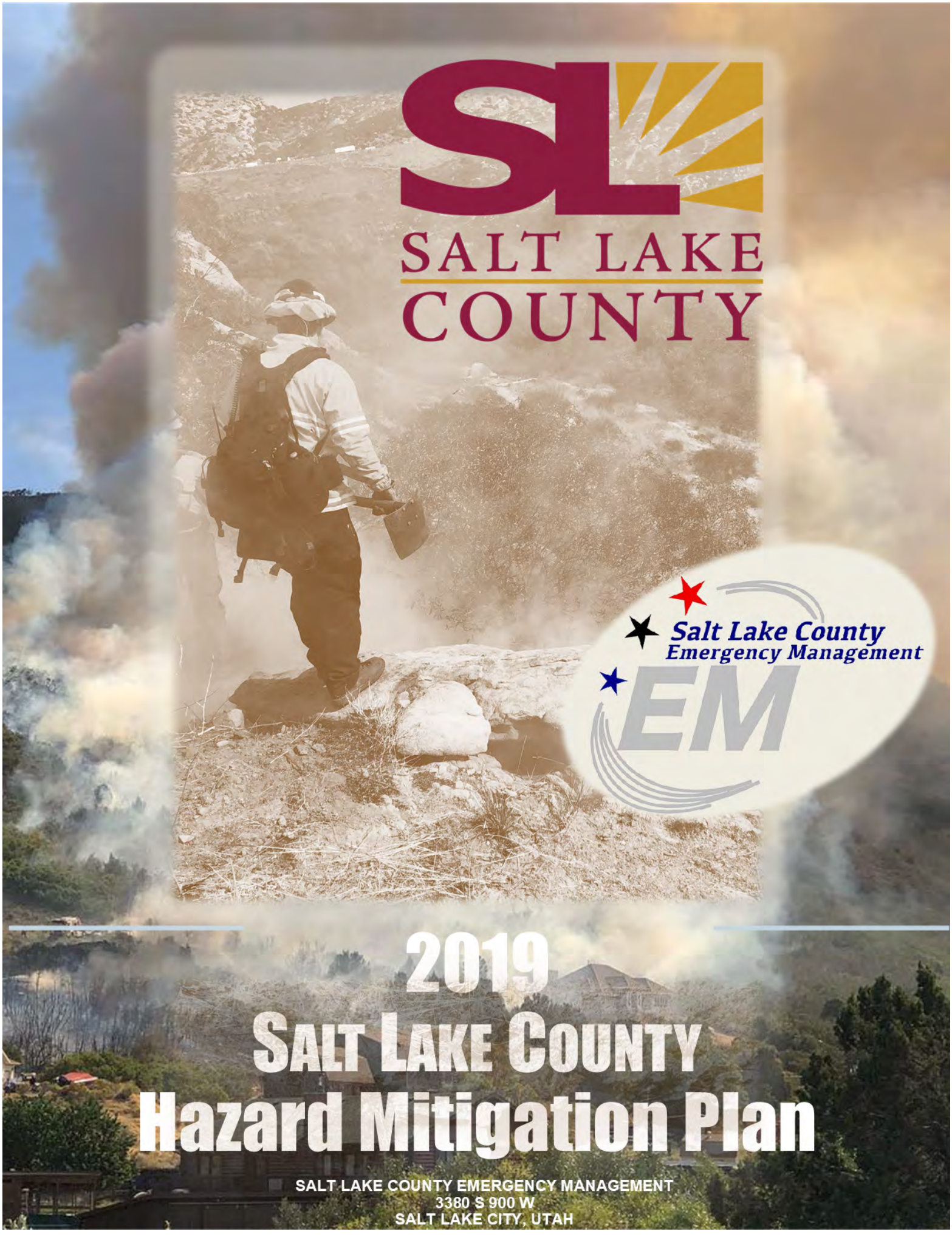

2019
Salt Lake County
Hazard Mitigation Plan

SALT LAKE COUNTY EMERGENCY MANAGEMENT
3380 S 900 W
SALT LAKE CITY, UTAH

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EXECUTIVE SUMMARY

It is an undeniable fact that the number of natural hazards has increased in recent years. Due to increased population density, natural hazards also have a greater effect. It is the responsibility of government to be prepared for these natural hazards. Government, by definition, has the responsibility for the planning and creation of mitigation strategies to lessen the damaging effects that disasters have on the community. Government at all levels is not only responsible for creating these mitigation strategies with citizen involvement, but is also responsible for their timely and cost-effective implementation.

With this in mind, Salt Lake County was awarded a federal grant to continue the hazard mitigation process following the creation of the Wasatch Front Regional Council's Natural Hazards Pre-Disaster Mitigation Plan that was approved on November 20, 2009 and expired on November 20, 2014. The plan was again updated in 2014-2015, and became the 2015 Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan. In 2019, Salt Lake County updated the mitigation plan to include five (5) new participating jurisdictions.

As part of the 2019 update, 24 jurisdictions located within Salt Lake County (23 cities/towns/townships and Salt Lake County itself) agreed to participate in the plan. At this point, planning teams were created, with Salt Lake County Emergency Management (SLCo EM) having the responsibility to complete the updated plan. Public Works, universities, GIS specialists, city administrators, emergency managers, and the public were all involved with the creation of the plan.

This plan consists of two parts. **Volume 1** contains the general Salt Lake County overview including hazard history, previous mitigation strategies, and the new mitigation strategies for the next five-year period. **Volume 2** contains the Individual Jurisdictional annexes with their respective hazard histories and previous mitigation strategies that have been newly initiated, still exist from prior years, or have been completed. New mitigation strategies have been designed based on the changing requirements of each jurisdiction moving forward for the next five-year period. There is some carry-over from plan to plan as ideas and strategies were created in groups, but they are also jurisdictionally specific, as every community will face different hazards and use unique strategies on how to combat these hazards.

Combined, both volumes make up the 2019 Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan (**MJ-HMP or Plan**). This plan and the implementation of these strategies will help Salt Lake County and its jurisdictions become better-prepared and more resilient communities. The plan was created to prevent and/or reduce the impacts of disasters on our citizens and communities.

PROMULGATION

This plan is promulgated as the "Salt Lake County's Multi-Jurisdictional Hazard Mitigation Plan." The plan is designed to comply with all applicable Federal, State and local ordinances and resolutions, and provides guidance to be followed to prepare for and mitigate hazards that threaten the community.

This plan has been constructed with the best information available and from a planning perspective. It is recognized that as new information becomes available, decisions and actions may be different than the plan envisioned at the time the plan was developed.

The County of Salt Lake gives full support to the plan and urges all officials, employees, and others involved in the total emergency management effort, individually and collectively, doing their share in making the Salt Lake County a disaster-resistant and resilient community.

This plan supersedes all previous hazard mitigation plans.

Promulgated this _____ day of _____, _____.

Authority

Federal Authority

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 the Stafford Act amended PL 93-288, several additional provisions were added that provide for the availability of significant mitigation measures in the aftermath of presidentially declared disasters. The current Stafford Act is the "Robert T. Stafford Disaster Relief and Emergency Assistance Act", as amended, August 2016.

State Authority

- The Governor's Emergency Operation Directive
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, amendments to Public Law 93-288, as amended.
- Title 44, CFR, Federal Emergency Management Agency Regulations, as amended.
- State Emergency Management Act of 1981, Utah Code 53-2, 63-5.
- Disaster Response Recovery Act, 63-5A.
- Executive Order of the Governor, Executive Order 11
- Emergency Interim Succession Act, 63-5B.

Utah State Code

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

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

Local Authority

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 within Salt Lake County, the local executives are responsible for carrying out plans and policies, including the county council 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. All jurisdictions in Salt Lake County participated in the development of this plan.

INTRODUCTION

Purpose and Scope

The four purposes of this Plan are:

1. To identify threats to the community
2. To create mitigation strategies to address those threats
3. To develop long-term mitigation planning goals and objectives
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 wellbeing of Salt Lake County and surrounding municipalities. This Mitigation Plan is intended to enhance the awareness 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.

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.

Salt Lake County and all participating jurisdictions, coupled with their respective citizens, stakeholders, and partner agencies, prepared this local hazard mitigation plan with the goal of guiding hazard mitigation planning in reducing the casualties and costs of natural disasters by providing comprehensive hazard identification, risk assessment, capability and vulnerability analysis, mitigation strategies, and an implementation schedule. This plan demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This plan was also developed to make Salt Lake County and participating jurisdictions eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program and Pre-Disaster Mitigation program, and to earn points for the National Flood Insurance Program's Community Rating System (CRS), which could lower flood insurance premiums in CRS communities.

This mitigation plan is a revision of the 2015 Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan. The 2015 plan was reviewed to evaluate its strengths, weakness and utility. The hazards, vulnerabilities, and risks were reviewed as to their impact, how hazards may affect the population, and their severity. Updates also describe hazard impacts that have occurred since the last plan revision. The planning team considered

previously unidentified hazards to include in the plan update. A capabilities assessment was conducted to identify potential mitigation needs and to further align the mitigation plan with other community planning efforts. The revision process also included a review of proposed mitigation goals, objectives and actions and to determine their validity and how effective they have been/or will be at reducing vulnerability in the county. New priorities have been set to support changes that were identified. The Mitigation Plan was also evaluated to support the State Mitigation Plan goals and objectives, as well as other local planning efforts. Finally, an implementation strategy and timeline will assign the responsibility and schedule for tracking implementation of the identified mitigation actions. The Mitigation Plan will be adopted through the normal legal process and will establish authority and guide all mitigation activities outlined in the plan.

This plan also utilized current county, city, and applicable private hazard mitigation, emergency operations plans, census data, and available GIS and assessor's data as resources for the planning team. SLCo EM staff, planning team members, county, city, and applicable emergency managers/planners, subject matter experts, recruits from other jurisdictions such as other local government units, private sector, non-governmental, academia, airports, and the military were consulted during this planning activity. This plan also demonstrates that there has been a proactively offered opportunity for participation in the planning process by the public and all community stakeholders (examples of participation include relevant involvement in an any planning process, attendance at meetings, contributing research, data, other information, commenting on drafts of the plan).

This plan was developed in accordance with the requirements of the FEMA Section 322 regulations, 44 CFR Part 201, the Utah Division of Emergency Management (UDEM) and local planning agencies. Regulations set forth by FEMA were followed during the development of this Plan. Future monitoring, evaluating, updating and implementation will occur annually or following any natural disaster. A major revision will occur every five years. Annual or any interim Plan review, updates and revisions will be the responsibility of each adopting jurisdiction.

Background

Salt Lake County is vulnerable to natural and technological (human-caused) hazards that threaten the health, welfare, and security of our citizens. Action taken to reduce or eliminate the long-term risk to human life and property from these hazards is known as mitigation. The losses and life and property, as well as the cost of response to and recovery from potential disasters can be substantially reduced when attention is turned to mitigation of the impacts and effects before they occur or re-occur.

Hazard mitigation planning is the process of identifying hazard risks and vulnerabilities, and establishing goals, policies and procedures to implement risk-reducing actions. This plan represents a collaborative effort of many participants in our community with the mission to engage community stakeholders in developing a comprehensive approach to reduce long-term hazard risk by identifying and implementing effective mitigation strategies.

Mitigation planning creates safer communities by reducing loss of life and property damage, and protecting community assets from the negative impacts of hazards. Implementing mitigation strategies can also reduce the cost of disaster response and recovery by:

- Identifying cost-effective actions that reduce risk
- Focusing resources on the greatest vulnerabilities
- Building partnerships between jurisdictions
- Increasing public awareness of hazards and risk
- Communicating planning priorities
- Aligning risk-reduction efforts with other community plans and objectives
- Establishing eligibility for mitigation grant programs.

Hazard mitigation is any cost-effective action that has the effect of reducing, limiting, or preventing the 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:

1. Those that keep the hazard away from people
2. Those that keep people, property, and structures away from the hazard
3. Those that do not address the hazard, but rather reduce the impact of the hazard on the victims, such as insurance.

Local mitigation plans are required to be updated every five years. This plan will be an update to the 2015 Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan. The Mitigation Plan is a collaborative effort, which will serve all of Salt Lake County, including each of the participating jurisdictions, as well as special service districts within the county. The revision of this plan supports the State Hazard Mitigation Plan mission, which is "to 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. The framework of this plan will now serve as a tool to guide, plan, and allocate resources across multi-jurisdictional boundaries. It will assist jurisdictions in making good assessments of their resilience to disasters and disruptions. It will serve as a guide to prioritize mitigation and preparedness efforts, allocate funding and guide development in innovative ways and to effectively utilize and share scarce resources. It is a representation of the county's commitment to reduce risks from natural hazards.

How to Navigate this Plan

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

- Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, countywide hazard risk assessment, countywide mitigation actions, and a plan maintenance strategy. The following appendices at the end of Volume 1 include information or explanations to support the main content of the plan:
    - Appendix A - Acronyms and Definitions
    - Appendix B - Plan Process and Development Documentation
    - Appendix C - Public Participation Documentation
    - Appendix D - Plan Adoption Resolutions from Planning Partners
    - Appendix E - References
- Volume 2 includes all federally required jurisdiction-specific elements, in annexes for each participating jurisdiction.

All planning partners will adopt Volume 1 in its entirety and their respective jurisdiction-specific annex within (Volume 2).

PLANNING PROCESS AND METHODOLOGY

To update the 2019 Salt Lake County, the County followed a process that had the following primary objectives:

- Form a planning team
- Engage the Steering Committee
- Establish a planning partnership with local jurisdictions and coordinate with other agencies
- Engage the public
- Define/Reassess the planning area
- Review existing data, programs, and prior plans
- Assess/Update the risk, vulnerabilities, capabilities within the planning area
- Formulate/update mitigation strategies to address identified areas of concern.
- Successfully meet all State and Federal requirements

These objectives are discussed in the following sections.

Planning Teams and Jurisdiction Participation

Core Planning Team

Salt Lake County hired Integrated Solutions Consulting (ISC) to assist with the update and implementation of the plan. The Integrated Solutions Consulting project manager and lead project planner reported directly to a County-designated project manager. A planning team was formed to lead the planning effort, made up of the following members:

- Clint Mecham, Division Chief, Salt Lake County Emergency Manager
- Keith Bevan, Deputy Emergency Manager, Planning Officer, Salt Lake County Emergency Manager
- Kristen Hansen, Planning Section, Administrator Coordinator, Salt Lake County Emergency Manager
- Sheldon Baumgartner, GIS Specialist, Salt Lake County Emergency Manager
- John McClure, Intelligence Specialist
- Tina Brown, PIO/Joint Information Center Manager
- Val Greensides, ECC Coordinator

The Steering Committee

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. In 2019, a steering committee was formed to oversee all phases of the plan.

The Steering Committee with representatives from each city and other major service districts provided extensive contributions to the information included in this plan. Other local and state agencies that have aided in the process include; city and county geographic information system (GIS) departments, elected officials, local officials, emergency managers, fire and law enforcement departments, planning departments, public works/engineering departments and other local government 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 Emergency Management (UDEM).

Table: Steering Committee Membership 2019 Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan Update			
Name	**Title**	**Committee Position**	**Agency/Organization**
Chris Cawley	Emergency Manager	Jurisdiction Representative	Town of Alta
Natalie Hall	Emergency Manager	Jurisdiction Representative	City of Bluffdale
Dan Knopp	Mayor	Jurisdiction Representative	Brighton
Jeff Boss	Council Member	Jurisdiction Representative	Brighton
Paul Brenneman	Emergency Manager	Jurisdiction Representative	Cottonwood Heights
Julie Sutch	Assistant Emergency Manager	Jurisdiction Representative	Cottonwood Heights
Robert Lambert	Emergency Manager	Jurisdiction Representative	Draper City
Bart Vawdrey	Deputy Fire Chief	Jurisdiction Representative	Draper City
Monte Johnson	Emergency Manager	Jurisdiction Representative	Herriman City
Tina Giles	Deputy Emergency Manager	Jurisdiction Representative	Herriman City
David Chisolm	Emergency Manager	Jurisdiction Representative	Holladay
Brandon Smith	Emergency Manager	Jurisdiction Representative	Midvale City
Julie Harvey	Emergency Management Planner	Jurisdiction Representative	Midvale City and Holladay
Andrew Clark	Emergency Manager	Jurisdiction Representative	Millcreek City
Joey Mittelman	Assistant Chief, Fire Marshall, Emergency Manager	Jurisdiction Representative	City of Murray
Jeff Puls	Paramedic, Assistant Emergency Manager	Jurisdiction Representative	City of Murray
Scott Chatwin	Emergency Manager	Jurisdiction Representative	Riverton City
Trace Robinson	Public Works Director	Jurisdiction Representative	Riverton City
Pam Lofgreen	Emergency Manager	Jurisdiction Representative	Salt Lake City
Jeffory Mulcahy	Emergency Manager	Jurisdiction Representative	City of Sandy
Aaron Sainsbury	Emergency/Safety Manager	Jurisdiction Representative	City of South Jordan
Blaine Daimaru	Emergency Manager	Jurisdiction Representative	City of South Salt Lake
Donny Gasu	Emergency Response Coordinator	Jurisdiction Representative	City of Taylorsville

Jared Smith	Emergency Manager	Jurisdiction Representative	West Jordan City
John Evans	Fire Chief and Emergency Services Director	Jurisdiction Representative	West Valley City
Chris Beichner	Deputy Fire Chief	Jurisdiction Representative	West Valley City
Sean Clayton	Mayor	Jurisdiction Representative	Copperton Metro Township
Joe Smolka	Mayor	Jurisdiction Representative	Emigration Metro Township
Jennifer Hawkes	Deputy Mayor	Jurisdiction Representative	Emigration Metro Township
Kelly Bush	Mayor	Jurisdiction Representative	Kearns Metro Township
Tina Snow	Deputy Mayor	Jurisdiction Representative	Kearns Metro Township
Greg Schulz	Engineer	Jurisdiction Representative	Magna Metro Township
Dan Peay	Mayor	Jurisdiction Representative	Magna Metro Township
Paulina Flint	Mayor	Jurisdiction Representative	White City Metro Township
Lisa L. Schwartz	Emergency Manager	Jurisdiction Representative	Salt Lake Community College

Representatives not only attended the meetings, but also participated by gathering appropriate data and historical information, completed the community preparedness survey, participated in their community hazard analysis, identified new mitigation strategies, updated past mitigation strategies, and participated in other efforts (i.e. webinars, phone interviews, and reviewing drafts).

