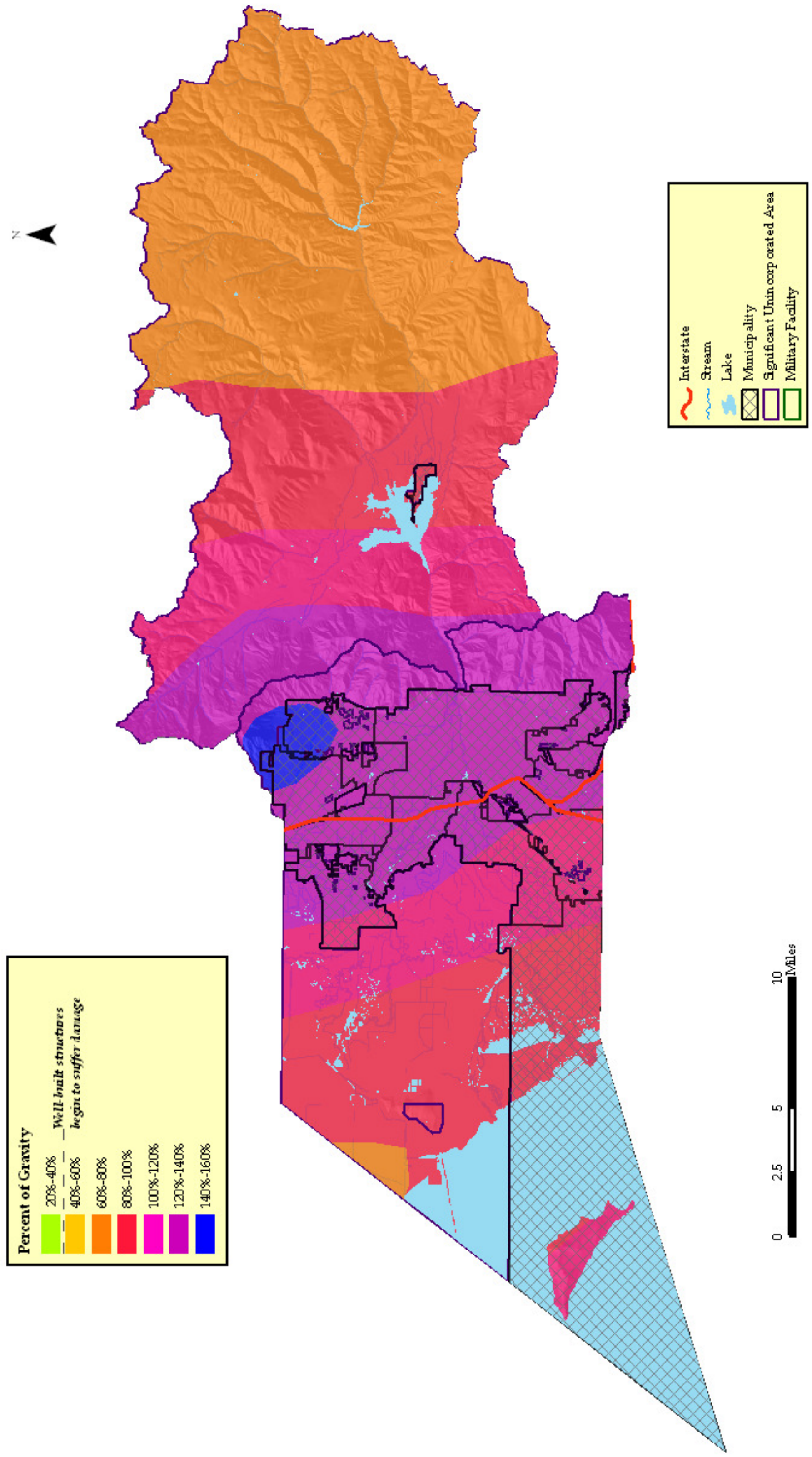
Table 13-8. Casualties



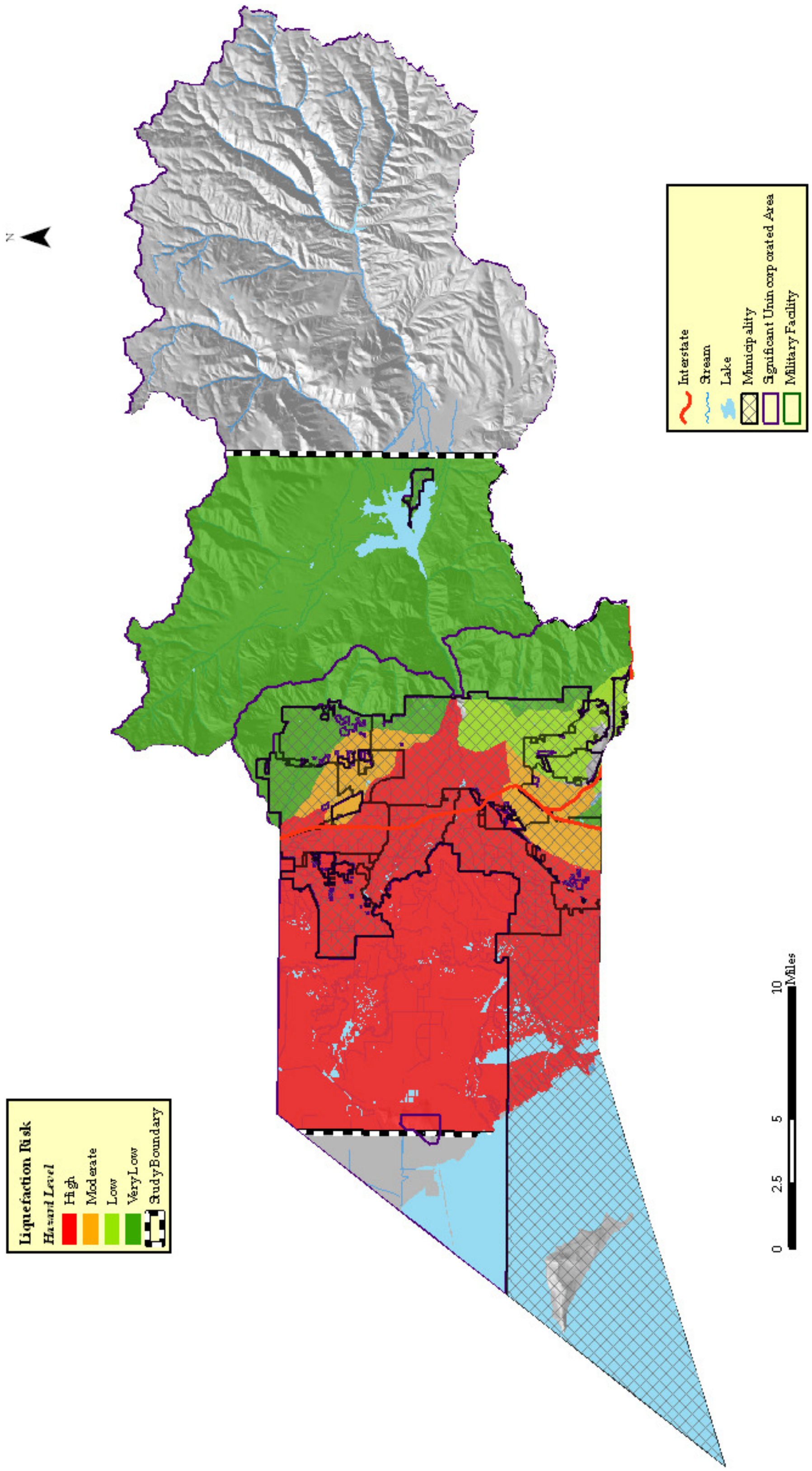
Map 13-2. Historical Weber County Earthquakes, 1962-2006 (UUSS 2007)



Map 12-3. 0.2 Spectral Acceleration, Weber County (NSHMP 2002)



Map 13-4. 1.0 Spectral Acceleration, Weber County (NSHMP 2002)



Map 13-5. Liquefaction Probability (Christenson and Shaw 2008)

2. Flood

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
		Critical (25-50%)		X	*Likely*
	X	*Limited (10-25%)*			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Alluvial fans, Great Salt Lake				
Frequency	Spring, Late Summer				
Conditions	Cloudburst Storms, extended wet periods				
Duration	Flooding can last anywhere from hours to days and even months.				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of FIRM, debris flow maps				

Description of Location and Extent

The greatest flood risk in Weber County is associated with long duration storms. A significant rain event on top of a heavy snowpack could also potentially cause localized flooding. Cloudburst storms generally result in flash flooding in localized areas. North Ogden has experienced flash flood events in the past fifteen years. Rapid snowmelt is another significant flood threat that results in unusually high runoff. Sheet flooding has occurred several times in the Upper Valley areas around Eden and Liberty.

The areas of greatest flood potential are within western Weber County, Ogden, and the Weber River in Uintah as well as in the flatlands in the western part of the County. The Weber and Ogden Rivers can experience flooding. However the dams on these rivers upstream help to mitigate the flood threat. Other smaller creeks that can create flood problems within the county include North Fork Ogden River, South Fork Ogden River, Taylor Canyon Creek, Wolf Creek, Sheep 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 2000). The Warren area could experience flooding on agricultural lands and homes from the failure of the West Dike of the Weber River between 4700 West and 1100 South. In the past businesses and roads were damaged from flooding between 1990 West and 1300 South near SR89 in the West Haven area.

Three irrigation canals in Weber County affect the flood threat: the Ogden-Brigham Canal, the Weber-Davis Canal and the Willard Canal. The Weber-Davis Canal breached in 1999 and flooded over 70 homes in Riverdale. This event was declared as a city, county, and state disaster. The Ogden-Brigham Canal breached in 1979, due to a rockslide. Since 1853, the County experienced over 360 flash floods and more than 170 snow melt floods. The Willard Canal has the potential to cause considerable damage should it breach.

Vulnerability Assessment

Vulnerability to flooding in Weber County was obtained from the modeling program Hazards United States – Multihazards (HAZUS-MH)**. Vulnerability was assessed for both 100-year (NFIP Zone A) and 500-year (NFIP Zone B or Zone X (shaded)) flood events.

Analysis was completed using Digital Flood Insurance Rate Maps (DFIRM). Only streams which contained detailed flood cross-section data could be used. Flooding from the Great Salt Lake was also not included. Consequently, the results should be considered conservative. Total monetary losses include structures, contents and business interruption. (***For a more detailed explanation of the loss estimation methodology of HAZUS-MH, please see Part VII or the <u>HAZUS-MH Technical Manual (Flood Model)</u> at www.fema.gov/hazus).*

	Acres Flooded	Population Displaced	Number of Structures in Floodplain	
			Residential Units (Total Losses)	Commercial/Industrial Units (Total Losses)
100-year Flood	845	1,789	378 $27,530,000	7 $30,570,000
500-year Flood	1,695	1,966	407 $35,440,000	7 $43,800,000

Table 13-9. Weber County Flood Hazard

Agricultural Losses

Agricultural losses are listed in Table 13-10. Losses are computed according to the number of days in which the crops are inundated with water. All numbers are estimated for a flood occurring near April 15th.