A monthly stakeholder Hazard Mitigation meeting was held on the 2nd Monday of each month. Meetings started in May 2019 and went through December 2019. All jurisdictional representatives and regional stakeholders were invited.

Additional Partners and Stakeholders that participated in the plan included:

- Rick Graham, Metro Township Executive at Salt Lake County
- Scott Baird, Director, Public Works & Municipal Services
- Kevyn Smeltzer, Director of Operations, Public Works & Municipal Services
- Leon Barret, Operations, Public Works & Municipal Services
- Tamaran Woodland, Flood Control, Public Works & Municipal Services
- Bart Barker, General Manager, Greater Salt Lake Municipal Services District
- Brian Hartsell, Associate General Manager, Greater Salt Lake Municipal Services District
- Kathy Holder, State Floodplain Manager, Utah Division of Emergency Management
- Lisa Bagley, Chair, VOAD Region 2
- Scott Neal, South Valley Sewer District
- Tara Behunin, Utah Division of Emergency Management
- Karen Wiley, Community Development Manager, Salt Lake County
- Beth Todd, Deputy Director, Salt Lake Valley Emergency Communications Center
- Jim Woodward, Emergency Management Planner/Municipal Services, Salt Lake County Emergency Management

- Julie Harvey, Emergency Management Planner/Municipal Services, Salt Lake County Emergency Management

Coordination with other Agencies, Partners, and Stakeholders

The following agencies and partners were instrumental in the update process:

- American Red Cross
- VOAD
- National Weather Service
- Federal Emergency Management Agency (How-to Guides)
- National Weather Service (hazard profile)
- National Climate Data Center (hazard profile)
- Sewer Districts
- Utah Division of Emergency Management (GIS data, flood data, HAZUS data for flood and earthquake)
- Utah Geologic Survey (GIS data, geologic information, various hazard reports)
- Utah Division of Forestry Fire and State Lands (fire data)
- Utah Avalanche Center, Snow and Avalanches, Annual Reports
- Utah Department of Transportation (traffic data and information)
- University of Utah Seismic Station (earthquake data)
- Utah State University (climate data)
- Salt Lake County Departments and municipalities (Emergency Operations Plans, histories, mitigation actions, public input, GIS, assessor, transportation, property and infrastructure)

Neighboring counties (Davis County, Utah County, Tooele County, Wasatch County, and Summit County) were granted access to the Plan for review and feedback via the online planning system at https://ut-slc.isc-cemp.com. An additional e-mail was sent to the designated emergency manager for each county with a link to the draft plan. Additionally, hazard mitigation plans for the adjacent counties (specifically Davis County and Tooele County and the Mountainland Pre-Disaster Hazard Mitigation Plan), as well as the planning for all other nearby counties were reviewed to determine region-wide risks and mitigation opportunities. Public input of residents who reside in surrounding counties (4.6%), but indicated they commute and work in the County was also analyzed and compared to residents who indicated they live in Salt Lake County.

A meeting to specifically address flooding in the County and related public works and engineering initiatives was held with Public Works & Municipal Services on December 2, 2019 to review existing flood mitigation projects, and to also identify new flood mitigation initiatives based on recent flood-related studies (i.e. Rose Creek Study) and other known issues. Please double-click the link below to access the sign-in sheet of attendees. The planning team also coordinated with the State Floodplain Manager to obtain information regarding repetitive loss data needed for the plan. During the annual review of the plan, and per the Plan Implementation and Maintenance section, efforts will be made to ensure all relevant stakeholders have continued input and participation in the MJ-HMP.

PWMunicipalServices-2Dec2019.pdf

Local Jurisdiction Plan Participation

The following local jurisdictions in Salt Lake County participated in the 2019 MJ-HMP:

Table: Participating Jurisdictions		
Jurisdiction	**Participating Jurisdiction in 2015**	**Participating Jurisdiction in 2019**
Town of Alta	Yes	Yes
City of Bluffdale	Yes	Yes
Brighton	No (Unincorporated)	Yes
Cottonwood Heights	Yes	Yes
Draper City	Yes	Yes
Herriman City	Yes	Yes
City of Holladay	Yes	Yes
Midvale City	Yes	Yes
City of Murray	Yes	Yes
Riverton City	Yes	Yes
Salt Lake City	Yes	Yes
City of Sandy	Yes	Yes
City of South Jordan	Yes	Yes
City of South Salt Lake	Yes	Yes
City of Taylorsville	Yes	Yes
West Jordan City	Yes	Yes
West Valley City	Yes	Yes
Copperton Metro Township	No (Unincorporated)	Yes
Emigration Metro Township	No (Unincorporated)	Yes
Magna Metro Township	No (Unincorporated)	Yes
City of Millcreek	No (Unincorporated)	Yes
Kearns Metro Township	No (Unincorporated)	Yes
White City Metro Township	No (Unincorporated)	Yes
Salt Lake Community College	No	No, but the Community College's annex is included as an appendix in Volume 2.
Salt Lake County	Yes	Yes

Local Outreach Meetings

The Core Planning Team worked with individual jurisdictions and planning partners in order to provide one-on-one guidance and support. Local outreach meetings occurred with every participating jurisdiction.

Mitigation Workshops

Two (2) workshops were held to identify hazards and update and consider new mitigation strategies.

SALT LAKE COUNTY

2019 Salt Lake County Mitigation Plan

Local Jurisdiction Workshops

What: These in-person workshops will give your jurisdictional planning team an opportunity to work with planning staff from the Salt Lake County Unified Fire Authority to identify local hazards and areas of concern, review previously identified mitigation actions, develop future mitigation projects, prioritize mitigation projects moving forward, and provide input/update for your jurisdiction's section of the *2019 Salt Lake County Mitigation Plan*.

Why: Participating in updates to the mitigation plan is a *FEMA Requirement* to be eligible for some federal disaster funding before and after disasters. By bringing your local planning team to one of these workshops, you will be fulfilling that requirement.

Who: *EVERY* jurisdiction within Salt Lake County should attend one workshop; recommended attendees from local jurisdictions include representatives from the following disciplines:

- **Building Code Enforcement**
- **Municipal Administration & Management**
- **Elected Officials**
- **Fire & Law Enforcement**
- **Floodplain Administrator**
- **Legal**
- **Treasurer/Tax Assessor**
- **Parks & Recreation**
- **Planning/Community Development/GIS**
- **Public Works/Transportation (Roads & Bridges)**
- **Sanitation/Storm Water Management/Utility Districts**
- **School Districts & Universities**

When & Where (*ATTEND ONLY ONE*):

- Hazard Mitigation Planning Workshop | Monday, August 12, 2019 (9:00 a.m.-11:30 a.m.) | 3380 S 900 W, Salt Lake City, UT 84119 | Salt Lake County Emergency Management
- Hazard Mitigation Planning Workshop | Monday, August 12, 2019 (1:30 p.m.- 4:00 p.m.) | 3380 S 900 W, Salt Lake City, UT 84119 | Salt Lake County Emergency Management

To Register Go To: http://www.isc-registration.com/saltlakecounty.html

Please contact Keith Bevan, Planning and Intelligence Section at **kbevan@unifiedfire.org or 801-743-7200,** for assistance with registration, and/or with any questions.

Salt Lake County
2019 Hazard Mitigation Plan (HMP) Update
Local Jurisdiction Workshops

August 12, 2019
Session 1: 9:00 AM - 11:30 AM
Session 2: 1:30 PM – 4:00 PM

Agenda

Meeting Purpose:

The purpose of this meeting is to engage and collect information from the individual jurisdictions of Salt Lake County.

- **Introductions**
- **Mitigation Overview**
- **Hazards**
- **Jurisdiction Hazard Summary Worksheet**
- **Mitigation Goals**
- **Mitigation Strategies**
- **Review Ongoing Mitigation Actions/Projects**
- **Identify New Mitigation Actions**
- **Salt Lake County Knowledge Management System**

2019 Municipal HMP Annex

As part of the 2019 MJ-HMP update, all participating jurisdictions were required to create and/or update their respective Municipal HMP Annex. 2019 jurisdiction-specific annexes can be found in Volume II.

New Mitigation Actions

Each participating jurisdiction was required to consider and submit at least one new mitigation action as part of the 2019 MJ-HMP. New mitigation actions are documented in each respective annex.

Online Planning System

The Online Planning System used to draft the plan, gave members of the Steering Committee and Local Planning Team access to the previous plan and the 2019 MJ-HMP update and resources, including documents and forms, instructions and examples, and contact for Core Planning Team members. In addition, the Online Planning System featured real-time access to the Plan and comment functionality. Crucially, the latter provided users the ability to directly interact with the Core Planning Team, encouraging engagement throughout the planning process and collaboration. The comment function was intuitive, allowing users to quickly acclimate to the system:

- To make a comment, users were instructed to click on the Comment link on the bottom of the content page and a pop-up box would appear. The person used the drop-down box to designate whether the comment was a Feedback or an Observation. After entering the comment, they clicked the Send Comments button to submit.
- The comments tool allowed the user to make comments on any page within the Plan.
- The comments for pages were visible to all administrators and users who had editing privileges for the specific page.
- An email notification was sent to users who were designated to receive a comment notification.

Table: Plan Participation						
Jurisdiction	**Attended at least one monthly meeting**	**Represented at Mitigation Workshop**	**Met with Core Planning Team**	**Reviewed and approved Hazard Risk Ranking**	**Submitted at least One New Mitigation Action**	**Completed Municipal Annex (Volume II)**
Town of Alta	Yes	Yes	Yes	Yes	Yes	Yes
City of Bluffdale	Yes	Yes	Yes	Yes	Yes	Yes
Brighton	-	-	Yes	Yes	Yes	Yes
Cottonwood Heights	Yes	Yes	Yes	Yes	Yes	Yes
Draper City	Yes	Yes	Yes	Yes	Yes	Yes
Herriman City	Yes	Yes	Yes	Yes	Yes	Yes
City of Holladay	Yes	Yes	Yes	Yes	Yes	Yes
Midvale City	Yes	Yes	-	Yes	Yes	Yes
City of Murray	Yes	Yes	Yes	Yes	Yes	Yes
Riverton City	Yes	Yes	Yes	Yes	Yes	Yes
Salt Lake City	Yes	Yes	Yes	Yes	Yes	Yes
City of Sandy	Yes	Yes	Yes	Yes	Yes	Yes
City of South Jordan	Yes	Yes	Yes	Yes	Yes	Yes
City of South Salt Lake	Yes	Yes	Yes	Yes	Yes	Yes
City of Taylorsville	Yes	Yes	Yes	Yes	Yes	Yes
West Jordan City	Yes	Yes	Yes	Yes	Yes	Yes
West Valley City	Yes	Yes	Yes	Yes	Yes	Yes
Copperton Metro Township	-	-	-	Yes	Yes	Yes
Emigration Metro Township	-	-	Yes	Yes	Yes	Yes
Magna Metro Township	Yes	Yes	Yes	Yes	Yes	Yes
City of Millcreek	Yes	Yes	Yes	Yes	Yes	Yes
Kearns Metro Township	-	-	Yes	Yes	Yes	Yes
White City Metro Township	-	-	Yes	Yes	Yes	Yes
Salt Lake Community College	Yes	-	Yes	Yes	Yes	Yes
Salt Lake County	Yes	Yes	Yes	Yes	Yes	Yes

Public Involvement

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). SLCo EM partnered with Integrated Solutions Consulting, Inc. (ISC) to engage Salt Lake County stakeholders and its citizens prior to and throughout the 2019 MJ-HMP update process. Per Federal Emergency Management Agency (FEMA) Comprehensive Preparedness Guide 101 (CPG 101) and Local Hazard Mitigation guidance, the public outreach efforts encompassed all jurisdictions, leveraging professional expertise to educate the population and engage them in developing new mitigation actions. The following section details the public outreach strategy, including a combination of in-person and virtual methods.

Salt Lake County Hazard Mitigation Questionnaire

In accordance with best practices as outlined in CPG 101 and the Local Hazard Mitigation Guide, this public-private effort engaged the whole community as part of its public outreach strategy, reaching citizens and key stakeholders across all jurisdictions via a combination of in-person and virtual methods. Elements of virtual public outreach included the 2019 Salt Lake County Preparedness Survey (http://prepare.community/slc), and social media engagement through mediums like Twitter and Nextdoor.

The 2019 survey included 31 questions and concluded with mitigation and preparedness resources for the public. The survey was shared electronically with the option of a hard copy survey upon request. 556 total residents participated. 428 residents completed the entire 31-question survey. On average, residents spent 12 minutes to complete the questionnaire. The survey and related public outreach invitations were shared through multiple sources including:

- Nextdoor, Facebook, and Twitter
- County and municipal web sites
- Individual jurisdiction social media and e-mail lists
- County e-mail lists
- Press release

Figure: SLCo EM Website Promoting the Survey

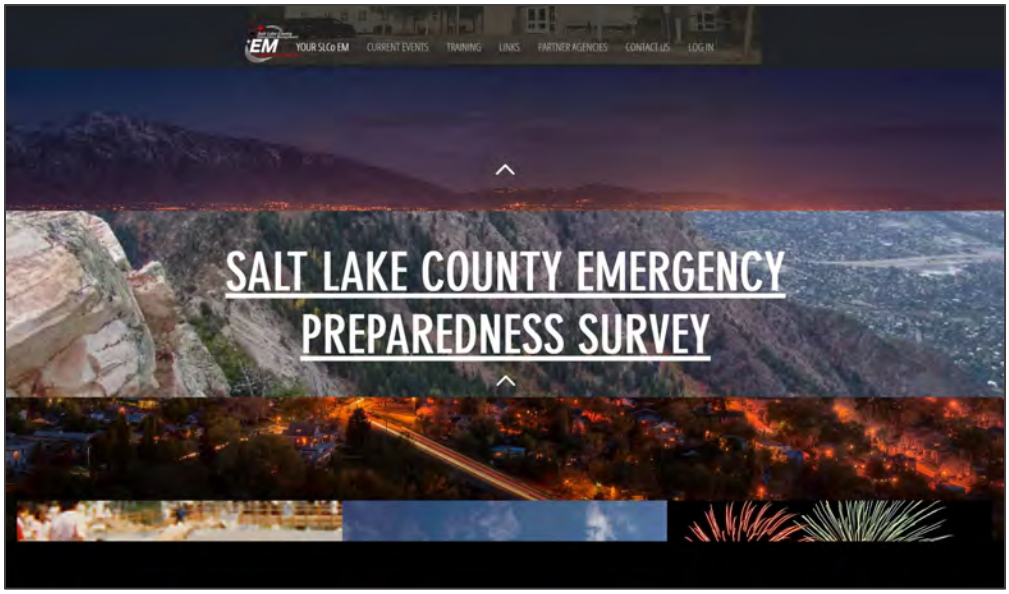
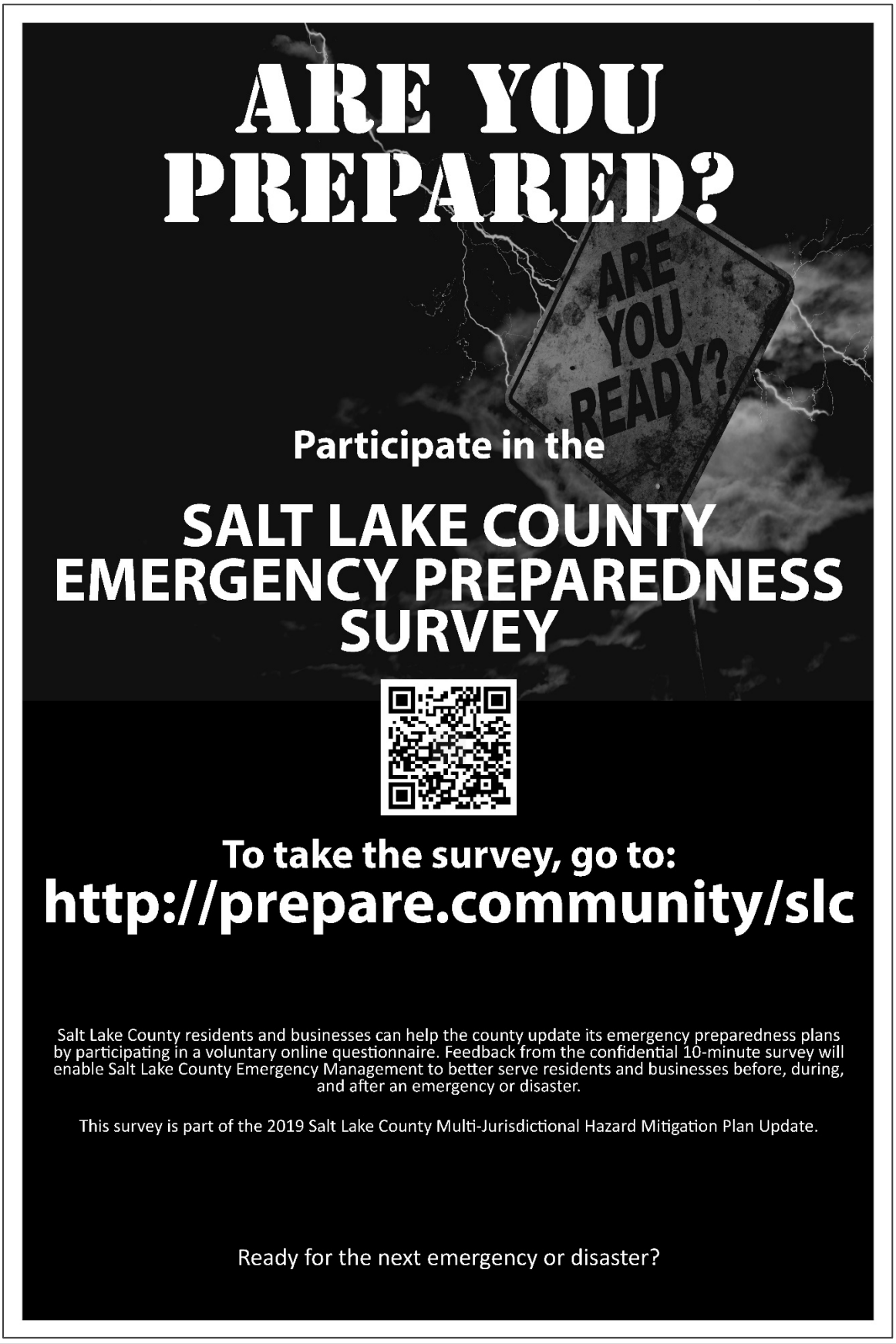


Figure: Poster Utilized as Various Events to Promote the Survey



Based on survey analytics, the greatest number of participants live in Salt Lake City, Millcreek, Riverton, and West Valley, which correlates with the larger populations in these jurisdictions.

Table: Public Participation by Jurisdiction	
Jurisdiction	**Percent**
Alta	0.2%
Bluffdale	6.2%
Cottonwood Heights	0.9%
Draper	1.3%
Herriman	4.3%
Holladay	2.1%
Midvale	0.4%
Murray	1.1%
Riverton	13.2%
Sandy	4.3%
Salt Lake City	14.1%
South Salt Lake	1.5%
South Jordan	4.1%
Taylorsville	10.0%
West Jordan	3.6%
West Valley	13.7%
Copperton	0.4%
Kearns	1.3%
Magna	0.4%
White City	0.2%
Millcreek	15.4%
Other [Unincorporated]	1.3%

Note: At the time the survey was conducted, Brighton was not an incorporated community.

Salt Lake County Hazard Mitigation Public Review

After the draft plan was completed, a link to the plan was placed on the SLCo EM website. A digital copy was also sent to the Utah Division of Emergency Management (UDEM) with a completed crosswalk for a pre-draft review. At the same time, public notices were distributed announcing the availability of the plan for review and comment. The draft plan remained on the SLCo EM website until the FEMA-approved and formally adopted Plan was made available. Upon formal adoption of the Plan, the public engagement strategy shifted toward continual engagement of the public by soliciting and offering the public an opportunity and forum to provide input regarding known hazards and risks, and implementation of identified mitigation strategies.

Throughout the plan development process, public input (townhall meetings, outreach activities, Community Mitigation Questionnaire) was incorporated into the Plan.

Appendix C: Public Participation Documentation details the specific activities and results from the Planning Team's public outreach efforts.

How Public Input was Incorporated into the Plan

When asked to what degree of emphasis the public would expect their jurisdiction to mitigate hazards, these hazards received the highest percentages of "high priority" in the survey:

- Earthquake (73.1%)
- Utility Failure (43.5%)
- Severe Weather (37%)
- Violent Mass Casualty Incident (36.6%)
- Wildfires (36.6%)
- Major Transportation Accident/Incident (35.5%)
- Drought (27.2%)
- Infrastructure Failure (26.7%)
- Structural Failure (23.3%)

Open-ended responses by the public offered greater insight to the damages experienced while residing in Salt Lake County.

These, and related findings, helped the planning team determine meaningful mitigation projects. For example, some communities recognized the importance of creating greater resiliency and redundancy to mitigate power failure. Public input also validated the County's plans to develop a region-wide notification system.

Plan Development Milestones

Appendix B: Plan Process and Development Documentation provides a more comprehensive documentation of the necessary detail of the various plan development activities that took place during the update of the 2019 Salt Lake County MJ-HMP.

The appendix details plan participation validation for local jurisdictions. In accordance with best practices as outlined in CPG 101 and the Local Hazard Mitigation Guide, SLCo EM and its partners embraced the whole community approach throughout the 2019 MJ-HMP Update process, involving civic leaders, community representatives/organizations, and the general public. Understanding that critical infrastructure and key resources, as well as public opinion and hazard likeliness, can dramatically change in a five-year period, SLCo EM and its partners leveraged in-person, on-site outreach opportunities to educate stakeholders and collect and validate the information. To support the 2019 MJ-HMP Update process, the following were facilitated for jurisdiction leaders and POCs:

- Letters of Intent
- Local Government Meetings
- Webinars
- Hazard Mitigation Planning Workshops

In summary, the planning process consisted of the following key tasks:

Task 1: Organize Resources

SLCo EM created a planning team to attend meetings, gather data and historical information, review drafts, and participate in mitigation brainstorming sessions. In addition to the core planning team, a steering committee was formed to provide overall guidance and direction throughout the mitigation planning process. Monthly steering committee meetings were held throughout the Plan update. Participating jurisdictions were invited to form Local Planning Teams to ensure their jurisdiction's mitigation needs and priorities were addressed. Mitigation Workshops were held in August, which provided local planning teams an opportunity to update hazards, identify new mitigation actions, and update past mitigation strategies.

Task 2: Risk Assessment

The planning team identified the natural and technological hazards to include in this Plan, as well as hazard event profiles to address the possible magnitudes and severities associated with each hazard. The team then used local resources to inventory the county's assets and estimate losses. The steering committee provided input and subject-matter expertise throughout this process. A standardized risk ranking methodology was developed, approved by the Steering Committee, and was applied to the County and all participating jurisdictions. Previously, each jurisdiction had their own risk ranking process and methodology. To enable stakeholders to compare risk from one jurisdiction to the other, a standardized methodology was created that measured and weighed the following variables: probability, population exposure, property exposure, property damages, economic impact, and catastrophic potential. A quantitative assessment was first conducted, followed by input from key stakeholders from that community. Minor adjustments were made, if needed. The countywide assessment provides a wholistic risk ranking of the entire county, whereas the individual jurisdiction assessments provide a very specific and unique view of risk as it pertains to that community.

Task 3: Public Involvement

A comprehensive public survey that reached over 500 residents was conducted. Additionally, after the planning team made final edits, the plan was posted on the SLCo EM web site, and the county sent a press release and used social media to invite the public to review the plan and submit comments.

Task 4: Develop Mitigation Strategies

The planning team met with representatives of each community (Local Planning Team) to develop and prioritize mitigation strategies and action items that would reduce the costs of disaster response and recovery, protect people and infrastructure, and minimize overall disruption to the county in the event of a disaster (see *Volume II*).

Task 5: Complete the Plan

The planning team compiled all of the relevant sections of the Plan to produce a draft plan for review. The Plan was submitted to the UDEM and FEMA for approval.

Task 6: Plan Adoption

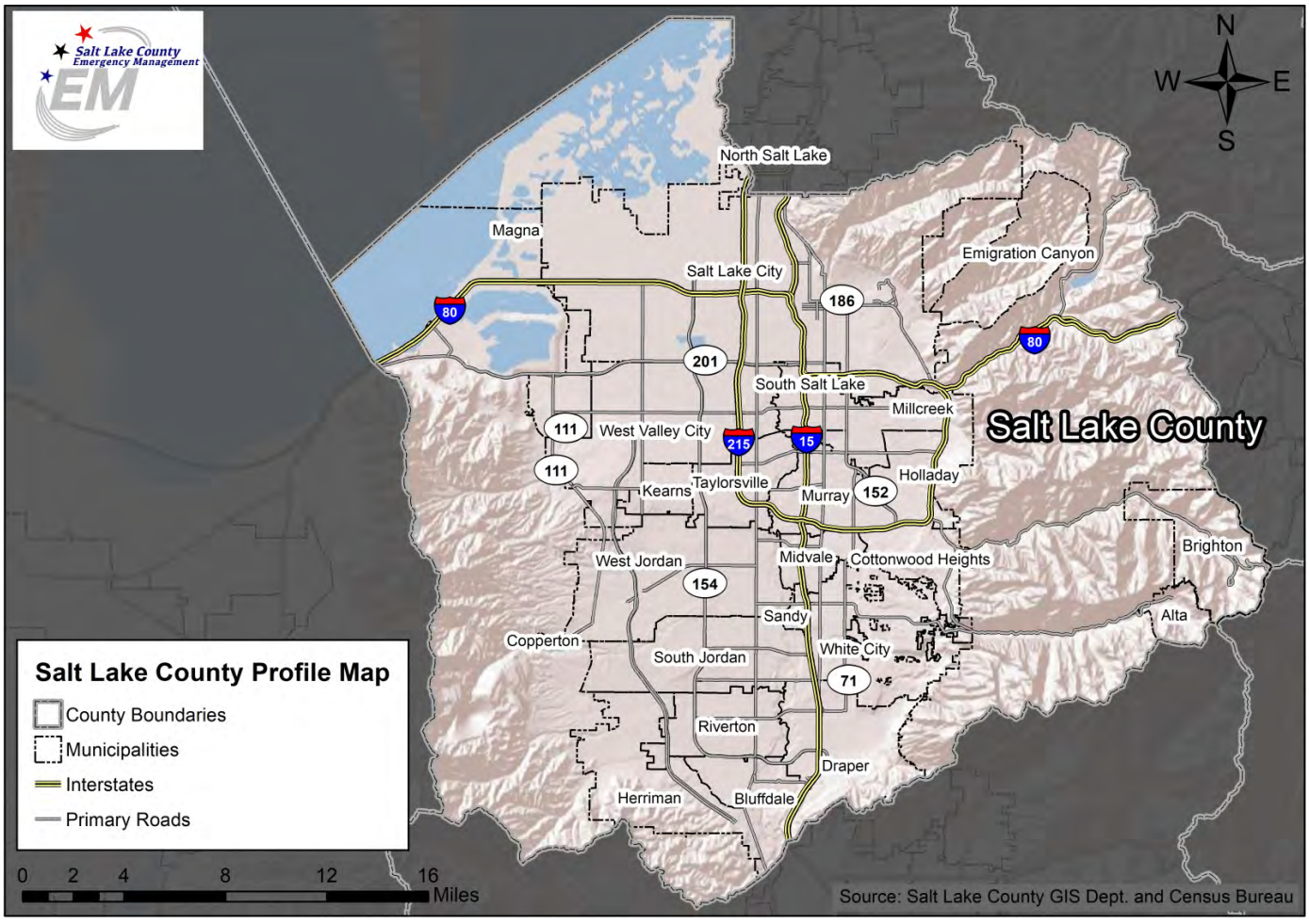
The SLCo EM coordinated the effort to ensure the Plan was formally adopted by each participating jurisdiction (see *Plan Adoption*).

Defining the Planning Area

All partners to this plan have jurisdictional authority within this planning area. The jurisdictions that meet these criteria include:

- Town of Alta
- City of Bluffdale
- Brighton
- Cottonwood Heights
- Draper City
- Herriman City
- City of Holladay
- Midvale City
- City of Murray
- Riverton City
- Salt Lake City
- Salt Lake County
- City of Sandy
- City of South Jordan
- City of South Salt Lake
- City of Taylorsville
- West Jordan City
- West Valley City
- Copperton Metro Township
- Emigration Metro Township
- Magna Metro Township
- City of Millcreek
- Kearns Metro Township
- White City Metro Township

The planning area was defined as all incorporated and unincorporated areas of Salt Lake County, as displayed below.



Review of Data, Programs, and Prior Plans

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). The following table contains key resources that were heavily used or integrated into the plan to affect mitigation in the planning area. A comprehensive list of every resource used within this plan can be found in Appendix E: References. In addition, in-text citations and sources have been inserted throughout the plan in order to better facilitate referencing or further study.

Source	Integration into Plan
2015 Salt Lake County Hazard Mitigation Plan	Used as a starting framework, which the 2019 SLC MJ-HMP updated and built upon. This source helped inform the choice of included hazards, key community profile sections to expand, and provided information for this plan's Existing Mitigation Actions section.
2015 Salt Lake County Integrated Watershed Plan (Revised 2017)	This document provided valuable watershed information.
2015 Salt Lake County Stormwater Management Plan	Used this document to review codes, ordinances, regulations and capabilities.
2019 Utah State Hazard Mitigation Plan	Used to supplement existing hazard descriptions, frequencies, and vulnerability data. This source was also used to provide data for comparing Salt Lake County vulnerabilities to other Utah counties.
2016 Tooele County Pre-Disaster Mitigation Plan	Reviewed to determine region-wide risks and opportunities for mitigation actions
2016 Davis County Natural Hazard Pre-Disaster Mitigation Plan	Reviewed to determine region-wide risks and opportunities for mitigation actions.
2017 Mountainland Pre-Disaster Hazard Mitigation Plan	Reviewed to determine region-wide risks and opportunities for mitigation actions.
National Oceanic and Atmospheric Administration (NOAA) Storm Events Database.	Used extensively to determine date, frequency, location, casualty, and cost information for natural hazard events. The Risk Assessment portion of this plan directly informed the Mitigation Strategies portion of the plan.
Wasatch Front Regional Council, Wasatch Choice: 2019 - 2050 Regional Transportation Map	Used to inform critical facilities, land use, and future development portions of this plan.
Utah Wildfire Risk Assessment Portal and West Wide Wildfire Risk Assessment	Used to quantify the magnitude of wildland fire risk to provide a baseline for quantifying mitigation activities and to monitor change over time.
National Inventory of Dams and National Levee Database	Used to map locations of dams and levees throughout the County.
Community Improvement Projects	Identify desired projects relating to mitigation in various communities

Capability Assessment Strategy

An assessment of all planning partners' legal, regulatory, fiscal, administrative, and technical capabilities to implement hazard mitigation actions is presented in the individual jurisdiction-specific annexes in Volume 2. Each planning partner contributed to the evaluation and development of their respective capability assessments. This process also encouraged planning partners to review the state of existing plans, studies, reports or other technical information with city planners, engineers, administrators and other individuals who contribute to decision making and community planning.

Risk Assessment Strategy

The natural hazards identified and investigated as part of the Risk Assessment for the Salt Lake County Multi-Hazard Mitigation Plan include:

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Flooding (Urban/Flash and Riverine Flooding)
- Landslide and Slope Failure
- Public Health Epidemic/Pandemic
- Radon
- Severe Weather
- Severe Winter Weather
- Tornado
- Wildfire

Other hazards of interest were identified as having some potential to impact the planning area. Other plans in the County specifically address the response and strategies for manmade hazards; however, mitigation strategies were identified by the County and participating communities that directly and indirectly result in greater resiliency to the hazards below. These hazards included:

- Civil Disturbance
- Cyber Attack
- Hazardous Materials Incident (Transportation and Fixed Facility)
- Terrorism (Including Active Shooter Events)

It should be noted that some jurisdictional annexes in Volume II identify unique hazards that are very specific to a jurisdiction. The Steering Committee approved the hazards that would be included for all jurisdictions and allowed for unique hazards to still be addressed in individual annexes.

Per FEMA's mandate to address all natural hazards, the following natural hazards were not included because these hazards do not directly impact the County. They are:

- Hurricanes
- Sea Level Rise
- Storm Surge
- Tsunami

The risk assessment describes the risks associated with each identified hazard of concern. Each section describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - General background of the hazard
  - Range of Magnitude and the possible extent of the hazard
  - Geographic areas most affected by the hazard
  - Records of past events and frequency estimates
  - Possible secondary hazard events
  - Vulnerability assessment for the impacts of a significant hazard event
- **Determine exposure to each hazard and assess the vulnerability of exposed assets**—Exposure was determined by analyzing hazard maps, historical occurrences, and an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard. Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA's hazard-modeling program called Hazus-MH were used to perform this assessment for the flood, dam failure, and earthquake hazards. Outputs similar to those from Hazus were generated for other hazards, using maps generated by the Hazus program.

Mitigation Strategy Development and Prioritization

Developing the mitigation strategies was a process in which all of the previous steps were taken into account. Each participating jurisdiction consulted internally, evaluated the hazard profiles and vulnerabilities presented by the planning team, and submitted mitigation strategies appropriate for their jurisdiction. The previous strategies from the 2015 Salt Lake County Hazard Mitigation Plan were also reviewed to identify which projects had been completed and integrate those which were still ongoing. The planning team met several times to brainstorm additional strategies and improve upon the existing strategies. Each mitigation strategy developed was evaluated to determine that actions were cohesive with the overall purpose and scope of this plan, as stated in the Introduction.