	100-year Losses Day 3	100-year Losses Day 7	500-year Losses Day 3	500-year Losses Day 7
Barley	$2,862	$3,815	$2,906	$3,875
Corn Silage	$30,110	$40,146	$27,769	$37,026

Table 13-10. Agricultural Losses, June 15th Scenario

Vehicle Losses

Table 13-11 contains losses for vehicles in floods during both daytime and nighttime scenarios. The scenarios assume ninety percent (90%) of vehicles being removed from hazard areas due to warning.

Category	100-year	500-year
Daytime Scenario	$1,311,774	$2,552,740
Nighttime Scenario	$1,955,096	$2,592,086

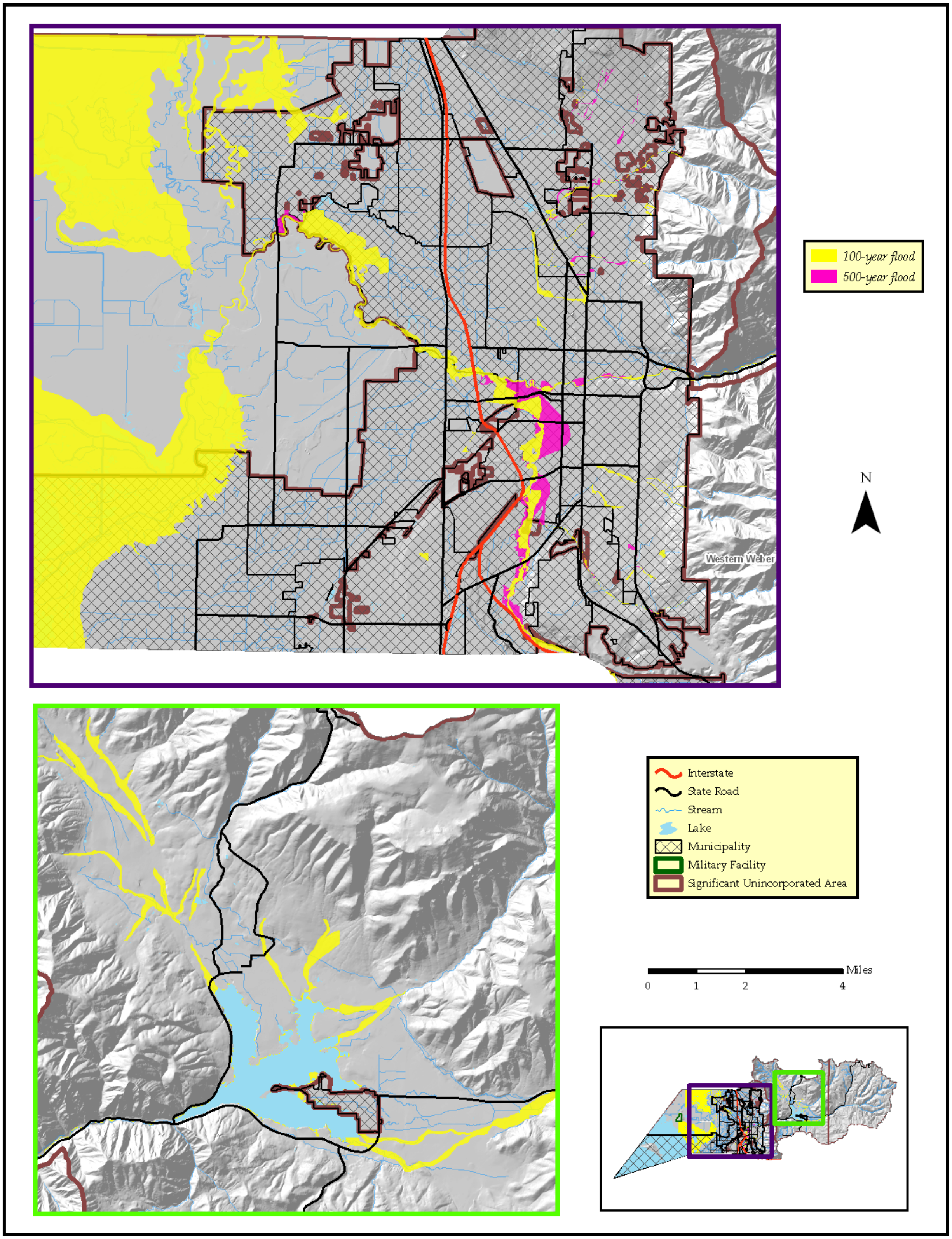
Table 13-11. Vehicle Losses

Debris Removal

Table 13-12 shows how much debris would be generated by flooding and how many loads it would take to remove the debris, based on a capacity of 25 tons per load. One truck can likely haul one load per hour. A second debris removal issue is landfill space. Fifty thousand tons at a weight-to-volume ratio of one ton per cubic yard would cover more than ten acres to a depth of three feet.

Category	100-year	500-year
Finishes	3,280 tons/132 loads	3,982 tons/160 loads
Structures	1,477 tons/60 loads	1,759 tons/ 71 loads
Foundations	1,813 tons/73 loads	2,041 tons/82 loads
Totals	**6,570 tons/265 loads**	**7,782 tons/313 loads**

Table 13-12. Debris Generation and Removal



Map 13-6. 100-year and 500 year Floodplains, Weber County (FIMA 2005)

3. Wildland Fire

Hazard Profile

Potential Magnitude		*Catastrophic (>50%)*	*Probability*		*Highly Likely*
	X	*Critical (25-50%)*		X	*Likely*
		Limited (10-25%)			*Possible*
		Negligible (< 10%)			*Unlikely*
Location	Wildland-urban interface (WUI) areas the foothills and in forested areas (See Map 13-7)				
Seasonal Pattern	Summer months.				
Conditions	Areas affected by drought, heavily overgrown, or with 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.				
Secondary Hazards	Landslides, debris flows, erosion, traffic accidents, air pollution				
Analysis Used	Review of plans and data provided by US Forest Service, National Climate Center, FEMA, AGRC, County Hazard Analysis Plans, and DHLS				

Description of Location and Extent

Potential wildfire hazard within Weber County is growing as population growth is spreading into wildland areas known as the Wildland-Urban Interface (WUI). Over the past 30 years urban sprawl has encroached upon forested foothill areas and wildland areas. A wildfire in these areas would threaten life and property. According to the County Emergency Operations Plan, the upper valley of Weber County will average one lightning caused fire approximately every 80-100 years. However, humans have increased wildfire threat to one every 8-10 years. Fire personnel respond to an average of 50 fires in the wildland areas every year; 20% of which are caused by lightning 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 on the mountain, which are more difficult to fight due to steep mountain terrain.

Large numbers of homes/structures make the wildfire threat within the county 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, Pleasant View, Wolf Creek, Powder Mountain, Maple Canyon, South Fork, and Snow Basin.

Vulnerability Assessment

Table 13-13 (next page) estimates infrastructure vulnerable to wildland fire in Weber County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 13-14 estimates the total area, population and buildings vulnerable to wildland fire for individual cities and unincorporated areas.

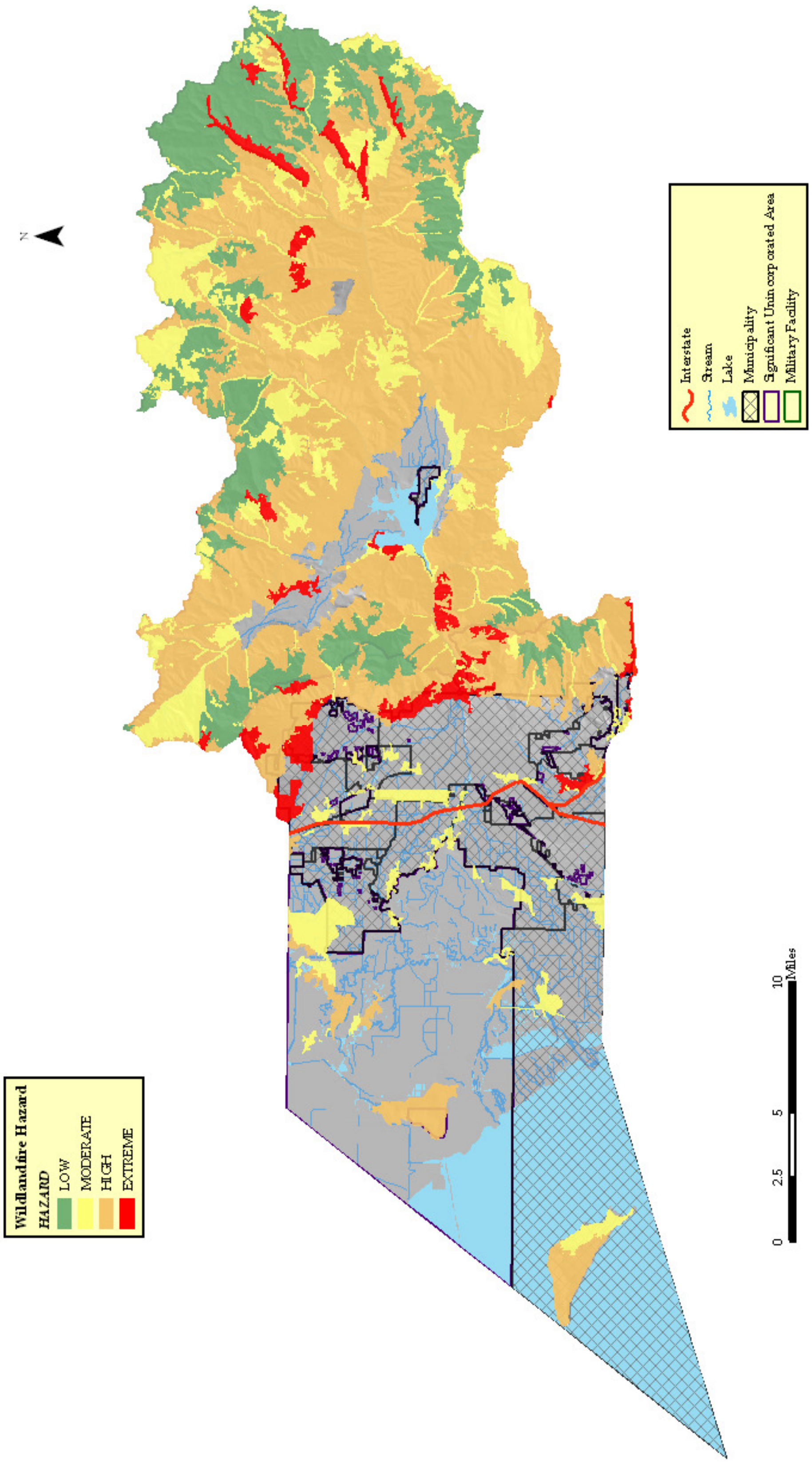
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	153.80 miles	$787,196,250
Highway Bridges	141 bridges	$1,845,264,307
Railway Segments	106.27 miles	$122,081,686
Railway Bridges	5 bridges	$884,940
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$2,755,427,183**