State Review

UDEM created a formal Plan review committee to ensure local plans met the requirements of DMA 2000. This committee reviewed the Plan subsequent to submission to FEMA for final review and acceptance.

COMMUNITY PROFILE

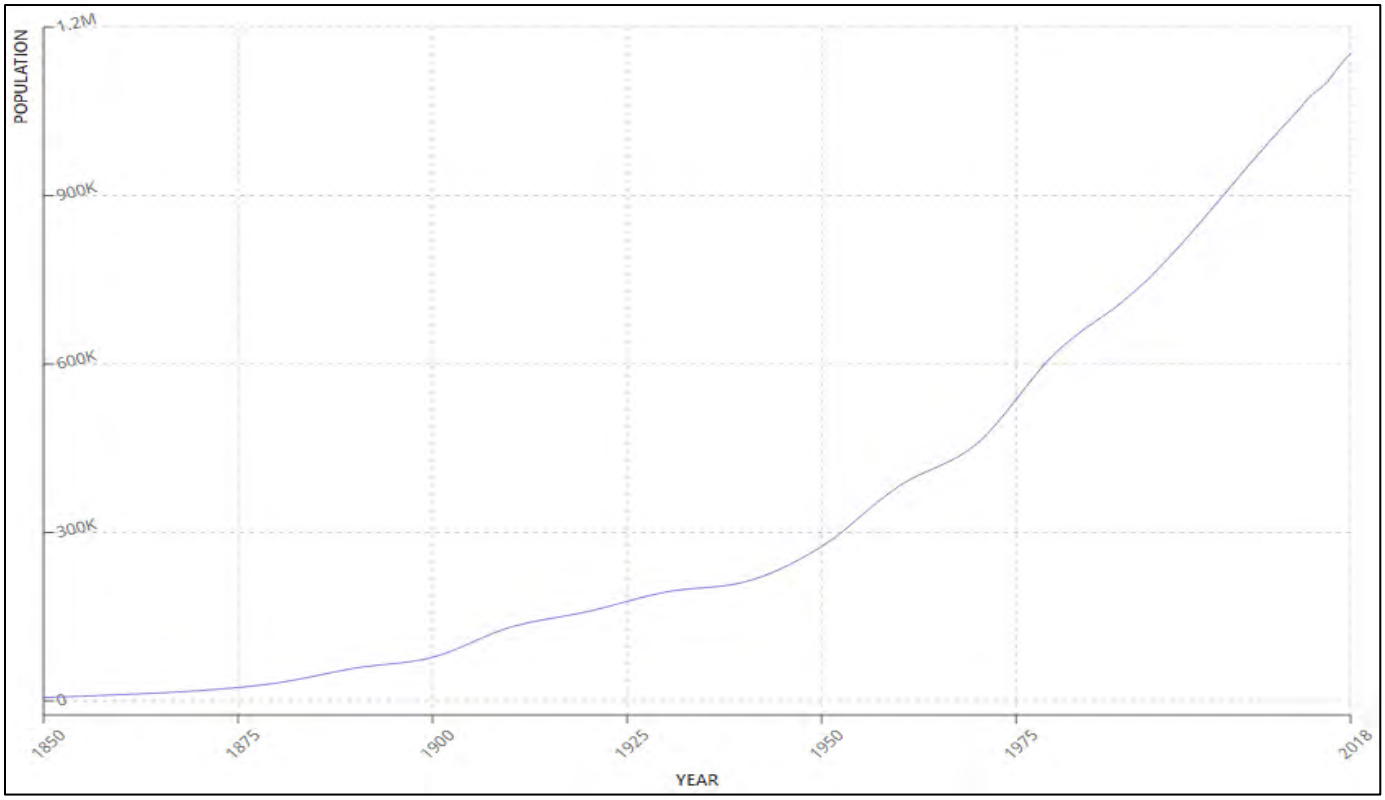
Demographics

Population

Salt Lake County continues to be the most populous county in the state, with a 2010 population of 1,029,655, according to the Census, that has continued to steadily grow over the past decade as can be seen below.

Salt Lake County, Utah Population

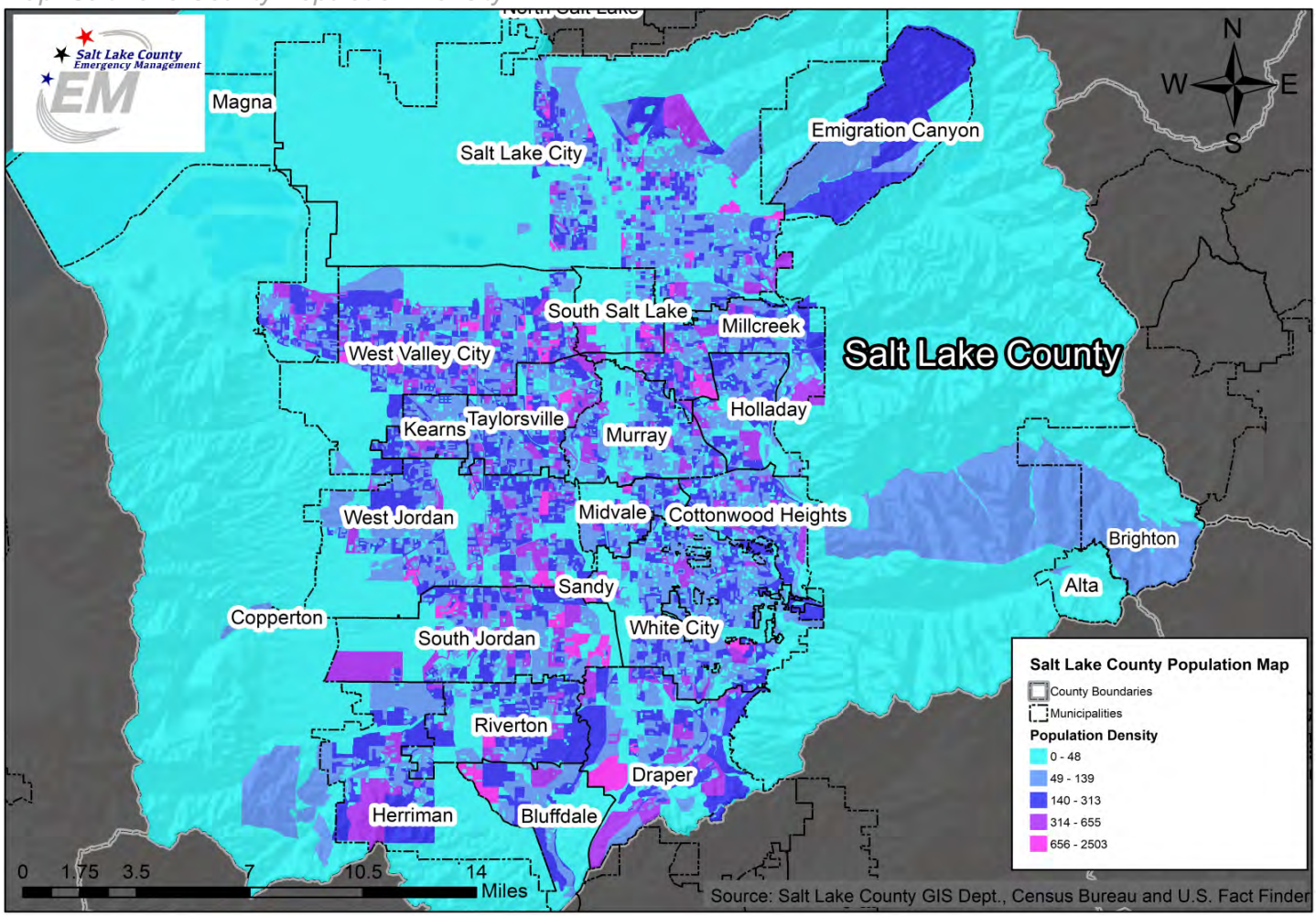
Year	Population	Growth	Growth Rate
2018	1,152,633	14,813	1.30%
2017	1,137,820	17,136	1.53%
2016	1,120,684	18,055	1.64%
2015	1,102,629	12,372	1.13%
2014	1,090,257	10,714	0.99%
2013	1,079,543	15,522	1.46%
2012	1,064,021	16,464	1.57%
2011	1,047,557	14,578	1.41%



Source: http://worldpopulationreview.com

Salt Lake County contains two of the largest cities in the state: Salt Lake City with approximately 194,188 people and West Valley City with 135,546, according to the 2017 American Community Survey. The map below shows the current population density throughout the County.

Map: Salt Lake County Population Density



As can be seen in the tables below, the population of Salt Lake County is projected to continue to grow by 55% from 2015 - 2065, according to the Kem C. Gardner Policy Institute.

Table: Salt Lake County Population Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	1,094,650	1,249,961	1,361,099	1,470,574	1,594,804	1,693,513	598,863	55%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

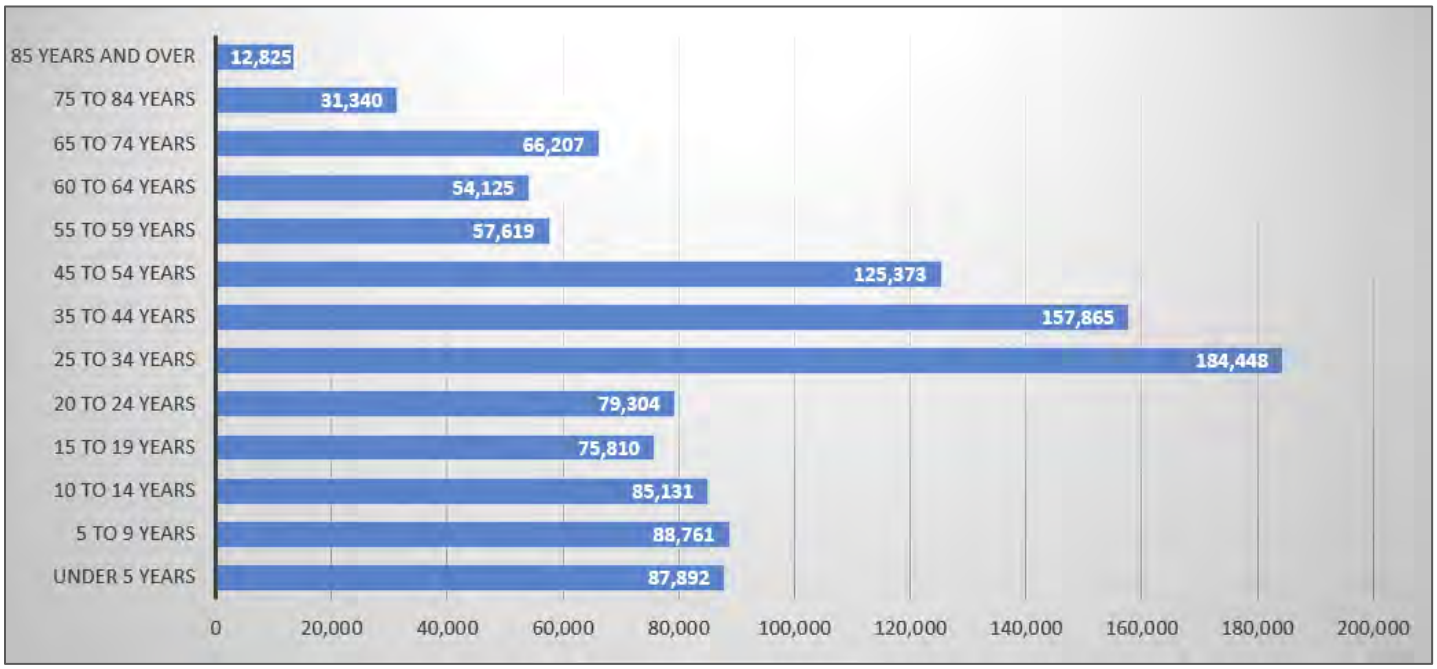
Table: Salt Lake County Household Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	379,320	454,929	521,352	579,472	635,143	689,490	310,170	82%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

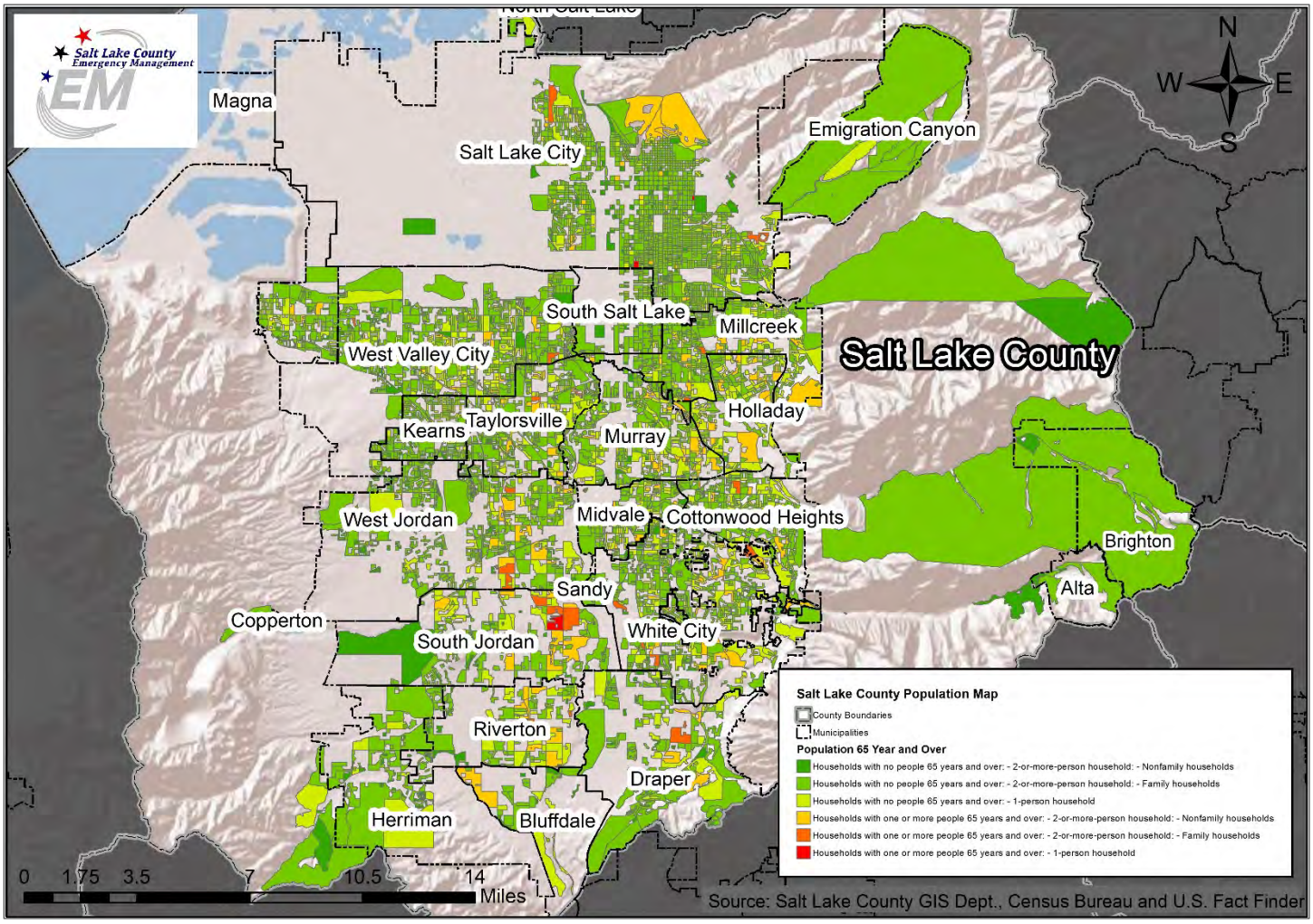
Age

	Number	Percent	National Avg
Under 5 years	87,892	7.9%	6.2%
5 to 9 years	88,761	8.0%	6.4%
10 to 14 years	85,131	7.7%	6.5%
15 to 19 years	75,810	6.9%	6.6%
20 to 24 years	79,304	7.2%	7.0%
25 to 34 years	184,448	16.7%	13.7%
35 to 44 years	157,865	14.3%	12.7%
45 to 54 years	125,373	11.3%	13.4%
55 to 59 years	57,619	5.2%	6.7%
60 to 64 years	54,125	4.9%	6.0%
65 to 74 years	66,207	6.0%	8.6%
75 to 84 years	31,340	2.8%	4.4%
85 years and over	12,825	1.2%	1.9%
Median age (years)	32.4		



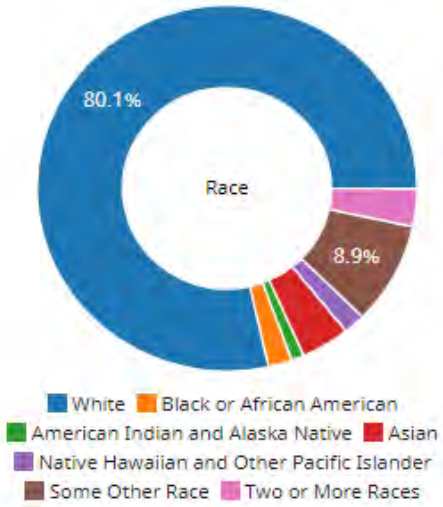
Source: 2017 American Community Survey

Map: Salt Lake County, Population 65 Years and Older



Race

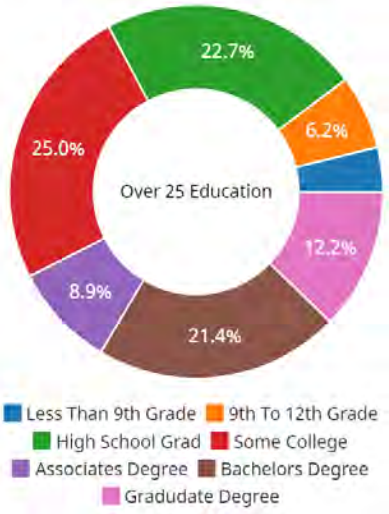
Race	Population	Percentage
White	887,004	80.15%
Some Other Race	98,444	8.90%
Asian	43,052	3.89%
Two or More Races	33,854	3.06%
Black or African American	19,098	1.73%
Native Hawaiian and Other Pacific Islander	16,935	1.53%
American Indian and Alaska Native	8,313	0.75%