TabTable 13-13. Infrastructure Vulnerable to Wildland Fire, Weber County

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Farr West	129	18	24 $3,547,600	5 $24,691,975
Harrisville	368	187	169 $48,012,600	14 $15,189,309
Hooper	174	129	47 $14,873,800	0 0$
Huntsville	0	0	0 $0	0 $0
Marriot-Slaterville	0	0	0 $0	0 $0
North Ogden	1,326	818	435 $95,782,600	9 $3,262,461
Ogden	1,618	1,150	684 $150,033,600	29 $13,113,043
Plain City	45	0	0 $0	0 $0
Pleasant View	1,445	170	188 $47,938,800	3 $1,252,280
Riverdale	462	43	14 $3,524,800	5 $3,511,241
Roy	0	0	0 $0	0 $0
South Ogden	22	0	0 $0	0 $0
Uintah	80	56	168 $58,693,200	0 $0
Washington Terrace	316	160	50 $15,416,000	3 $1,425,273
West Haven	25	0	0 $0	0 $0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Little Mountain Test Annex	781	0	0 $0	0 $0
Ogden Valley	207,682	610	1,250 $436,026,600	34 $21,451,812
Western Weber	9,869	509	159 $47,136,600	5 $2,849,781

Table 13 14. Vulnerability Assessment for Wildland Fire, Weber County



Map 13-7. Wildland Fire Hazard, Weber County (UDFFSL 2007)

4. Slope Failure

Hazard Profile

<table>
<tr><td rowspan="4">Potential Magnitude</td><td></td><td>Catastrophic (>50%)</td><td rowspan="4">Probability</td><td></td><td>Highly Likely</td></tr>
<tr><td></td><td>Critical (25-50%)</td><td>X</td><td>Likely</td></tr>
<tr><td>X</td><td>Limited (10-25%)</td><td></td><td>Possible</td></tr>
<tr><td></td><td>Negligible (< 10%)</td><td></td><td>Unlikely</td></tr>
<tr><td>Location</td><td colspan="5">Generally occur in canyon mouths and foothill areas (See Map 13-8)</td></tr>
<tr><td>Seasonal Pattern</td><td colspan="5">Spring and summer; after heavy or long-duration precipitation</td></tr>
<tr><td>Conditions</td><td colspan="5">Usually caused by the stress release of over-weighted soils, shallow groundwater in certain soils or loosening of rock and debris</td></tr>
<tr><td>Duration</td><td colspan="5">Generally last hours or days, but some can last for longer periods</td></tr>
<tr><td>Secondary Hazards</td><td colspan="5">Flooding (natural dams), traffic accidents</td></tr>
<tr><td>Analysis Used</td><td colspan="5">Information and maps provided by UGS, DHLS, AGRC</td></tr>
</table>

Description of Location and Extent

Future landslide areas are usually located near the areas of historical landslides, which are well-defined localized areas. Historically, landslides have been one of the most frequent hazards within Weber County. Homes high along the benches and in the canyons are at the greatest risk of rockfalls, debris flows, landslides and other types of slope failure. Refer to Map 13-8, page 299.

Historic 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 have also occurred in Ogden Canyon between the mouth and Pineview Dam and over North Ogden Pass as well.

East of Plain City and Harrisville there is evidence of lateral spread of more than 2,000 feet. The north-central portion of the county shows evidence of slumps, earth flows and other deep-seated landslides. Extending north to south in the central portion of the county are smaller (less than 2000 ft) lateral spread landslides. The eastern portion of the county exhibits rockfall, colluvial, talus, glacial and soil-creep landslides larger than 2000 ft.

There are three prominent rockslide areas in the county and many smaller areas. The North Ogden rockslide is 100 acres in size and is one mile northwest of the mouth of North Ogden Canyon. The College rockslide is about 80 acres in size and is located east of the Weber State University campus. The Beus Canyon 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. Potential rockslide hazards exist north of Taylor Canyon.

Debris flows and mudslides are possible near the mouth of Weber Canyon west to Riverdale, which could impact railroads, utilities, storm drainage lines, and residential property. Past landslides have 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.

Vulnerability Assessment

Table 13-15 (below) estimates infrastructure vulnerable to landslides in Weber County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 13-16 estimates the total area, population, and buildings vulnerable to landslides.

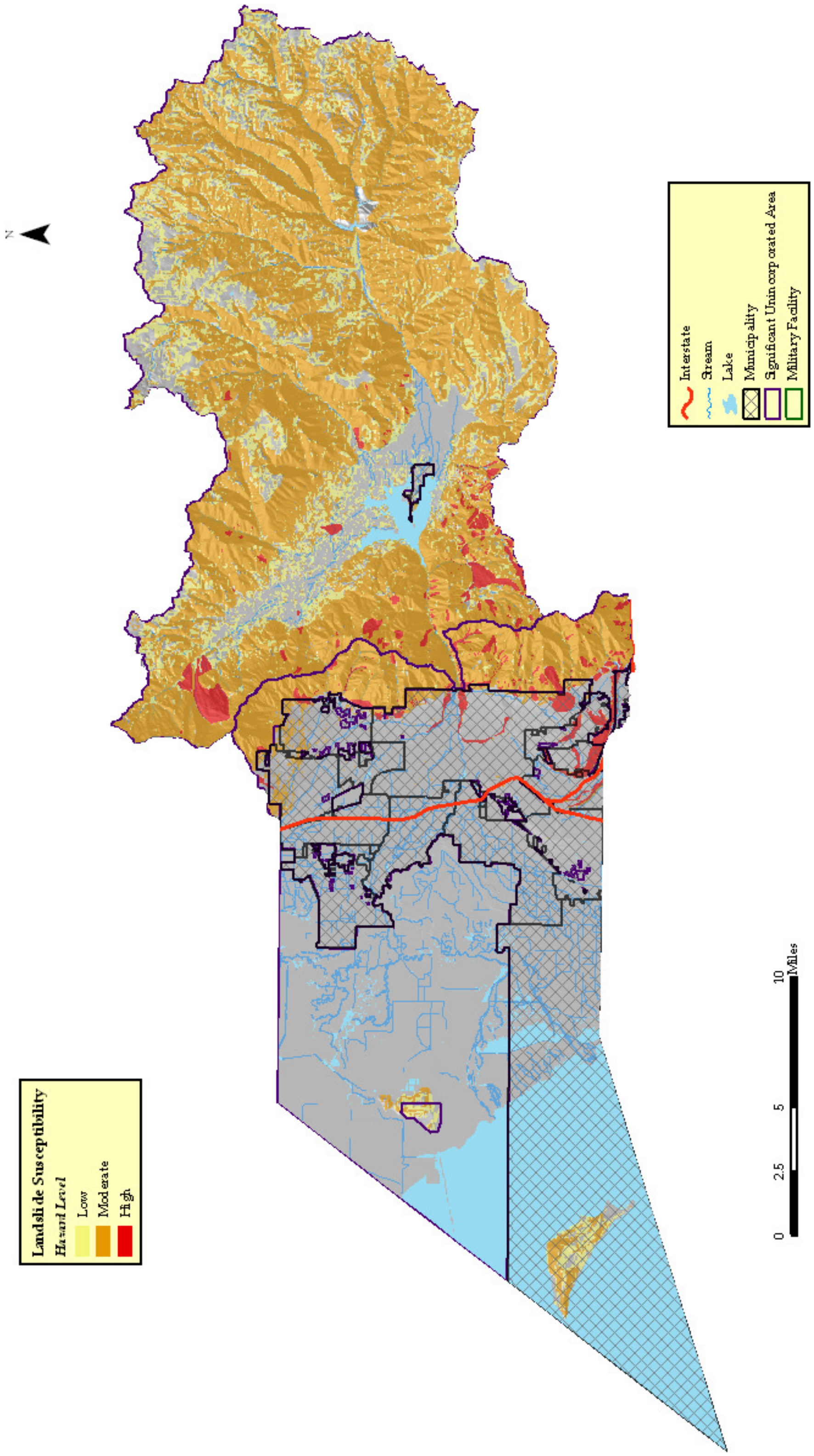
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	36.85 miles	$173,291,730
Highway Bridges	13 bridges	$6,752,222
Railway Segments	9.44 miles	$10,846,560
Railway Bridges	0 bridges	$0
Water Distribution Lines	503.25 miles	$16,196,665
Gas Lines	201.32 miles	$6,478,679
Sewer Lines	301.92 miles	$9,718,041
Total Estimated Infrastructure Replacement Cost		**$223,283,897**

Table 13-15. Infrastructure Vulnerable to Landslide, Weber County

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Farr West	0	0	0 $0	0 $0
Harrisville	0	0	0 $0	0 $0
Hooper	0	0	0 $0	0 $0
Huntsville	14	20	5 $727,000	0 0$
Marriot-Slaterville	0	0	0 $0	0 $0
North Ogden	857	6,147	1,744 $253,577,600	7 $1,400,682
Ogden	2,458	13,630	4,856 $706,062,400	3,568 $1,855,498,277
Plain City	0	0	0 $0	0 $0
Pleasant View	683	2,043	500 $72,700,000	4 $1,418,263
Riverdale	466	2,119	826 $120,100,400	33 $25,727,502
Roy	16	131	51 $7,415,400	1 $12,489
South Ogden	535	4,347	1,702 $247,470,800	31 $10,945,604
Uintah	110	2,085	830 $120,682,000	4 $822,853
Washington Terrace	481	3,606	1,444 $209,957,600	18 $2,666,940
West Haven	0	0	0 $0	0 $0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Little Mountain Test Annex	143	0	0 $0	0 $0
Ogden Valley - East	68,579	408	116 $16,866,400	5 $905,219
Ogden Valley - West	70,003	5,995	1,842 $267,826,800	22 $4,209,746
Western Weber - North	0	0	0 $0	0 $0
Western Weber - South	0	0	0 $0	0 $0
Western Weber - West	0	0	0 $0	0 $0

Table 13-16. Vulnerability Assessment for Landslides, Weber County



Map 13-8. Landslide Susceptibility, Weber County (Giraud and Shaw 2007)

5. Dam Failure

Hazard Profile

Potential Magnitude	X	***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
		Limited (10-25%)		X	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See Map 13-9 (page 305)				
Frequency	*Rainy Day Failure:* Spring, Late Summer *Sunny Day Failure:* Anytime				
Conditions	*Rainy-day failure* happens mainly during heavy precipitation events, can have some warning time. *Sunny day failure* happens with no warning at all and can happen at anytime.				
Duration	Hours - Days				
Secondary Hazards	Raw sewage/health risk, electrical fires, gas spills				
Analysis Used	Review of Bureau of Reclamation inundation maps and plans, Flood Insurance Studies, Utah Division of Water Rights				

Description of Location and Extent

Seven dams are designated as high hazard within Weber County, meaning if they fail they have a high probability of causing loss of life and extensive economic loss. Twenty-one dams are listed as being moderate (low probability of causing loss of life; appreciable property damage) (Table 13-17).

The dam safety hazard is classified by the State Engineer. This classification is based upon the damage caused if the dam were to fail, not the dam's probability of failure. Therefore, the classification of a high hazard dam does not mean that the dam has a high probability of failure.

Other dams outside the County boundaries that could also affect Weber County include: Echo Dam, located between Morgan and Park City; 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 has a capacity greater than 215,000 acre-feet of water. A catastrophic breach of the reservoir could flood much of the northwestern portion of Weber County.

NAME	RATING
BOR WASTEWAY RESERVOIR NO. 2	Moderate
BOR WASTEWAY RESERVOIR NO. 3	Moderate
FOURMILE DEBRIS BASIN-HARRISVILLE DAM	Moderate
GRAND LEGACY IRRIGATION RESERVOIR	Moderate
HOOPER IRRIGATION COMPANY	Moderate
KELLY CANYON	Moderate
NORTH OGDEN CITY COLDWATER CANYON	Moderate
NORTH OGDEN CITY OAK LAWN PARK	Moderate
OGDEN CITY BEUS POND	Moderate
PINEVIEW DETENTION BASIN	Moderate
PLEASANT VIEW RESERVOIR (WEBER/BE #6)	Moderate
SOURDOUGH WILDERNESS RANCH	Moderate
UTABA RETARDING	Moderate
WEBER/BOXELDER RESERVOIR #4	Moderate
WEBER/BOXELDER RESERVOIR #5	Moderate
WEBER/BOXELDER RESERVOIR #7	Moderate
WEBER/BOXELDER RESERVOIR #8	Moderate
WEBER-BOX ELDER CONSERVATION DISTRICT	Moderate
WOLF CREEK IRRIGATION CO. 99-35-72MD	Moderate
WOLF CREEK IRRIGATION COMPANY	Moderate
WOLF CREEK WATER CONSERVANCY DISTRICT	Moderate
BOR CAUSEY	High
BOR COMBE EQUALIZING RESERVOIR	High
BOR PINEVIEW	High
NORTH OGDEN CITY ORTON PARK/2100 NORTH	High
OGDEN CITY - SULLIVAN HOLLOW	High
SOUTH OGDEN CITY BURCH CREEK (GLASMANN)	High
SOUTH OGDEN CITY BURCH CREEK DEBRIS	High

Table 13-17. Inventory of High and Moderate Hazard Dams (Utah Division of Water Rights 2007)

Vulnerability Assessment

Table 13-18 (page 303) estimates the total area, population and buildings vulnerable to dam failure for individual cities and Table 13-19 examines the same for unincorporated areas. Table 13-20 estimates infrastructure vulnerable to dam failure in Weber County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Editors Note: These estimates include a catastrophic failure of the Bureau of Reclamation Dams. Specific dam failure data was not available when this plan was developed and will be added in subsequent plan updates.

Incorporated Areas	Acres Affected	Population Affected	Structures in Inundation Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Farr West	2,000	4,800	0 $0	0 $0
Harrisville	640	1,500	0 $0	0 $0
Hooper	4,800	2,000	0 $0	0 $0
Huntsville	320	250	0 $0	0 $0
Marriot-Slaterville	4,000	0	0 $0	0 $0
North Ogden	109	583	184 $26,753,600	17 $20,253,156
Ogden	1,285	10,000	654 $95,091,600	229 $136,063,049
Plain City	4,000	8,000	0 $0	0 $0
Pleasant View	0	0	0 $0	0 $0
Riverdale	1,800	4,500	20 $2,908,000	2 $1,111,176
Roy	0	0	0 $0	0 $0
South Ogden	38	251	96 $13,958,400	1 $530,390
Uintah	640	800	0 $0	0 $0
Washington Terrace	0	0	0 $0	0 $0
West Haven	1,800	1,500	0 $0	0 $0

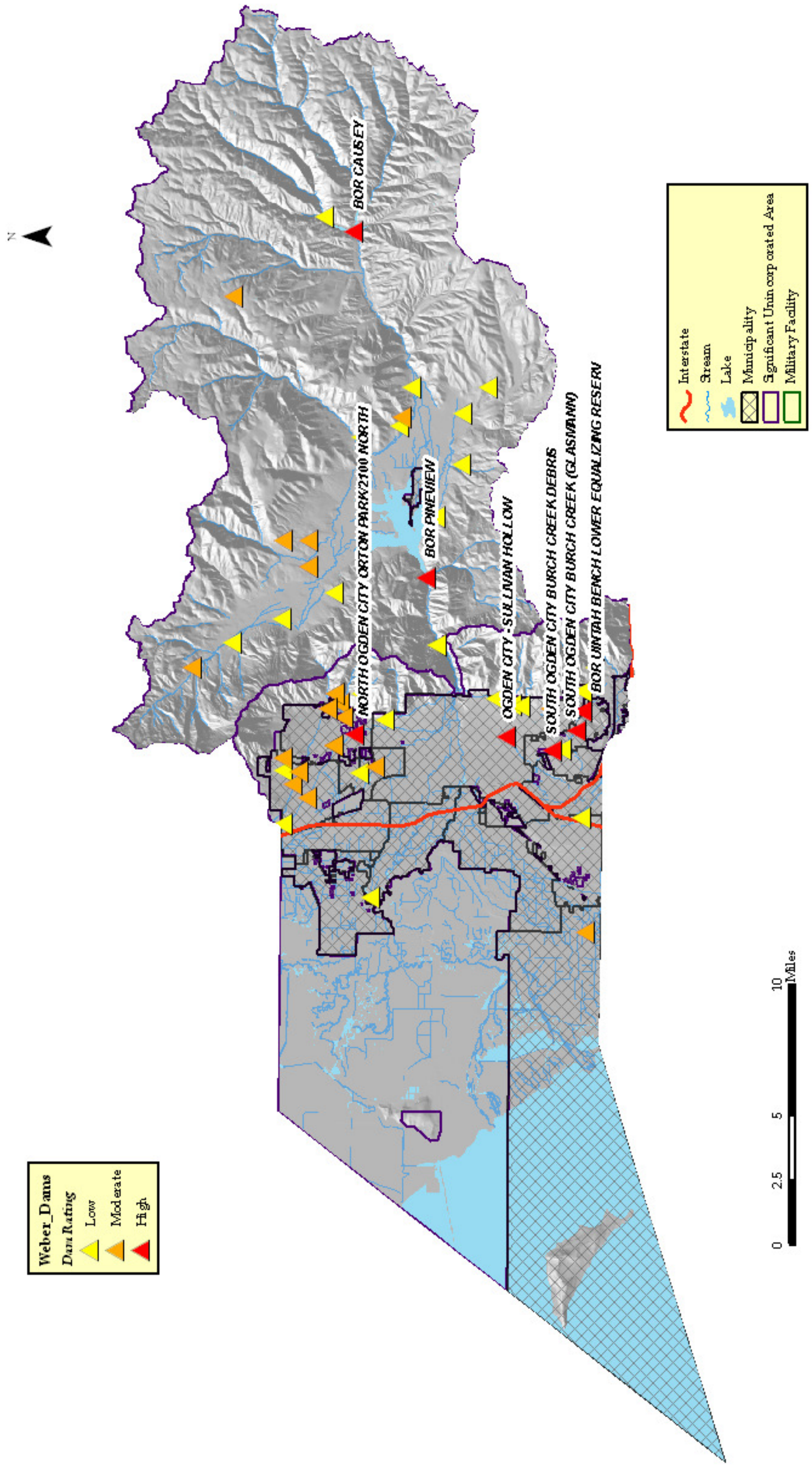
Table 13-18. Vulnerability Assessment for Dam Failure, Incorporated Weber County

Unincorporated Areas	Acres Affected	Population Affected	Structures in Inundation Areas	
			Residential (Replacement Value)	Commercial (Annual Sales)
Little Mountain Test Annex	0	0	0 0$	0 $0
Ogden Valley	5,400	950	0 0$	0 $0
Western Weber - South	1,200	104	37 $5,379,800	0 $0
Western Weber - West	36,000	3,500	0 0$	0 $0

Table 13-19. Vulnerability Assessment for Dam Failure, Unincorporated Weber County

Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	1.71 miles	$7,367,592
Highway Bridges	0 bridges	$0
Railway Segments	1.93 miles	$2,219,238
Railway Facilities	0 bridges	$0
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total Estimated Infrastructure Replacement Cost		**$9,586,830**

Table 13-20. Infrastructure Vulnerable to Dam Failure, Weber County



Map 13-9. Dams and Associated Risk Levels, Weber County (Utah Division of Water Rights 2007)

6. Problem Soils

Hazard Profile

Potential Magnitude		***Catastrophic (>50%)***	***Probability***		***Highly Likely***
		Critical (25-50%)			***Likely***
	X	***Limited (10-25%)***		*X*	***Possible***
		Negligible (< 10%)			***Unlikely***
Location	See Map 13-10 (page 308)				
Frequency	Continuous				
Conditions	Conditions vary by geologic formation				
Duration	Minutes to Years				
Secondary Hazards	Flooding (broken water pipes), fire (broken gas pipes)				
Analysis Used	Utah Geological Survey				

Description of Location and Extent

Two types of problems soils are present in Weber County – limestone and expansive soils. Both of these hazards are primarily found in the Wasatch Mountains in the eastern part of the County. See Map 13-10 (page 308) for more information on the locations of problem soils in Weber County.

Limestone karst structures are easily eroded by water and therefore often form caverns and crevices. If these caverns become large enough, the overlying ground can give way causing sink holes and other forms of subsidence. Structures directly over the karst structure have a high potential for collapse. Ground water contamination is also possible (Mulvey 1992). Developed areas of Ogden Canyon may present some evidence of karst hazard. Expansive soils can absorb significant quantities of water. When a home or road is placed on top of these soils, normal evaporation cannot take place. The clay begins to absorb more water than is evaporated and begins to expand, causing heaving. During especially dry periods, these soils can contract significantly causing subsidence and ground cracking. Residents already living in these areas should avoid excessive watering, make sure sufficient water drainage is in place around the home and ensure plumbing and irrigation pipes and fixtures are well protected from breakage or leaks (Kaliser 1972). Developments around Pineview Reservoir and northern Ogden Valley may experience some drainage problems, subsidence and/or landslides.