Source: 2017 American Community Survey

Educational Attainment

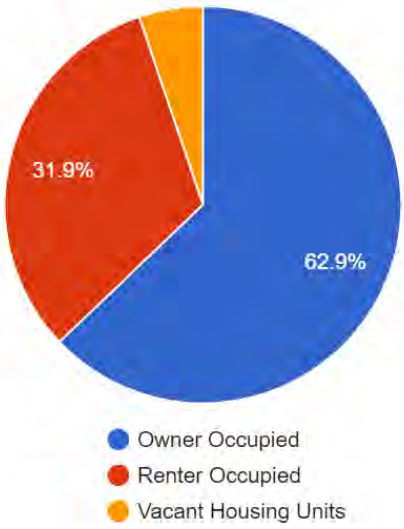
Education Attained	Count	Percentage
Less Than 9th Grade	24,879	3.61%
9th to 12th Grade	42,848	6.21%
High School Graduate	156,804	22.73%
Some College	172,232	24.97%
Associates Degree	61,140	8.86%
Bachelors Degree	147,726	21.42%
Graduate Degree	84,173	12.20%



Source: 2017 American Community Survey

Housing

Housing Occupancy	Number	Percent	National Avg
Total Housing Units			
Occupied Housing Units	366,239	94.8%	87.6
Owner Occupied	242,933	66.3%	63.1
Renter Occupied	123,306	33.7%	36.9
Vacant Housing Units	20,195	5.2%	12.4
Homeowner Vacancy Rate	1	0.0%	0.0
Rental Vacancy Rate	5	0.0%	0.0
Average household size of owner-occupied unit	3.2	0.0%	2.7
Average household size of renter-occupied unit	2.7	0.0%	2.5



Source: www.homefacts.com

Economy

Employment

Salt Lake County is the backbone of Utah's economy, making up approximately 39% of the labor force and 47% of the non-farm job market. The trade and transportation industry, the largest employment division within the County, supplies approximately 20% of the County's employment share. Trade is the second major component followed by government and education, health, and social services. Salt Lake is a regional center for finance, health care, and high tech industries as well. Major employers include the University of Utah, the State of Utah, Intermountain Healthcare, Granite School District, Jordan School District, Salt Lake County, Wal-Mart, Discover Financial Services Inc., Delta Airlines, the United States Postal Service, Salt Lake City School District, and Salt Lake City.

Table: Employment Share within Salt Lake County (Non-Farm Jobs)

Industry	Employment Share
Trade/Transport/Utilities	20%
Prof/Business Services	18%
Government	15%
Education/Health/Social Services	11%
Leisure/Hospitality	8%
Financial Activities	8%
Manufacturing	8%
Construction	6%
Information	3%
Other Services	3%
Mining	<1%

Source: Department of Workforce Services

According to the Bureau of Labor Statistics, the unemployment rate in Salt Lake County in September, 2018, was 2.9%, but had dropped to 2.0% by September, 2019. Looking ahead, the table below shows the employed population within the County are projected to increase by 72% from 2015 to 2065.

Table: Salt Lake County Employment Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	844,316	1,053,362	1,182,092	1,293,225	1,385,240	1,454,567	610,251	72%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

Income

According to the Bureau of Labor Statistics, the average weekly wages for all industries within the Salt Lake City area is $1,130. A further income breakdown can be seen below.

	Number	Percent	National Avg.
Total households	363,058	-	
Less than $10,000	15,516	4.3%	6.7%
$10,000 to $14,999	11,481	3.2%	4.9%
$15,000 to $24,999	25,869	7.1%	9.8%
$25,000 to $34,999	29,505	8.1%	9.5%
$35,000 to $49,999	45,206	12.5%	13.0%
$50,000 to $74,999	72,896	20.1%	17.7%
$75,000 to $99,999	54,190	14.9%	12.3%
$100,000 to $149,999	61,450	16.9%	14.1%
$150,000 to $199,999	23,214	6.4%	5.8%
$200,000 or more	23,731	6.5%	6.3%
Median household income	$67,922		
Mean household income	$88,315		

Source: 2017 American Community Survey

Poverty

A breakdown of poverty numbers by gender and age, race and ethnicity, education, employment status, and income for the County, according to 2015 ACS data, can be seen in the following figure.

Figure: Salt Lake County Poverty Breakdown

Gender & Age	Salt Lake County Poverty Rates	State of Utah Poverty Rates	United States Poverty Rates
Overall	12.4%	12.3%	15.5%
Children (under 5)	17.3%	15.7%	24.5%
Children (under 18)	16.2%	14.3%	21.7%
Adults (18-64 yrs)	11.4%	12.2%	14.5%
Seniors (65 and older)	6.8%	6.5%	9.4%
Men	11.5%	11.4%	14.2%
Women	13.2%	13.2%	16.7%
Race & Ethnicity			
White Alone, not Hispanic or Latino	8.2%	9.5%	10.8%
Hispanic or Latino	24.6%	24.8%	24.3%
African American	25.9%	23.2%	27.0%
Asian	17.1%	17.8%	12.6%
American Indian and Alaska Native	31.5%	31.7%	28.3%
Hawaiian or Pacific Islander	25.4%	22.3%	21.0%
Education (25 years & older)			
Less than high school graduate	23.5%	23.2%	27.5%
High school graduate (and equiv.)	11.8%	11.2%	14.3%
Some college, associate's degree	8.0%	8.5%	10.5%
Bachelor's degree or higher	4.5%	4.5%	4.5%
Employment Status (16 years & older)			
Employed Men	6.2%	6.9%	6.3%
Employed Women	7.5%	8.9%	8.4%
Unemployed Men	29.6%	27.2%	30.3%
Unemployed Women	34.5%	32.7%	36.4%
Income and Benefits (by household)			
Less than $10,000	4.8%	4.9%	7.2%
$10,000 to $14,999	3.6%	3.8%	5.3%
$15,000 to $24,999	8.5%	8.6%	10.6%
$25,000 to $34,999	8.9%	9.2%	10.1%
$35,000 to $49,999	13.3%	13.8%	13.4%
$50,000 to $74,999	20.5%	21.1%	17.8%
$75,000 to $99,999	14.8%	15.0%	12.1%
$100,000 to $149,999	15.0%	14.6%	13.1%
$150,000 to $199,999	5.3%	4.8%	5.1%
$200,000 or more	5.1%	4.2%	5.3%

Source: 2015 U.S. Census, American Community Survey; Data Compiled by Weber.edu.

Critical Facilities and Infrastructure

State-Owned Facilities

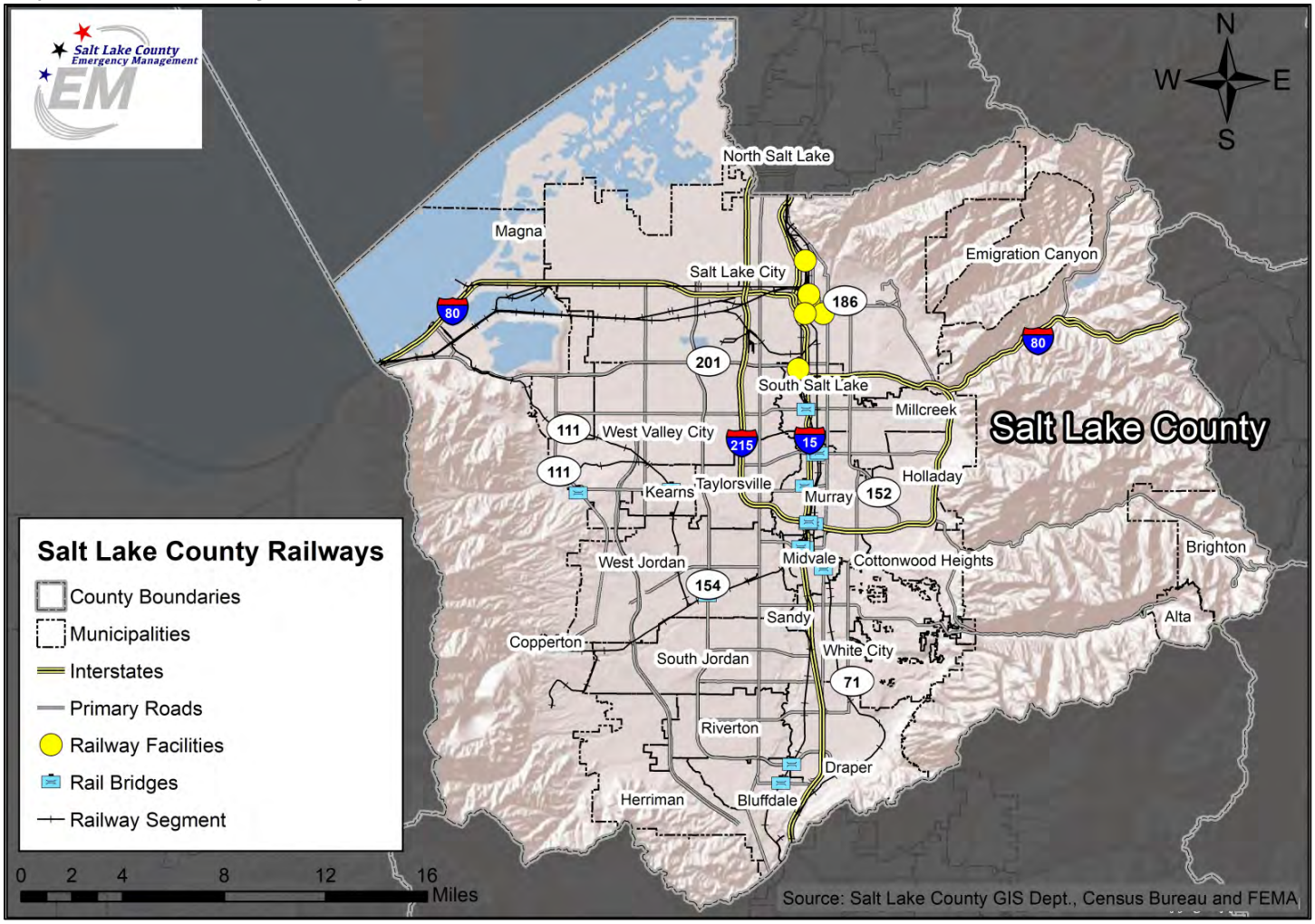
There are currently 1,463 state-owned facilities within Salt Lake County, with a total insured value of approximately $7.3 billion.

Transportation

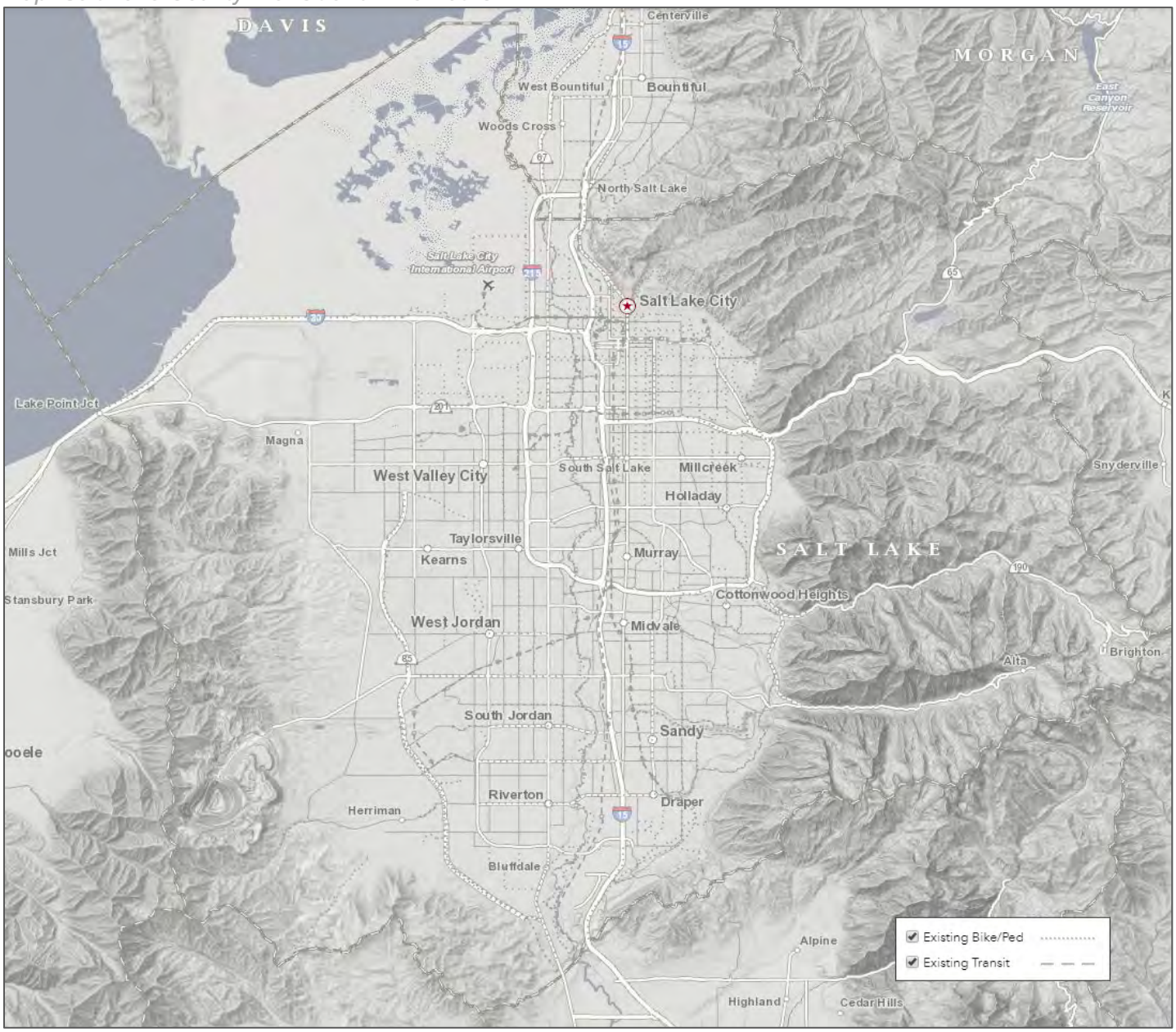
As of 2018, the Salt Lake County International Airport was the 23rd busiest airport in the United States, operating as a major hub for both Delta Air Lines and SkyWest Airlines. Although not visible in the image below, the South Valley Regional Airport is also available for public use and is located in West Jordan.

As can be seen in the image below, Salt Lake County can be traversed by several Interstate Highways, including I-15, I-80, and I-215. Numerous other freeways, expressways, and significant arterial routes interconnect within the County, including routes like SR-68, SR-201, and SR-154. The County also contains numerous bike paths for active transportation.

Map: Salt Lake County Railways

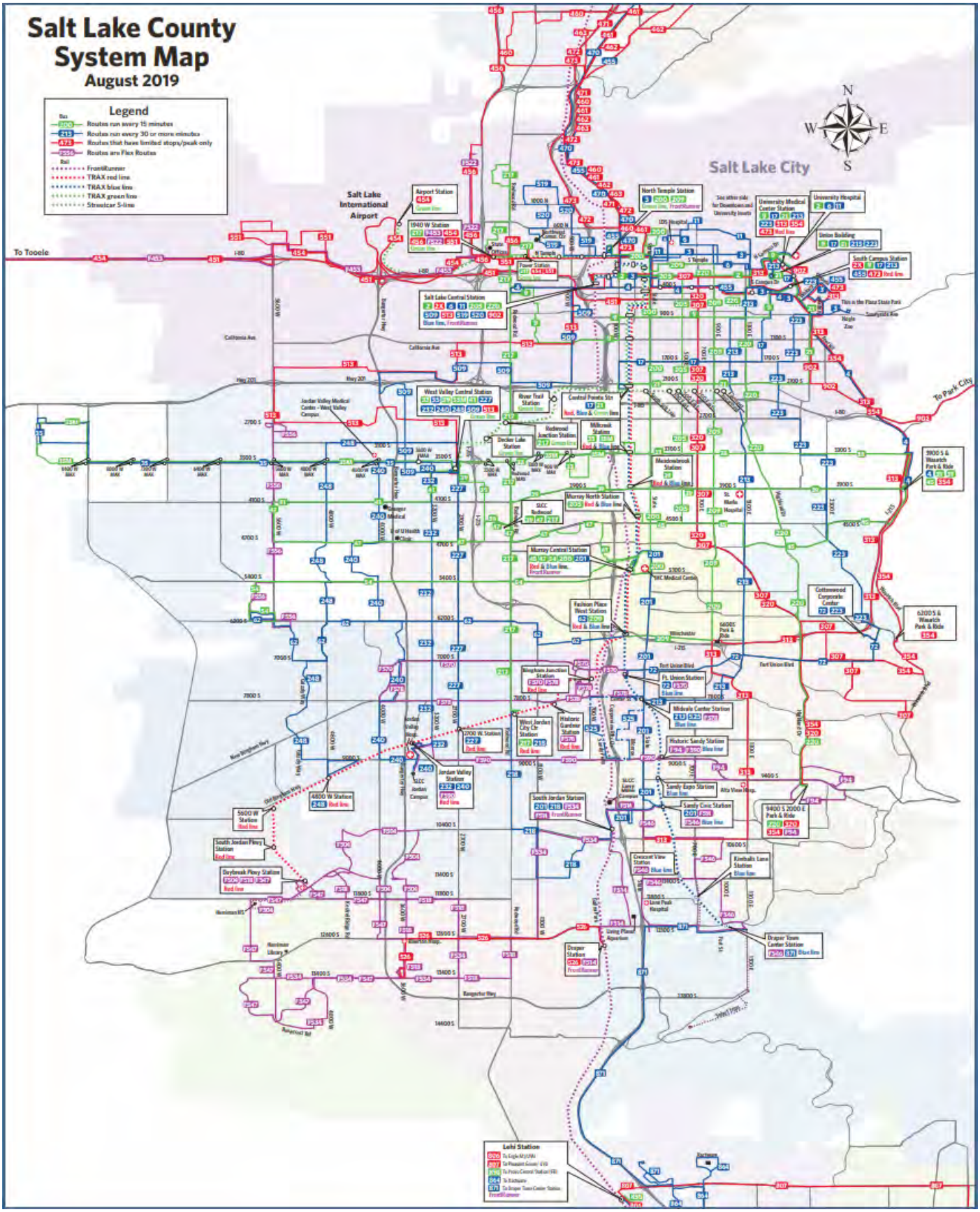


Map: Salt Lake County Transit and Bike Paths



Source: Wasatch Choice: 2019 - 2050 Regional Transportation Map

The County is also heavily networked with bus and commuter rail lines operated by the Utah Transit Authority (UTA). The *FrontRunner* commuter rail line, TRAX light rail system, S-Line historic streetcar, and numerous bus routes are all used for public transportation throughout Salt Lake County.