Vulnerability Assessment

Table 13-21 (page 307) estimates infrastructure vulnerable to problem soils in Weber County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software. Table 13-22 estimates the total area, population, and buildings vulnerable to problem soils for individual cities and unincorporated areas.

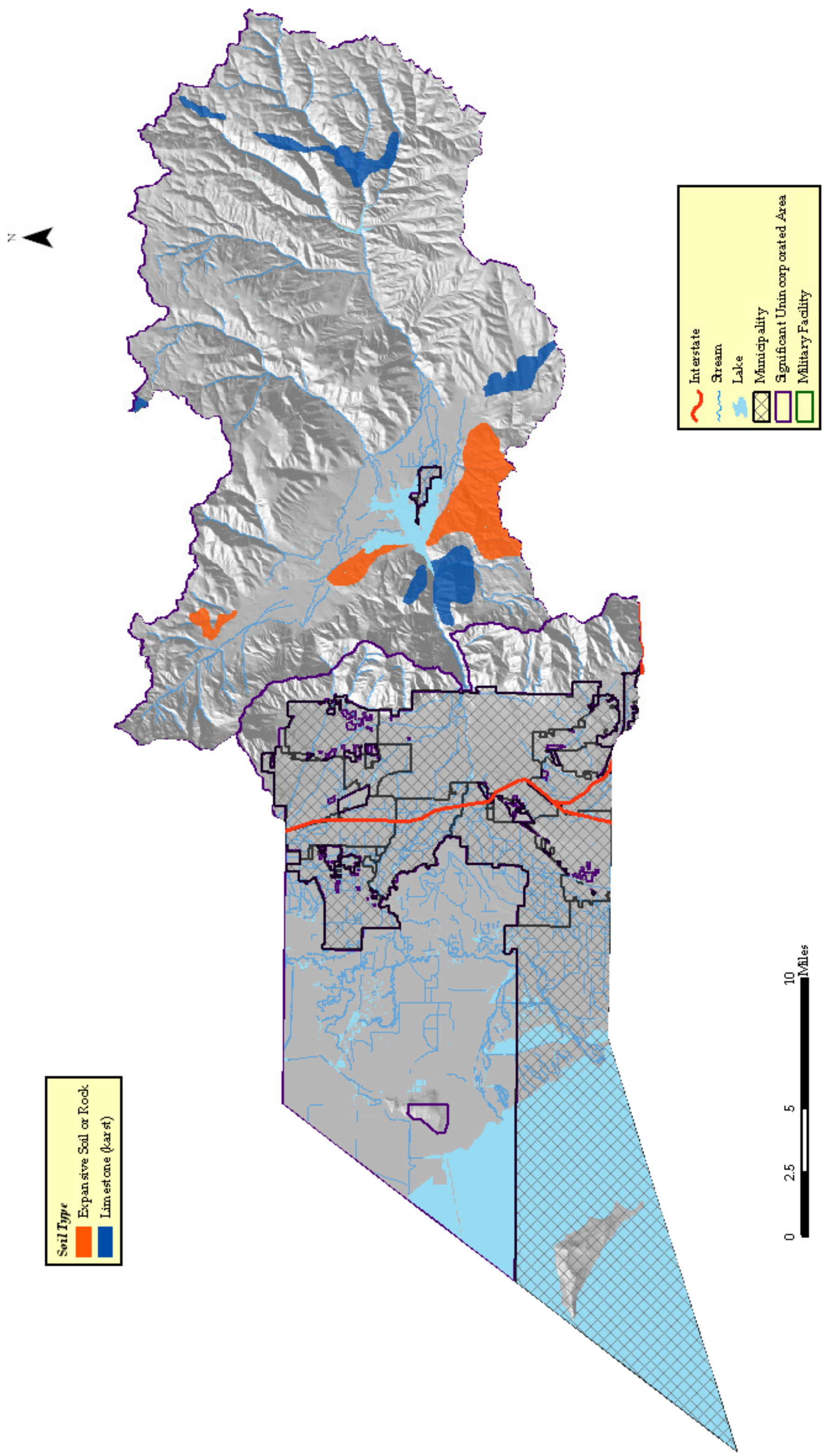
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	9.28 miles	$39,945,034
Highway Bridges	1 bridge	$476,756
Railway Segments	0 miles	$0
Railway Facilities	0 bridges	$0
Water Distribution Lines	35.91 miles	$1,155,825
Gas Lines	14.36 miles	$462,331
Sewer Lines	21.55 miles	$693,499
Total Estimated Infrastructure Replacement Cost		$42,733,445

Table 13-21. Infrastructure Vulnerable to Problem Soils, Weber County

Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Farr West	0	0	0	0
Harrisville	0	0	0	0
Hooper	0	0	0	0
Huntsville	0	0	0	0
Marriot-Slaterville	0	0	0	0
North Ogden	0	0	0	0
Ogden	0	0	0	0
Plain City	0	0	0	0
Pleasant View	0	0	0	0
Riverdale	0	0	0	0
Roy	0	0	0	0
South Ogden	0	0	0	0
Uintah	0	0	0	0
Washington Terrace	0	0	0	0
West Haven	0	0	0	0

Unincorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	*Commercial* (Annual Sales)
Little Mountain Test Annex	0	0	0	0
Ogden Valley	36,208	0	0	0
Western Weber	0	0	0	0

Table 13-22. Vulnerability Assessment for Problem Soils, Weber County



Map 13-10. Problem Soils Hazard, Weber County (Mulvey 1992)

Hazards and Future Development

Population Estimates									
County	**2000 Pop (July 1)**	**2006 Pop (est.)**	**Absolute Change 2000-2006**	**% Change 2000-2006**	**AARC 2000-2006**	**Rank by 2000 Pop**	**Rank by Absolute Change**	**Rank by % Change**	**Rank by AARC**
Weber County	197,541	215,870	18,329	9.3%	1.3%	4	5	14	13
Population by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	941,172	1,104,356	1,389,252	1,665,238	1,966,372	2,207,282	2,429,057	2,654,682	1.3%
Weber County	145,000	158,673	197,541	230,145	271,339	306,227	338,579	371,429	1.3%
Households by County and Multi-County District									
MCD/ County	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**AARC 2000-2050**
Wasatch Front	298,700	357,257	446,844	565,333	679,589	780,369	870,671	960,756	1.5%
Weber County	50,501	57,851	66,082	80,279	99,428	119,489	140,478	163,561	16.4%

Table 13-23. Demographic and Economic Projections (UPEC 2007, 2008) All statistics are based on July 1. AARC = Average Annual Rate of Change

Some Weber County development has recently slowed, with many new developments stalled. Development that is still occurring is found in the foothills and on agricultural lands. The Wasatch Mountain Range and the Great Salt Lake restrain development in the eastern and western reaches of Weber County.

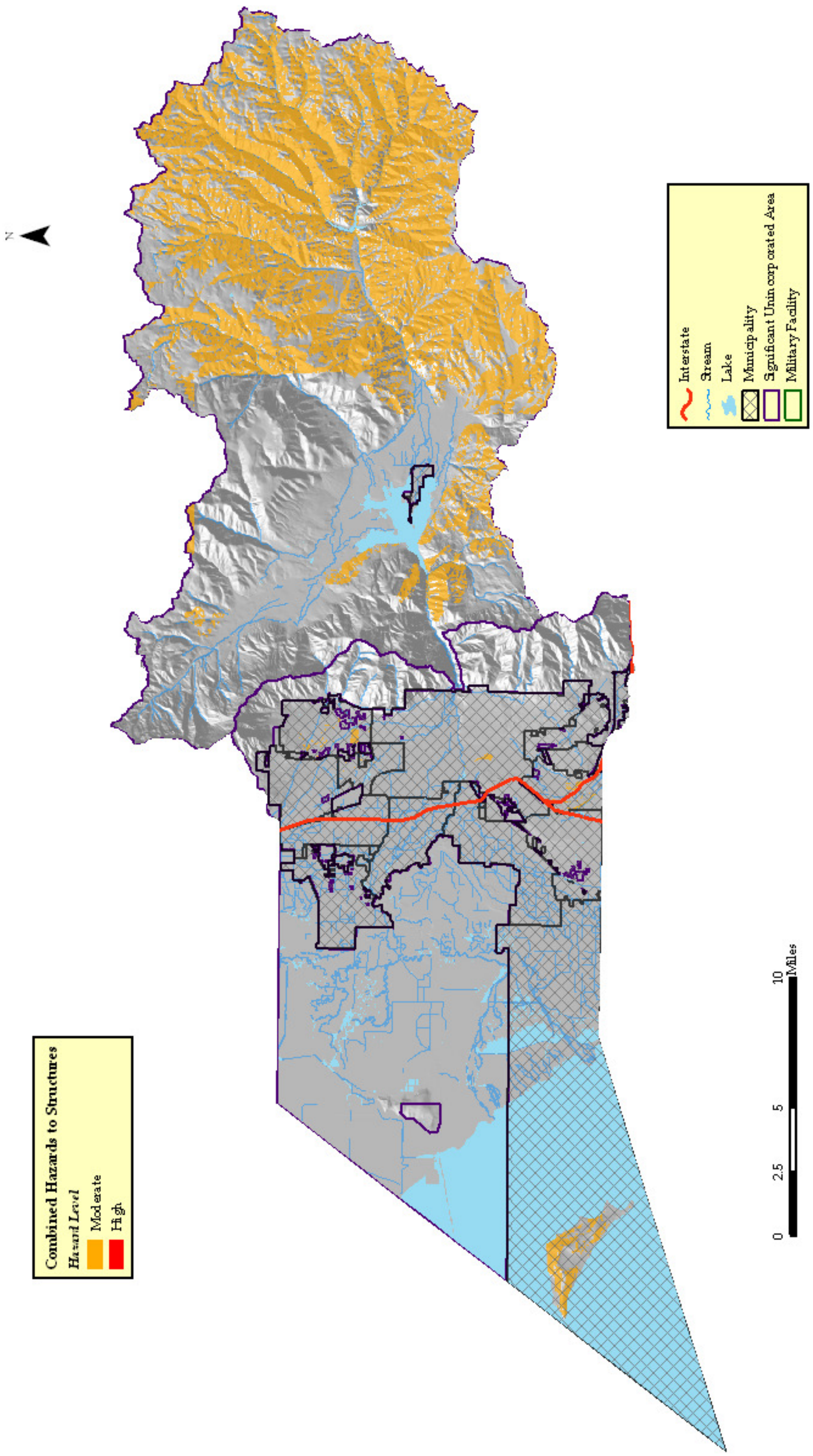
Those portions of the County that are near the Great Salt Lake are subject to high liquefaction in the event of an earthquake and therefore pose a risk to residents and structures. The County and municipalities can mitigate the earthquake threat and its secondary risks through the continued use of zoning ordinances and building codes. Examples of appropriate forms of land use along fault lines include “farms, golf courses, parks, and undeveloped open space” (UGS 1996).

Flooding is also of considerable concern along the Weber River. Zoning restrictions on building location and building codes preventing basements would be well-suited in these areas.

Wildfire risk is most severe in the foothills of the Wasatch Mountain Range. These areas, known as Wildland-Urban Interface (WUI) zones, are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. This threat may be mitigated by encouraging communities to become “Fire Wise Communities”, continued use of building and zoning codes and increasing the public’s awareness.

Landslide/slope failure is another threat near the foothills of the Wasatch Mountains. Much new development can be found near areas of current landslides. More detailed landslide studies and zoning appropriate for high hazard areas will decrease the likelihood of landslides damaging persons and property.

Map 13-11 shows the combined risk of nine structurally-threatening hazards (dam failure, earthquake, flood, landslide, lightning, problem soils, tornado, wildland fire and wind) in Weber County. The areas of high hazard (red) are areas of high landslide and flood risk as well as the "extreme" risk wildland fire areas. These areas are best preserved as open space to protect citizens from almost certain disasters. The moderate areas of the map (orange) are those areas having moderate or greater risk from five (5) or more structurally-threatening hazards. These areas should be preserved as open space if not already developed or hazard-appropriate development encouraged. If already developed, these areas should be the initial focus of education campaigns and for regulatory requirements of hazard mitigation techniques by residents.



Map 13-11. Combined Structural Hazards, Weber County

Mitigation Strategies

The following mitigation strategies were formulated by the Weber County Mitigation Strategies Working Group on September 18th, 2007, at the Weber County Sheriff's Office. The Working Group sought to refine and expand on efforts already in place from the 2003 edition of this Plan. Information on Working Group members can be found in Part III.

Dam Failure

Problem Identification: The failure of federal, state and private dams can impact Weber County. Debris basins of concern include Birch Creek, Glassman Way and Harrison Blvd.

OBJECTIVE #1 (Priority MEDIUM): Reduce the impact of catastrophic flooding due to dam failure

Action 1: Re-evaluate current high hazard dams and evaluate use of early warning sirens to warn public.

Time Frame: Ongoing
Funding: Local and State
Estimated Cost: Unknown
Staff: County Emergency Management
Jurisdictions: Countywide

Action 2: Identify and fund dams needing armored concrete chutes.

Time Frame: Unknown; based on funding
Funding: Local and State
Estimated Cost: Unknown
Staff: Stormwater Management, County Engineer, State Engineer
Jurisdictions: Countywide

Action 3: In partnership with the U. S. Bureau of Reclamation (BOR), develop accurate dam failure inundation maps for BOR dams.

Time Frame: Unknown, based on funding
Funding: Local, state and federal
Estimated Cost: Unknown
Staff: County Emergency Management, State, BOR
Jurisdictions: Countywide

Earthquake

Problem Identification: Non-structural hazards in the Weber County schools are a threat to students, employees, and facilities while also causing increases in recovery time/activities following an earthquake.

Objective #1 (Priority HIGH): Reduce the impact of non-structural events following an earthquake

Action 1: Develop and implement a manual similar to Salt Lake City (SLC) school districts

Time Frame:	Immediate
Funding:	School Districts, State Earthquake Program Grant
Estimated Cost:	Minimal if using SLC School District template
Staff:	School Districts, County Emergency Management
Jurisdictions:	Countywide

Action 2: Develop a training document for schoolteachers showing non-structural mitigation activities for classrooms

Time Frame:	Ongoing
Funding:	County Emergency Services, State Earthquake Program
Estimated Cost:	Minimal
Staff:	County Emergency Services, School District
Jurisdictions:	Countywide

<u>Problem Identification:</u> Critical facilities (public safety, utilities, water/wastewater, schools, hospitals), need to be made less vulnerable from the impacts of earthquakes to allow for a more timely and efficient response and recovery.

Objective #2 (Priority HIGH): Reduce the vulnerability of critical facilities

Action 1: Develop an earthquake vulnerability study for identified critical facilities, including schools, public safety facilities, hospitals and utilities.

Time Frame:	5-10 years
Funding:	Pre-Disaster Mitigation Grant
Estimated Cost:	Unknown
Staff:	Local Emergency Planning Committee (LEPC)
Jurisdictions:	Countywide

Action 2: Study hazardous materials Tier 2 sites for possible seismic retrofit

Time Frame:	2 years
Funding:	Federal grants
Estimated Cost:	Unknown
Staff:	LEPC
Jurisdictions:	Countywide

Action 3: Complete vulnerability analysis and develop mitigation plan for Weber Basin Water Conservancy District (WBWCD) facilities.

Time Frame:	2 years
Funding:	PDM grant and WBWCD funds
Estimated Cost:	$300,000
Staff:	WBWCD staff
Jurisdiction:	WBWCD and U. S. Bureau of Reclamation

<u>Problem Identification:</u> Areas of high liquefaction (western Weber county: Hooper, Far West, West Warren, West Haven, Marriott-Slaterville, Plain City) are experiencing increased growth.

Objective #3 (Priority HIGH): Increased awareness of high liquefaction areas

Action: Include current liquefaction maps on the County website

Time Frame:	Within 1 year
Funding:	County Emergency Services, County Engineer
Estimated Cost:	Minimal
Staff:	County Emergency Services, County Engineer, GIS and Web
Jurisdictions:	Jurisdictions with potential for liquefaction

<u>Problem Identification:</u> Development on identified fault traces increases the risk to life and property.

Objective #4 (Priority HIGH): Promote natural hazards ordinance limiting development in high-risk areas

Action: Make available copies of county natural hazards ordinance for cities within the county and educate citizens on its implementation

Time Frame:	Within 1 year
Funding:	County Emergency Services, County Engineer
Estimated Cost:	Minimal
Staff:	County Emergency Services and County Engineer
Jurisdictions:	Countywide

Flood

<u>Problem Identification:</u> Some communities not participating in the National Flood Insurance Program (NFIP).

Objective #1 (Priority MEDIUM): Make federal flood insurance available within communities and adopt flood loss prevention ordinances.

Action: Encourage the communities of Hooper, Farr West, Marriott-Slaterville, Washington Terrace and Huntsville to participate in the NFIP.

Time Frame: Ongoing
Funding: None required
Estimated Cost: Minimal
Staff: State Floodplain Manager, City Officials, Building Officials
Jurisdictions: Washington Terrace, Huntsville

<u>Problem Identification:</u> Stormwater continues to be a critical flood issue in the county. Stormwater drains are illegally connected to the sewer system in many areas.

Objective #2 (Priority HIGH): Implement and fund identified stormwater projects to lessen impact of flooding in the county.

Action 1: Include current stormwater plans and projects in hazard mitigation plan

Time Frame: Ongoing
Funding: Project specific; funding from County, Stormwater, State and Federal Programs
Estimated Cost: Dependant on project
Staff: County Stormwater, County Engineer, Stormwater Coalition
Jurisdictions: Countywide

Action 2: Reduce stormwater infiltration into sewer system

Time Frame: 2-3 years
Funding: City/County funds, Stormwater
Estimated Cost: Minimal
Staff: Central Weser Sewer
Jurisdictions: Countywide

Action 3: Update Regional Stormwater Management Plan

Time Frame: Spring 2008
Funding: Weber County Stormwater monies
Estimated Cost: Unknown
Staff: County Engineer, City Stormwater Managers
Jurisdictions: Countywide

<u>Problem Identification:</u> Weber County has an extensive canal system. A canal breach or overtopping has occurred and possible future occurrences continue to be a significant flood threat.

Objective #3 (Priority HIGH): Evaluate canals in the county that may cause flooding

Action 1: Identify canals in the county that have the potential to cause damage due to flooding

Time Frame: Two years
Funding: County Emergency Management, State Mitigation Program Grant
Estimated Cost: Dependant on scope of study
Staff: County Stormwater, County Engineer
Jurisdictions: Countywide, Special Service Districts

Action 2: Identify areas of stormwater entering canals

Time Frame: Ongoing
Funding: County Emergency Management, water districts
Estimated Cost: Unknown
Staff: County Stormwater, County Engineer, County Emergency Management
Jurisdictions: Countywide

Action 3: Create sub-committee under Stormwater Coalition to handle canal flooding issues

Time Frame: November 2009
Funding: Stormwater Coalition
Estimated Cost: Minimal
Staff: Stormwater Coalition
Jurisdictions: Countywide

<u>Problem Identification:</u> Several infrastructure additions and upgrades are needed to mitigate the flood threat.

Objective #4 (Priority HIGH): Add/upgrade mitigation infrastructure

Action 1: Levee needed on Lower Weber River

Time Frame: 3-5 years
Funding: Federal and State grants; Local match
Estimated Cost: Unknown
Staff: County Engineer
Jurisdictions: Countywide

Action 2: Bridge widening needed on Ogden River at Washington and Lincoln Boulevards

Time Frame: 3-5 years
Funding: Federal and State grants; Local match
Estimated Cost: Unknown
Staff: Ogden City
Jurisdictions: Ogden City

Action 3: Mitigate flooding on hot springs/sloughs

Time Frame: 3-5 years
Funding: Local funds
Estimated Cost: Unknown
Staff: County Engineer
Jurisdictions: Countywide

Severe Weather

Problem Identification: Most disaster declarations are generated from weather related incidents. Weber County continues to be impacted by snowstorms, hail, thunderstorms/lightning, tornadoes, heavy rain and avalanche.

Objective #1 (Priority MEDIUM): Reduce impact to life and property from severe weather related incidents

Action 1: Establish and support countywide National Weather Service (NWS) StormReady program

Time Frame: Two years
Funding: County Emergency Management
Estimated Cost: Dependant on scope of study
Staff: County Emergency Management, NWS Salt Lake City Forecast Office
Jurisdictions: Countywide

Action 2: Identify areas of avalanche risk. Develop and post signs for avalanche danger

Time Frame: Ongoing
Funding: County Emergency Management, County/City Planners, County/City Engineers, Road Dept/Public Works
Estimated Cost: Minimal, for signs and placement of signs
Staff: County/City Engineers, Road Department/Public Works
Jurisdictions: Countywide

Slope Failure

Problem Identification: **Weber County has a significant number of landslide hazard areas.**

Objective #1 (Priority HIGH): Re-evaluate current county landslide map

Action: Update current landslide map and supporting data

Time Frame: Unknown; based on funding
Funding: Local and State
Estimated Cost: Unknown

Staff: County/City Engineering
Jurisdictions: Countywide

Objective #2 (Priority HIGH): Develop a county landslide pre-stabilization ordinance for landslide areas in the Norwood Tuff soils area of the Ogden Valley 6:1 or steeper.

Action: Require land stabilization engineered design for properties subject to slope failure in identified risk areas.