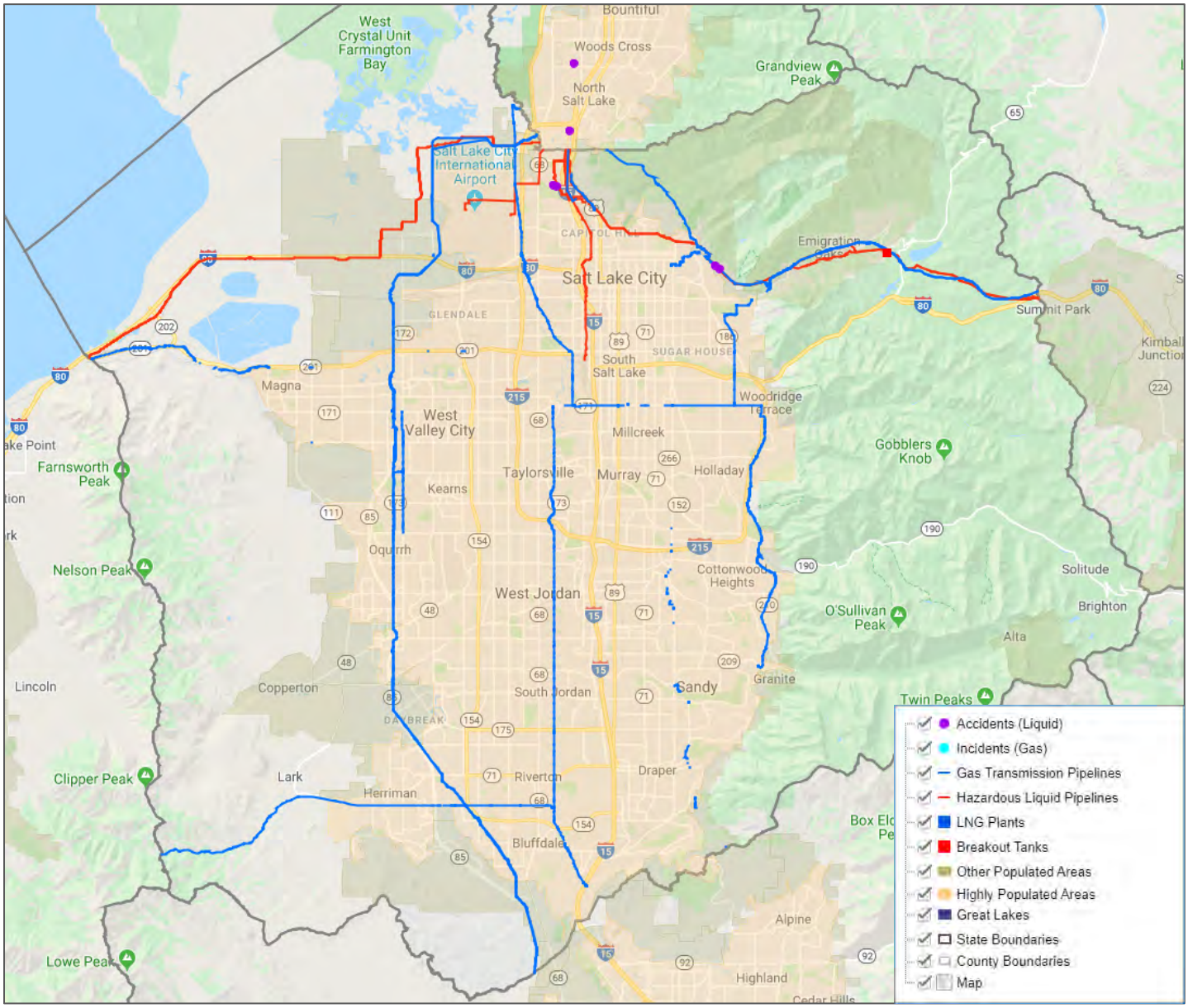
Source: www.RideUTA.com

Water Control Structures

According to the 2019 Utah State Hazard Mitigation Plan, there are approximately 282 dam structures within Salt Lake County. The National Levee Database also maps 5 levee systems (160 levee structures) within the County.

Pipelines

The National Pipelines Mapping System has a public map viewer that can be used to view the gas transmission and hazardous liquid pipelines within Salt Lake County, as can be seen in the image below.



Source: https://pvnpms.phmsa.dot.gov/PublicViewer/

Communications

The major newspapers within the County include the *Salt Lake County Tribune* and *Deseret News*, although numerous others are in circulation within the County. There are approximately 17 full-power television stations in the Salt Lake City market. There are also approximately 30 Trunked Radio Systems in Salt Lake County, as can be seen in the image below.

System Name	Type	City
Alta Ski Lifts Company	Motorola Type II Smartnet	Alta
Brian Leifson	Motorola Type II Smartnet	Salt Lake City
Church of Jesus Christ of Latter Day Saints	Project 25 Phase I	Salt Lake City
City Creek Center	DMR Motorola Capacity Plus Single Site (TRBO)	Salt Lake City
Delta Air Lines, Inc.	Motorola Type II Smartnet	Salt Lake
DMR-Utah Amateur Radio Network	DMR Conventional Networked	Multiple
Hill Air Force Base	Project 25 Phase I	Various
Intel Corporation	Motorola Type II	Salt Lake City
Intermountain Health Care Hospital	NXDN NEXEDGE 4800	Various
Kennecott Utah Copper (Capacity Plus)	DMR Motorola Capacity Plus Multi Site (TRBO)	Magna
Kennecott Utah Copper (Connect Plus)	DMR Motorola Connect Plus (TRBO)	Magna
Kennecott Utah Copper (P25)	Project 25 Phase I	Magna
Kilgore Companies	NXDN Icom IDAS Type C	Various
Little America	DMR Motorola Capacity Plus Multi Site (TRBO)	Salt Lake City
McIntosh Communications (Ensign Peak)	LTR Standard	Salt Lake City
National Security Agency Data Centers	Project 25 Phase I	Multiple
Peak Wireless Services	NXDN NEXEDGE 9600	Multiple
Questar-Dominion DT3	DMR Tier 3	Multiple
RPAI Southwest Management	DMR Motorola Capacity Plus Single Site (TRBO)	Salt Lake City
Salt Lake City Public Safety	Motorola Type II	Salt Lake City
Salt Lake County Public Works	Motorola Type II Smartnet	Salt Lake City
Sun Communications	DMR Motorola Capacity Plus Single Site (TRBO)	Salt Lake City
Tesoro Refinery	Motorola Type II	Salt Lake City
UCS Wireless	Motorola Type II Smartnet	Salt Lake City
Unified Fire Authority	Project 25 Phase I	Salt Lake City
Unified Fire Authority (BD10)	Motorola Type II	Salt Lake City
University of Utah Hospitals	NXDN NEXEDGE 4800	Salt Lake City
Utah Communications Authority	Motorola Type II SmartZone Omnilink	Various
Utah Communications Inc	DMR Motorola Connect Plus (TRBO)	
Utah Transit Authority	MPT-1327 Standard	Salt Lake City

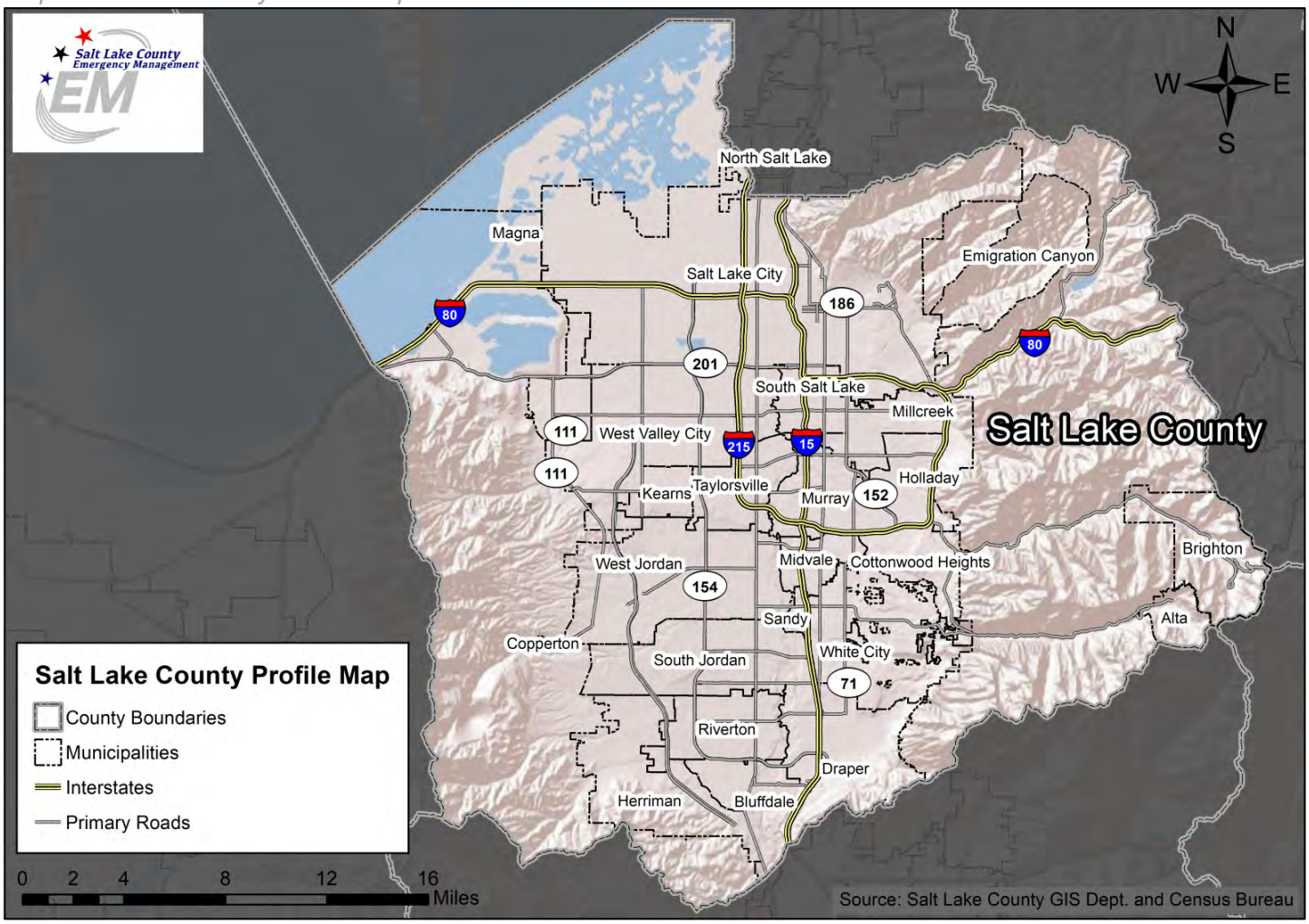
Source: www.radioreference.com

Geography, Land Use, and Development

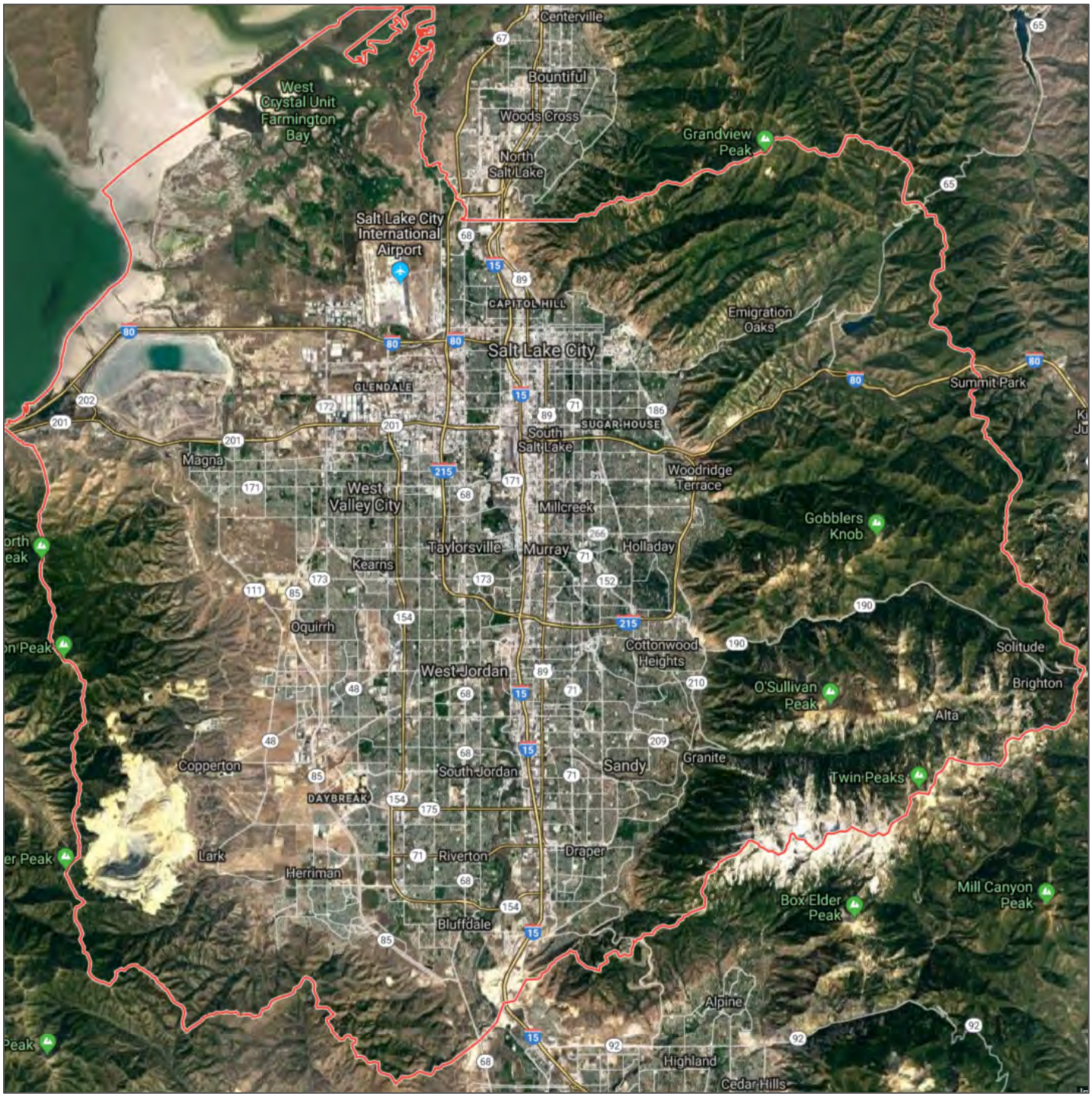
Geography

At approximately 807.37 square miles, including 65.09 square miles of water area, Salt Lake County is the fifth smallest county in Utah by land area. Tooele County borders Salt Lake County 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 Great Salt Lake occupies much of the northwest corner of the county. The Wasatch and Oquirrh Mountains form the East and West borders of the County respectively, as can be seen in the image below.

Map: Salt Lake County Profile Map



Map: Salt Lake County Topographical View

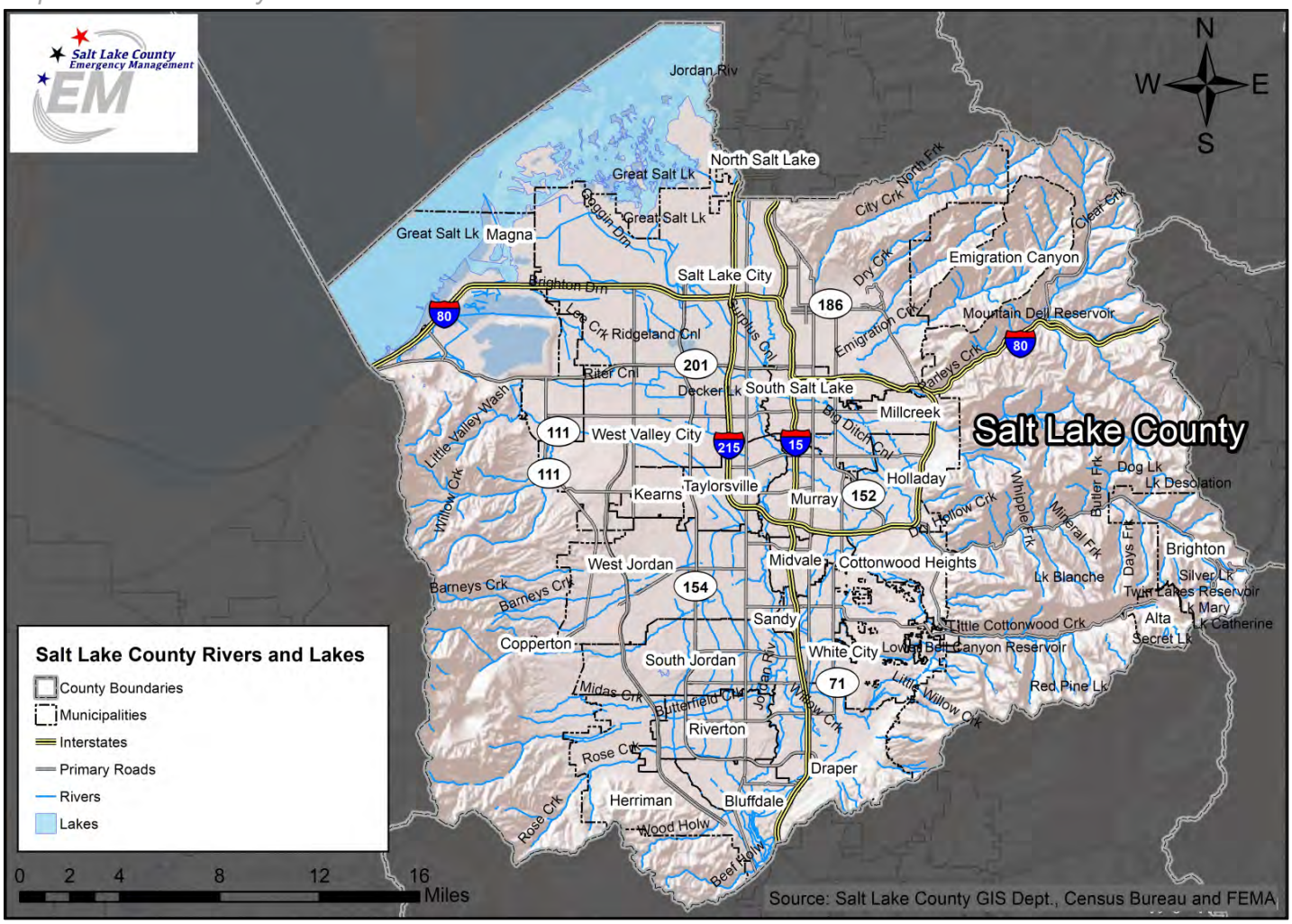


Source: Google Maps

Land Use and Development

Within Salt Lake County are 17 cities: Alta, Bluffdale, Cottonwood Heights, Draper, Herriman, Holladay, Midvale, Millcreek, Murray, Riverton, Sandy, Salt Lake City, South Jordan, South Salt Lake, Taylorsville, West Jordan, and West Valley City. There are also 5 Metro Townships: Copperton, Emigration, Kearns, Magna, and White City. Brighton was incorporated in 2020. There are also several distinct unincorporated areas with substantial populations including Big Cottonwood, Camp Williams, Canyon Rim, Granite West, Mount Olympus, Parley's Canyon, Sandy Hills, Southwest, and Willow Canyon. Salt Lake County's land ownership is approximately 72.8% private, 20.4% Federal, 2.3% State, and 4.6% water.

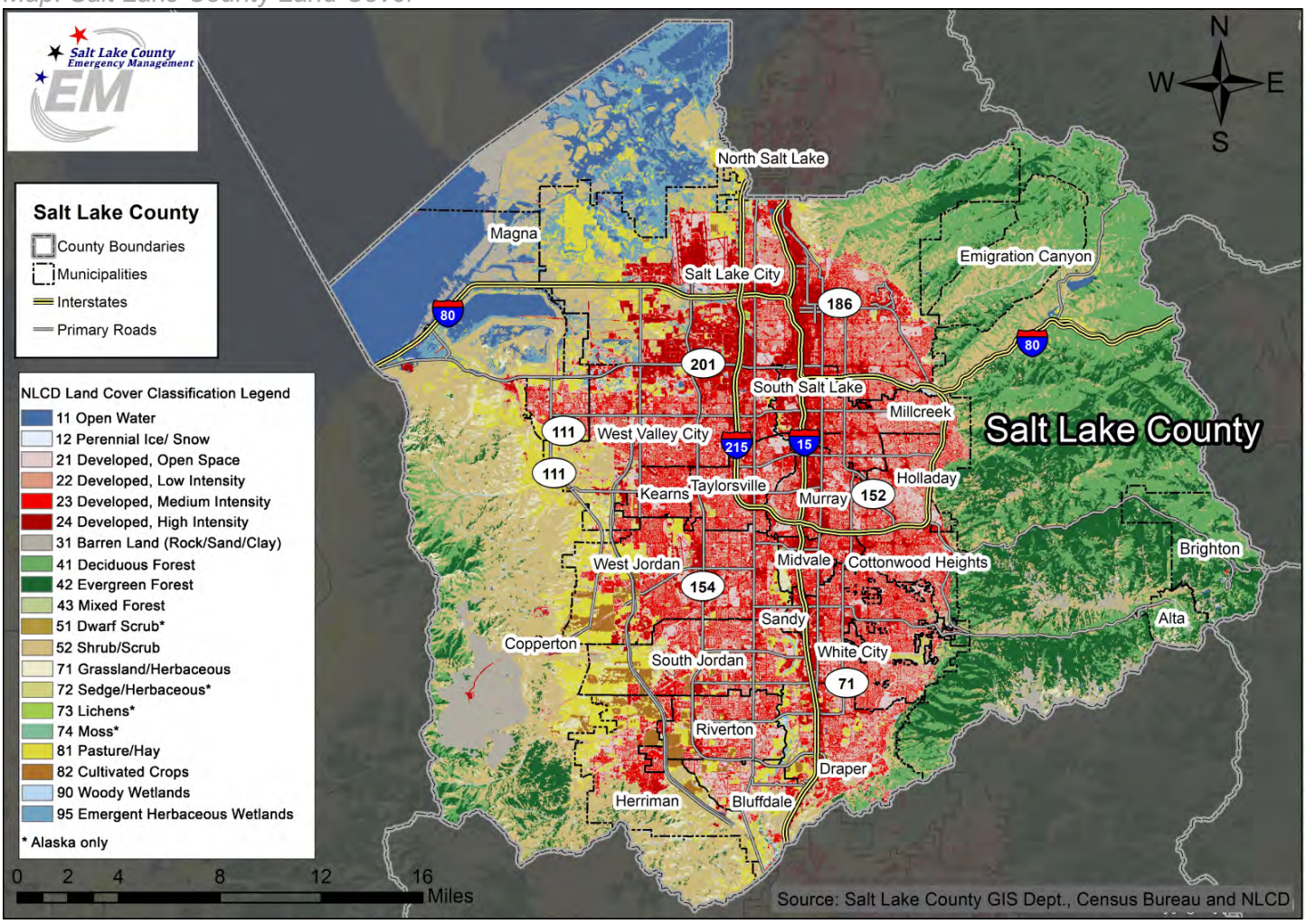
Map: Salt Lake County Rivers and Lakes



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 still 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. Kennecott Utah Copper Corporation currently holds much of this land.

Map: Salt Lake County Land Cover



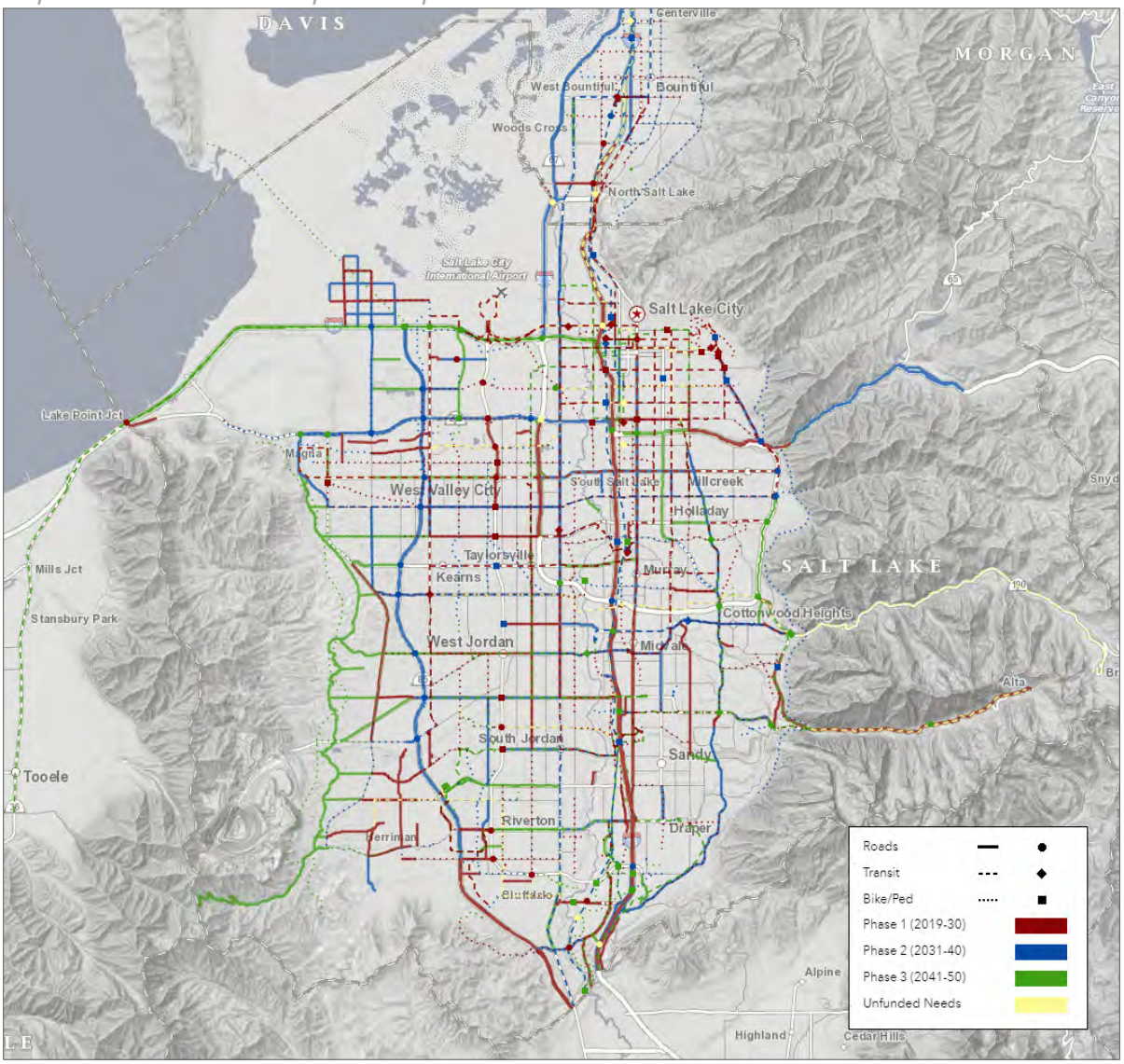
Salt Lake County anticipates continued population growth over the next 30 years, reaching almost 5 million by 2050. This growth necessitates development of key infrastructure guided by long range planning. To that end, the Wasatch Front Regional Council (WFRC) is responsible for coordinating the transportation planning process for the region. WFRC is an Association of Governments comprised of elected officials from Box Elder, Davis, Morgan, Salt Lake, Tooele, and Weber counties. The WFRC has facilitated the development of the Wasatch Choice 2050 Plan, which is the communities' shared vision for transportation investments, development patterns, and economic opportunities. Wasatch Choice envisions transportation investments and inter-related land and economic development decisions that achieve desired local and regional outcomes.

Four key strategies represent the overarching themes in the WC2050 Vision and help achieve the Regional Goals. The key strategies of Wasatch Choice are as follows.

- **Provide Transportation Choices:** Help us have real options in how we choose to get around and increase the number of easily reached destinations.
- **Support Housing Options:** Support housing types and locations that we can both afford and work best for our lives.
- **Preserve Open Space:** Preserve sufficient and easily accessible open lands that provide us with recreational opportunities.
- **Link Economic Development with Transportation and Housing Decisions:** Create a synergy between these three key building blocks. Enable shorter and less expensive travel to afford us more time and money. Efficiently utilize infrastructure to save taxpayer dollars. Provide housing options and increase housing affordability. Improve the air we breathe by reducing auto emissions.

Wasatch Choice is implemented through Comprehensive Economic Development Strategy, Local Planning, and Regional Transportation Plans (RTP). The maps below from the 2019 - 2050 RTP show the region's vision for future transportation and land use.

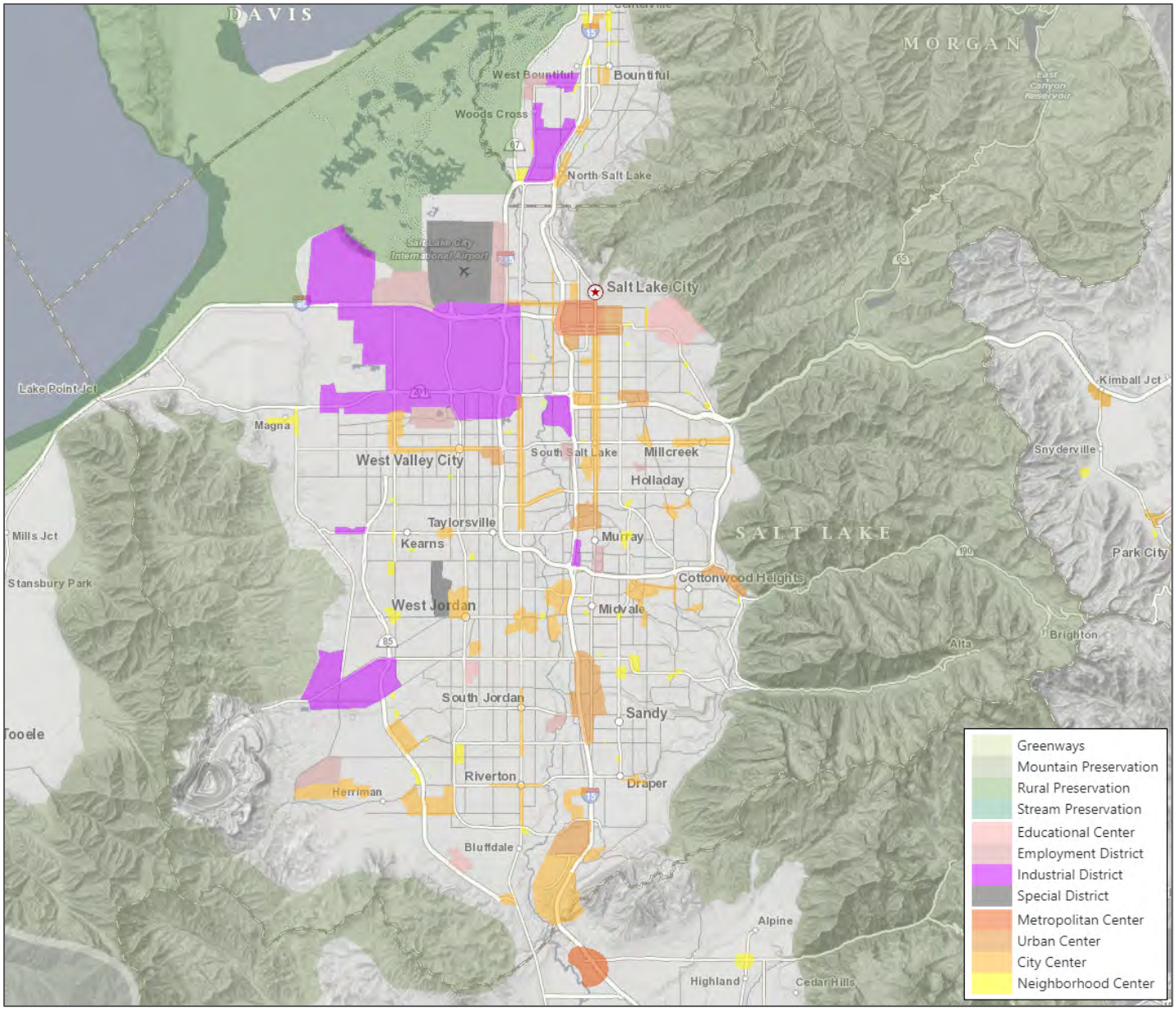
Map: Wasatch Choice Map - Transportation



Source: *www.wfrc.org*

As can be seen in the map below, the regionally significant land uses include a hierarchy of centers. Centers are the hearts of a community and are locations where communities anticipate welcoming more intense buildings, even as they may maintain lower levels of intensity elsewhere. They vary in scale but in all cases are more intense than their surrounding area, are walkable, and offer a mix of uses. Because of these traits, residents within or near centers drive shorter distances and are more apt to walk, bike, and ride transit. Overall, this means less traffic congestion and reduced air emissions. In addition, they are typically good candidate locations for providing a variety of housing options, including units that impact housing affordability.