Time Frame: Ongoing
Funding: County, Property Owners,
Estimated Cost: Unknown
Staff: County Engineer, Engineering Consultants, UGS
Jurisdictions: Jurisdictions prone to landslide hazard

Objective #3 (Priority LOW): Reduce risks from debris flow hazard

Action 1: Add debris basins to master plans

Time Frame: January 2008
Funding: Local
Estimated Cost: Minimal
Staff: County Engineering, County Emergency Services
Jurisdictions: Countywide

Action 2: Educate cities on debris basins

Time Frame: 1-2 years
Funding: Local
Estimated Cost: Minimal
Staff: County Engineering, County Emergency Services
Jurisdictions: Countywide

Objective #4 (Priority HIGH): Evaluate hazards to the Weber Aqueduct and develop a long-term mitigation plan.

Action: Develop long-term mitigation plan.

Time Frame: 2-3 years
Funding: WBWCD, PDM grant, U.S. Bureau of Reclamation
Estimated Costs: Unknown
Staff: WBWCD
Jurisdiction: WBWCD

Wildland Fire

<u>Problem Identification:</u> The Wildland-Urban Interface (WUI) continues to be of concern in the Uintah Highlands, Wolf Creek, North Ogden and several areas in Ogden Valley.

Objective #1 (Priority MEDIUM): Reduce potential impact to life and property in WUI areas

Action 1: Develop and implement a strong land use ordinance that addresses fuel reduction in areas at risk from fire.

Time Frame:	Ongoing
Funding:	County/City Emergency Management, Planning and Zoning, County/City Attorneys, Public Officials
Estimated Cost:	Minimal
Staff:	County/City Emergency Management, Planning and Zoning, County/City Attorneys, Public Officials
Jurisdictions:	Countywide

Action 2: Encourage communities to participate in the Fire Wise Community programs

Time Frame:	Ongoing
Funding:	County Emergency Management, County/City Planners, County/City Engineers, Road Dept/Public Works
Estimated Cost:	Minimal
Staff:	Contractors, County/City Fire, Local participation
Jurisdictions:	Countywide

Action 3: Create County ordinance adopting 2006 Wildland-Urban Interface Code

Time Frame:	60 days
Funding:	County funds
Estimated Cost:	Minimal
Staff:	Weber Fire District
Jurisdictions:	Countywide

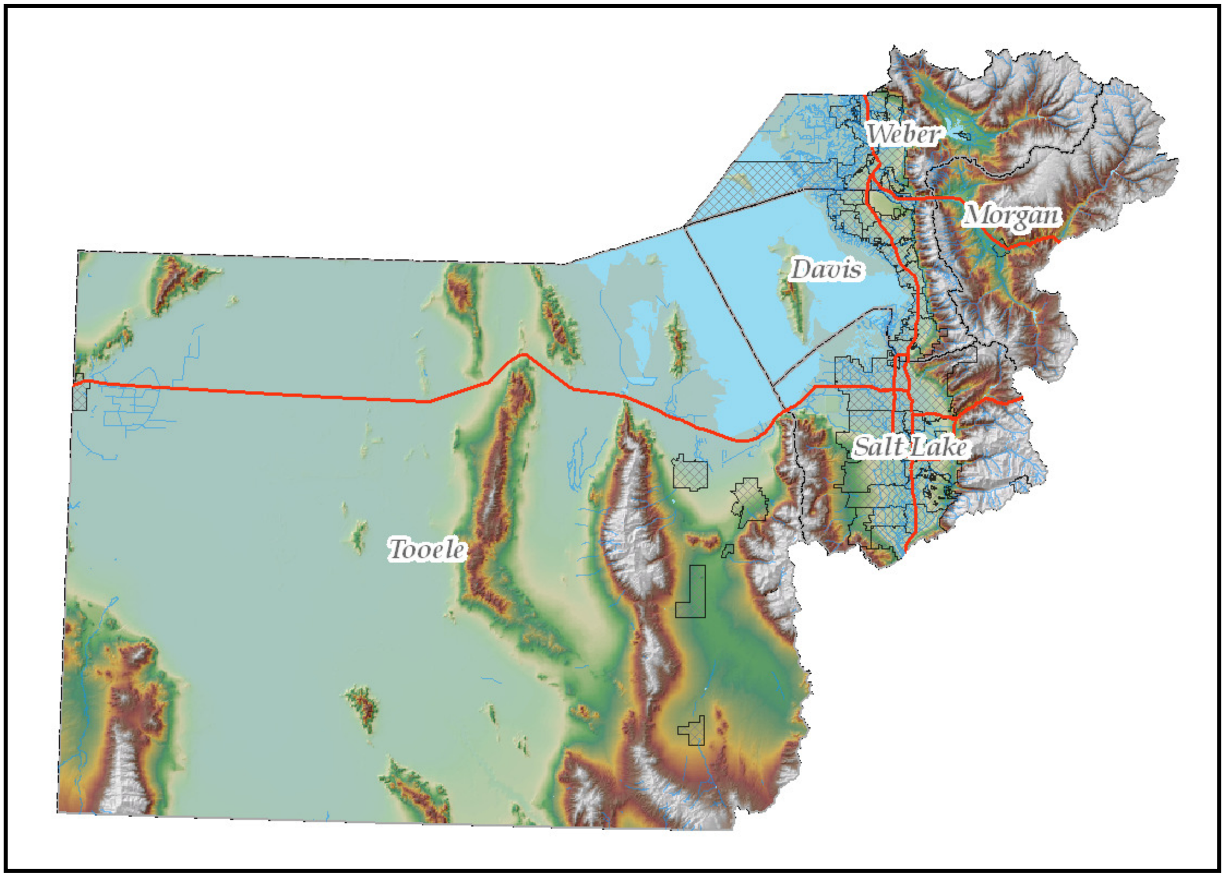
Action 4: Urge cities to adopt the 2006 Wildland-Urban Interface Code

Time Frame:	60 days
Funding:	County funds
Estimated Cost:	Minimal
Staff:	Weber Fire District
Jurisdictions:	Countywide

Objective #2 (Priority MEDIUM): Organize community to reduce wildfire hazard

Action 1: Create Wildfire Community Councils

Time Frame: 4-5 years
Funding: Utah Division of Forestry, Fire, and State Lands
Estimated Cost: Unknown
Staff: Weber Fire District
Jurisdictions: Countywide



Map 14-1. Wasatch Front Region

Part XIV. Specialized Local Districts

Utah State Code, Annotated, Section 17B-1-102, defines Specialized Local Districts (SLD) as a local district that is a cemetery maintenance district, a drainage district, a fire protection district, an improvement district, an irrigation district, a metropolitan water district, a mosquito abatement district, a public transit district, a service area or a water conservancy district. An SLD is a body corporate with perpetual succession, a quasi-municipal corporation, and is a political subdivision of the state.

SLD's may be created to provide services consisting of: airport operations; cemetery operations; fire, paramedic, and emergency services; garbage collection and disposal; health care including health department or hospital service; library operations; abatement or control of mosquitoes and other insects; park or recreation facilities or services; sewage system operations; street lighting; construction and maintenance of curb, gutter and sidewalk; transportation, including public transit and providing streets and roads; water system operations, including the collection, storage, retention, control, conservation, treatment, supplying, distribution, or reclamation of water, including storm, flood, sewage, irrigation, and culinary water, whether the system is operated on a wholesale or retail level or both.

Because SLD's are defined as quasi-municipal, they may be eligible for FEMA disaster funding reimbursement under the Stafford Act. Most of the SLD's have jurisdictional boundaries within a specific county. Others, such as the Utah Transit Authority (UTA), have jurisdictional boundaries that include multiple counties.

Specialized local districts identified in the WFRC Region are listed below. There may be others not identified here which will be included as they adopt this plan.

Multi-County

Weber Basin Water Conservancy District (serves Davis, Weber and Morgan Counties)
2837 East Highway 193
Layton, UT 84040
(801) 771-1677

Central Utah Water Conservancy District (serves Salt Lake and Utah Counties)
355 West University Parkway
Orem, UT 84058
(801) 226-7100

Utah Transit Authority (serves Weber, Davis, Salt Lake and Tooele Counties)
3600 South 700 West
Salt Lake City, UT 84119
(801) 262-5626

Weber-Box Elder Conservation District (serves Weber and Box Elder Counties)
South Ogden Conservation District
Ogden River Water Users Association
471 West 2nd Street
Ogden, UT 84404
(801) 621-6555

Davis County

Davis School District
P.O. Box 588
Farmington, UT 84025
(801) 397-8400

Bountiful Water Sub-Conservancy District
385 West 500 South
Bountiful, UT 84010
(801) 295-5573

Central Davis Sewer District
2200 South Sunset Drive
Kaysville, UT 84037
(801) 451-2190

Clinton City Sanitary Sewer Special Service District
2267 North 1500 West
Clinton, UT 84015
(801) 774-2600

Echo Creek Ranches Special Service District
670 North 900 East
Bountiful, UT 84010
(801) 298-7422

Benchland Water District
485 East Shepherd Lane
Kaysville, UT 84037
(801) 451-2105

Mutton Hollow Improvement District
151 East 1050 North
Kaysville, UT 84037
(801) 668-3109

North Davis Fire Department
381 North 3150 West
West Point, UT 84015
(801) 525-2850

North Davis Sewer District
4252 West 2200 South
Syracuse, UT 84075
(801) 825-0712

South Davis Metro Fire Agency
255 South 100 West
Bountiful, UT 84010
(801) 677-2400

South Davis Recreation District
550 North 200 West
Bountiful, UT 84010
(801) 298-6220

South Davis Sewer Improvement District
1800 West 1200 North
West Bountiful, UT 84087
(801) 295-3469

South Davis Water Improvement District
407 West 3100 South
Bountiful, UT 84010
(801) 295-4468

Morgan County

Morgan School District
P.O. Box 530
240 East Young St.
Morgan, UT 84050
(801) 829-0589

Mountain Green Fire Protection District
5593 Park View Drive
Mountain Green, UT 84050
(801) 876-2277

Mountain Green Sewer Improvement District
4274 Blue Jay Circle
Morgan, UT 84050
(801) 876-2287

Salt Lake County

Granite School District
2500 South State St.
Salt Lake City, UT 84115
(801) 646-5000

Jordan School District
9361 South 300 East
Sandy, UT 84070
801-646-4523

Murray School District
147 East 5065 South
Murray, UT 84107
(801) 264-7400

Salt Lake City School District
440 East 100 South
Salt Lake City, UT 84111
801-578-8599

Alta Canyon Recreation Special Service District
9565 South Highland Drive
Sandy, UT 84092
(801) 568-4600

Central Valley Water Reclamation Facility
800 West Central Valley Road
Salt Lake City, UT 94119
(801) 973-9100

Copperton Improvement District
8565 West State Highway
Copperton, UT 84006
(801) 255-3411

Cottonwood Improvement District
8620 Highland Drive
Sandy, UT 84093
(801) 943-7671

Cottonwood Heights Parks and Recreation
7500 South 2300 East
Cottonwood Heights, UT 84121
(801) 943-3190

East Riverton Drainage District
12765 South 2700 West
Riverton, UT 84065
(801) 208-1314

Emigration Improvement District
3350 Emigration Canyon
Salt Lake City, UT 84108
(801) 582-6176

Glenmoor Special Service District
9738 Stonehaven Street
South Jordan, UT 84095
(801) 280-9046

Granger Hunter Improvement District
2888 South 3600 West
West Valley City, UT 84119
(801) 968-3551

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, UT 84404
(801) 565-4300

Kearns Improvement District
5350 West 5400 South
Kearns, UT 84118
(801) 968-1011

Magna Water Company and Improvement District
2711 South 8600 West
Magna, UT 84044
(801) 250-2118

Metropolitan Water District of Salt Lake and Sandy
3430 Danish Road
Cottonwood Heights, UT 84093
(801) 942-1391

Midvalley Improvement District
160 East 7800 South
Midvale, UT 84047
(801)255-7321

Oquirrh Recreation and Parks District
5624 South 4800 West
Kearns, UT 84118
(801) 966-5555

Salt Lake City Suburban Sanitary #1
3932 South 500 East
Salt Lake City, UT 84107
(801) 262-2904

Salt Lake City Suburban Sanitary #2
160 East 7800 South
Midvale, UT 84074
(801) 255-7321

Salt Lake County Regional Service Area
5624 South 4800 West
Kearns, UT 84118
(801) 966-5555

Salt Lake County Service District #3
Snowbird Fire Station
9400 East State Hwy. 210
Snowbird, UT 84092
(801) 278-9660

South Valley Reclamation Facility
7495 South 1300 West
West Jordan, UT 84084
(801) 566-7711

South Valley Sewer District
874 East 12400 South
Draper, UT 84020
(801) 571-1166

Sandy Suburban Improvement District
8855 South 700 West
Sandy, UT 84070
(801) 561-7662

Solitude Improvement District
12000 Big Cottonwood Canyon
Salt Lake City, UT 84121
(435) 645-7153

Taylorsville-Bennion Improvement District
1800 West 4700 South
Salt Lake City, UT 84118
(801) 968-9081

Unified Fire Authority
3380 South 900 West
Salt Lake City, UT 84119
(801) 743-7100

White City Water Improvement District
999 East Galena Drive
Sandy, UT 84094
(801) 571-3991

Tooele County

Tooele School District
92 South Lodestone Way
Tooele, UT 84074
(435) 833-1931

Deseret Peak Special Service District
2930 West, Hwy 12
Tooele, UT 84074
(435) 843-4000
*functions under purview TOCO Commission

Lake Point Improvement District
1926 Shepard Lane
Lake Point, UT 84074
(435) 508-0397

North Tooele County Fire Protection Service District
179 Country Club
Stansbury Park, UT 84074
(435) 882-6730

North Tooele City Special Service District
1979 North 120 West
Tooele, UT 84074
(435) 882-1234

Rush Valley Water Conservancy District
P.O. Box 113
Vernon, UT 84080
(435) 837-2294

Saddleback Special Service District

Stansbury Park Improvement District
#30 Plaza
Stansbury Park, UT 84074
(435) 882-7922

Stansbury Service Agency
1 Country Club
Stansbury Park, UT 84085
(435) 882-6188

(Stockton) South Rim Special Service District

Tooele City Water Special Service District
90 North Main Street
Tooele, UT 84074
(435) 843-2100

Tooele County Recreation Service District
47 South Main Street
Tooele, UT 84074
(435) 840-0549

Tooele Valley Mosquito Abatement District
P.O. Box 788, 1535 Sunset Rd.
Lakepoint, UT 84074
(435) 250-3879

West Erda Improvement District
Tooele County Engineer
47 South Main
Tooele, UT 84074
(435) 840-0549

Weber County

Ogden School District
1950 Monroe Blvd.
Ogden, UT 84401
(801) 737-8837

Weber School District
5320 South Adams
Ogden, UT 84405
801-476-7825

Bona Vista Water Improvement District
1483 Wall Avenue
Ogden, UT 84044
(801) 621-0474

Central Weber Sewer District
2618 West Pioneer Road
Ogden, UT 84404
(801) 731-3011

Eden Park Service District
2544 North East
Eden, UT 84310
(801) 745-3942

Green Hills Estate Water and Sewer Improvement District
8975 East Pineview Drive
Huntsville, UT 84317
(801) 745-0722

Hooper Water Improvement District
5555 West 5500 South
Hooper, UT 84315
(801) 985-1991

Hooper Irrigation Co.
(801) 388-3956

Huntsville Hollow Sewer Improvement District
10331 East Highway 39
Huntsville, UT 84317
(435)745-4409

Little Mountain Service Area
10,000 West 900 South
Ogden, UT 84044
(801) 732-2205
North View Fire District
315 East 2550 North
North Ogden, UT 84414-2221
(801) 782-8159

Powder Mountain Water and Sewer Improvement District
1623 Hislop Dr
Ogden, UT 84404
(801) 621-4075

Pioneer Special Service District
Marriott Slaterville City
1570 W. 400 N.
Marriott Slaterville, UT 84404

Pineview Water Systems
471 W. 2nd St.
Ogden, UT 84404
(801) 621-6555

Roy Water Conservancy Sub-District
5440 S. Freeway Park Drive
Riverdale, UT 84405
(801) 825-9744

South Weber Water Conservancy District
7924 South 1900 East
South Weber, UT 84405
(801) 475-4749

Taylor-West Weber Water Improvement District
4660 West 1150 South
Ogden, UT 84404
(801) 731-1668

Uintah Highlands Water Sewer Improvement District
2401 East 6175 South
Ogden, UT 84403
(801) 476-0945

Warren – West Warren Water District
1688 South 7500 West
Ogden, UT 84404
(801) 621-0721

Weber Area Dispatch 911 and Emergency Services District
2186 Lincoln Avenue
Ogden, UT 84401
(801) 629-8007

Weber County Service Area #5 (Liberty Park)
Liberty, UT 84310
(801) 458-4187

Weber County Service Area #6
947 South 7900 West
Ogden, UT 84404

Weber Fire District
1871 North 1350 West
Ogden, UT 84404
(801) 782-3580

West Haven Special Services District
4150 South 3900 West
West Haven, UT 84401
(801) 731-5819

West Weber Sanitary Sewer District
4214 West 4275 South
West Haven, UT 84315
(801) 731-7917

Specialized Local Districts (SLD) are subject to the same hazards as the local jurisdictions in which they are located. The following general mitigation objectives have been developed for SLD's.

Problem Identification: Infrastructure vulnerability – Special Local Districts

Objective: Assess the vulnerability of critical facilities owned outside the WRFC Region that can impact service delivery inside the WFRC Region.

Objective: Retrofit or replace critical lifeline facilities and or their backup facilities that are shown to be vulnerable to damage in natural disasters

Objective: Conduct comprehensive programs to identify and mitigate problems with facility contents, architectural components, and equipment that will prevent critical buildings from being functional after major natural disasters

Objective: Develop and maintain a system of interoperable communications for first responders from cities, counties, special service districts, local school districts, state and federal agencies.

Objective: Identify and undertake cost effective retrofit measures on critical facilities when these buildings undergo major renovations.

Objective: Engage in, support and or encourage research by others on measures to further strengthen transportation, water, sewer, and power systems so that they are less vulnerable to damage in natural disasters.

Objective: Encourage a higher priority for funding seismic retrofit of existing transportation and infrastructure systems, such at UTA.

Problem Identification: Vulnerability of critical educational facilities

Objectives: Retrofit or replace critical education facilities that are shown to be vulnerable to damage in natural disasters,

Objectives: Conduct comprehensive programs to identify and mitigate problems with facility contents, architectural components, and equipment that will prevent critical buildings from being functional after major natural disasters

Objective: Identify and undertake cost effective retrofit measures on critical facilities when these buildings undergo major renovations

Objective: Develop and maintain a system of interoperable communications for first responders from cities, counties, special service districts, local school districts, state and federal agencies.

Objective: As a secondary focus, assess the vulnerability of non-critical educational facilities to damage in natural disasters based on occupancy and structural type, make recommendations on priorities for structural improvements or occupancy reductions, and identify potential funding mechanisms.

Part XV. Plan Maintenance and Implementation

Monitoring, Evaluating and Updating the Plan

Periodic monitoring and updates of this Plan are required to ensure that the goals and objectives for the region are kept current and that local mitigation strategies are being carried out. This Plan has been designed to be user-friendly in terms of maintenance and implementation.

Annual Review Procedures

Local jurisdictions shall annually review this Plan, as required by the Utah Division of Homeland Security (DHLS), or as situations dictate such as following a disaster declaration. If the participating jurisdictions or DHLS determines that a modification of the Plan is warranted, an amendment to the Plan may be initiated.

Revisions and Updates

Each county emergency manager will regularly monitor and annually review the Plan and is responsible to make revisions and updates. The annual review is 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. The Plan will also be revised to reflect lessons learned or to address specific hazard incidents arising out of a disaster.

Five Year Plan Review

The entire Plan including any background studies and analysis shall be revised and updated every five 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 and Local Working Groups, with a potential membership representing every jurisdiction in the WFRC Region, will be reconstituted for the five year review/update process. Typically, the same process that was used to create the original Plan will be used to prepare the update.

If the participating jurisdictions or DHLS determine that the recommendations warrant modification to the Plan, an amendment may be initiated as described below.

Plan Amendments

The Utah DHLS State Hazard Mitigation Officer, Local Mitigation Committee, or Mayor/City Manager of an affected community, will initiate amendments and updates to the Plan.

Upon initiation of an amendment to the Plan, DHLS 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 DHLS website at http://homelandsecurity.utah.gov. The review and comment period for the proposed Plan amendment will last for not less than forty-five (45) days.

At the end of the comment period, the proposed amendment and all review comments will be forwarded to participating jurisdictions for consideration. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly. DHLS will review the proposed amendment along with comments received from other parties and submit a recommendation to FEMA 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 DHLS, a public hearing will be held. DHLS will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, DHLS 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 the Plan is promulgated, participating cities and counties will be able to include this Plan's information in existing programs and plans. These could 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 National Flood Insurance Program (NFIP), the Utah Wildland-Urban Interface Code, the Building Code Effectiveness Grading System (BCEGS), and Community Rating System (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 shall 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: Small Business Administration (SBA) Disaster Assistance Program
Agency: U.S. SBA

> 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 American 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 DHLS 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 Natural Hazards 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 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 Hazards 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 conduct 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.