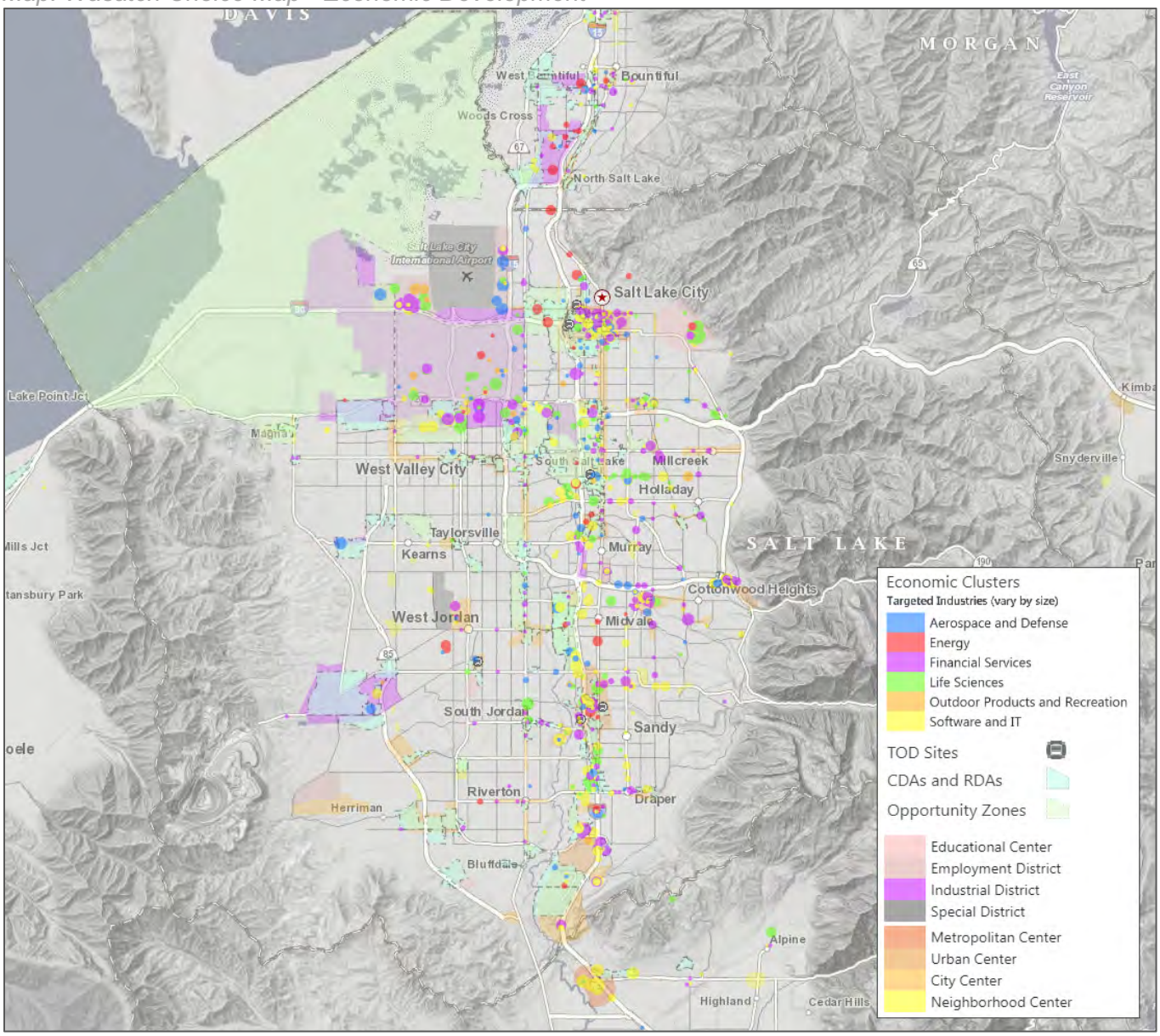
Map: Wasatch Choice Map - Land Use



Source: www.wfrc.org

The Economic Development information shown on the map shows several important regional policy and geographic considerations: Utah State Economic Clusters, Opportunity Zones, CDA and RDA areas, and Transit Oriented Developments. Utah's industry clusters are aerospace and defense, energy, financial services, life sciences, outdoor products and recreation, and software and IT. Nurturing industry clusters helps both the State and Salt Lake County sustain a competitive business advantage. Opportunity Zones are areas determined by the US census as "low-income communities." Designated Opportunity Zones incentivize private sector investments in housing and economic development in these areas by providing tax incentives for the developments. CDAs and CRAs are public financing tools. They temporarily utilize the increase in tax revenue spurred by land reinvestment in order to pay for things like infrastructure improvements. By doing so they further encourage land reinvestment. TOD refers to housing, jobs, and commercial developments focused around transit. Development that is well integrated with transit choices provides additional transportation choices, and positively impacts the economy through increased accessibility to jobs and housing. TOD helps reduce household transportation costs, congestion, and emissions of air pollution.

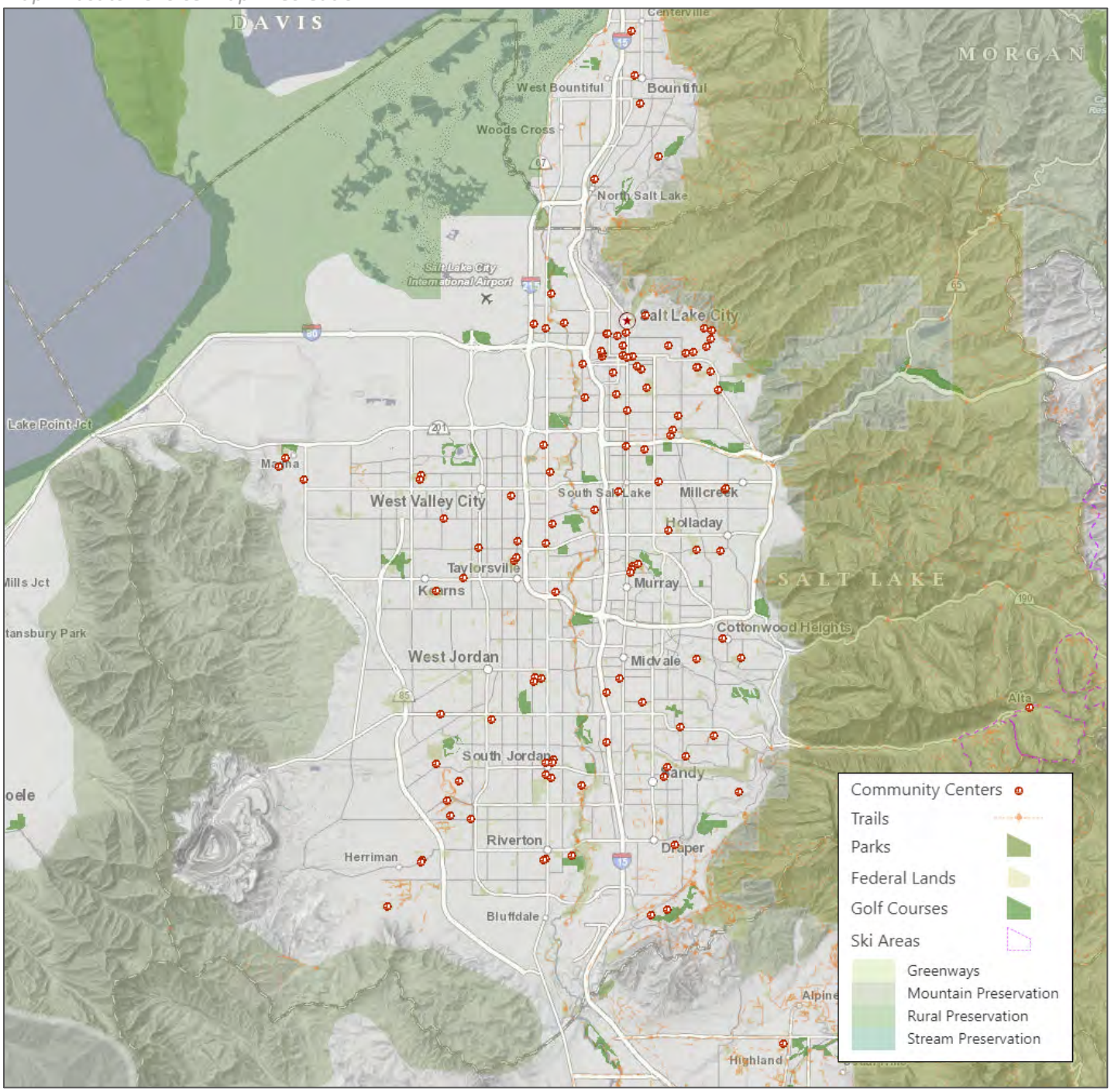
Map: Wasatch Choice Map - Economic Development



Source: www.wfrc.org

The Wasatch Front region is endowed with a stunning natural setting. One of the challenges as growth continues is to ensure residents have sufficient open space and recreational opportunities that are also easy to access. Open space can manifest itself in a number of different ways: natural, untouched landscapes; mountain trails; bird sanctuaries; rivers and lakes; places of solitude; playgrounds; paved urban trails; neighborhood pocket parks; regional urban parks; sports complexes; and places of community gathering, among many more. In addition to the health benefits, both mental and physical, for people using these spaces, open space is critical green infrastructure.

Map: Wasatch Choice Map - Recreation



Source: www.wfrc.org

As the region grows, a diversity of open space and recreation opportunities must be planned to maintain the quality of life that so many Utah and County residents currently enjoy. Setting local goals for park space per household, is one way to focus attention on providing recreational spaces in growth areas. Attention to parks is becoming even more important as the region densifies with high rates of multifamily residential development. Establishing goals and intentions is a great step, but energy and funding must also be put into making new parks become reality.

In addition, recreation planning should look to enhance access to these spaces via walking and biking. This can be accomplished by linking these spaces through a biking and walking network such as the 100 mile Golden Spoke network of off-street paved pathways consisting of the Provo River Parkway, Murdock Canal Trail, Jordan River Parkway, Legacy Parkway Trail, Denver & Rio Grande Western Trail, and Ogden River Trail.

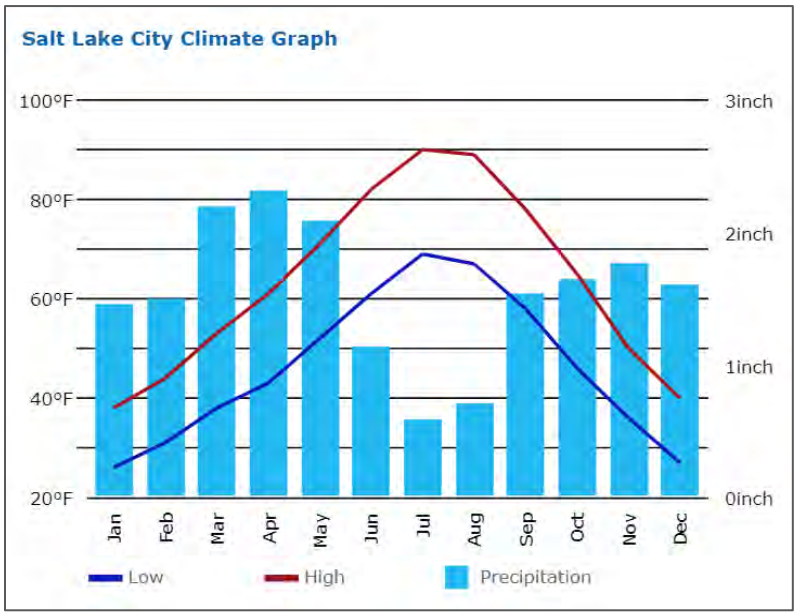
Climate and Weather

The climate averages and weather data for Salt Lake County can be seen in the tables below.

Table: Salt Lake County Climate Overview

	Salt Lake, Utah	United States
Rainfall	19.6 in.	38.1 in.
Snowfall	54.2 in.	27.8 in.
Precipitation	90.2 days	106.2 days
Sunny	226 days	205 days
Avg. July High	91.4º	85.8º
Avg. Jan Low	22.8º	21.7º
Comfort Index (higher=better)	7.1	7
UV Index	4.7	4.3
Elevation	5599 ft.	2443 ft.

Source: www.bestplaces.net



Source: www.climatedata.com

Table: Average Monthly High and Low (ºF)

	High	Low
January	38º	23º
February	44º	26º
March	54º	34º
April	62º	40º
May	72º	48º
June	83º	57º
July	91º	65º
August	89º	63º
September	79º	53º
October	65º	42º
November	50º	32º
December	39º	24º

Source: www.bestplaces.net

Table: Average Monthly High and Low (ºF)

	Hot Days	Freezing Days	Rainy Days	Snowy Days
January	0	26	9	6
February	0	21	9	5
March	0	12	9	3
April	0	5	10	2
May	1	1	9	0
June	7	0	5	0
July	20	0	4	0
August	15	0	5	0
September	2	0	6	0
October	0	3	7	1
November	0	16	9	3
December	0	26	9	6

Source: *www.bestplaces.net*

CAPABILITY ASSESSMENT

This section provides an assessment of county hazard mitigation capabilities, including any policies, regulations, procedures, programs, and projects that contribute to the lessening of disaster damages within all of the communities listed in this Plan. At the County level, a summary of the jurisdiction's tools available for pre- and post-disaster hazard mitigation is provided as well as development management. For jurisdictions, a comprehensive overview of existing planning policies, programs, and capabilities which support hazard mitigation activities are included in Volume 2 as well.

The purpose of conducting a capability assessment is to determine the ability of the County to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing for enhancing specific mitigation policies, programs or projects. The assessment has two primary components: an inventory of the County's relevant plans, laws regulations and policies and/or programs already in place and an analysis of its capacity to carry them out. A careful examination of capabilities will detect any existing gaps, shortfalls or weaknesses associated with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate hazard vulnerability. The capability assessment also provides an opportunity to highlight the positive mitigation measures already in place or being implemented throughout the County, which should continue to be supported and enhanced if possible, through future mitigation efforts.

Countywide Capability Assessment

Plans	Yes/No Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Yes 1989 to Present	Yes to All
Capital Improvements Plan	Current	Yes to All
Economic Development Plan	Current	Yes to All
Local Emergency Operations Plan	Current	Yes to All
Continuity of Operations Plan	Current	Yes to All
Transportation Plan	Current	Yes to All
Stormwater Management Plan	Current	Yes to All
Community Wildfire Protection Plan	Current	Yes to All
Other special plans (i.e., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		

Building Code, Permitting, and Inspections	Yes/No	Are codes adequately enforced?
Building Code	Yes	Yes – 2012 International Codes (ICC)
Fire department ISO rating	Yes	Yes
Site plan review requirements	Yes	Yes
Land Use Planning and Ordinances	**Yes/No**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	Yes	Yes to All
Subdivision ordinance	Yes	Yes to All
Floodplain ordinance	Yes	Yes to All
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Yes	Yes to All
Flood insurance rate maps	Yes	Yes to All
Acquisition of land for open space and public recreation uses	Yes	Yes to All
Other		
Administration	**Yes/No**	**Describe capability Is coordination effective?**
Planning Commission	Yes	Salt Lake County Council of Governments; Regional Development
Mitigation Planning Committee	Yes	Representatives from the agencies listed in this document are members of the Mitigation Planning Committee
Maintenance programs to reduce risk, e.g., tree trimming, clearing drainage systems	Yes	Ongoing – Regulated through ordinance and part of the County's responsibility as well
Mutual aid agreements	Yes	Public Works and other County Agencies have mutual aid agreements with the other jurisdictions and special service districts throughout the valley as well as neighboring counties.

Staff	Yes/No FT/PT[1]	Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?
Chief Building Official	Yes	Yes to All
Floodplain Administrator	Yes	Yes to All
Emergency Manager	Yes	Yes to All
Community Planner	Yes	Yes to All
Civil Engineer	Yes	Yes to All
GIS Coordinator	Yes	Yes to All
Other		
Technical	**Yes/No**	**Describe capability Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)	Yes	Yes – As shortfalls are identified, action is taken to correct deficiencies. A county-wide notification system is currently being considered.
Hazard data and information	Yes	Hazards data and information is available via SLCo EM.
Grant writing	Yes	Salt Lake County employs a number of personnel who seek and write grant proposals. Grant personnel are also found throughout the various departments and agencies of Salt Lake County.
Hazus analysis	Yes	The County performs HAZUS analysis and uses this data in conjunction with all planning efforts.
Other		

[1] Full-time (FT) or part-time (PT) position

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Yes	Yes – NRCS for Flood Control Facilities
Authority to levy taxes for specific purposes	Yes	Yes - Fire Area Tax – Levied with property taxes
Fees for water, sewer, gas, or electric services	Yes	Yes - These services are provided in part by the private sector
Impact fees for new development	Yes	Yes - All new development.
Storm water utility fee	Yes	Yes
Incur debt through general obligation bonds and/or special tax bonds	Yes	Yes – Used to upgrade water systems to meet fire-flow requirements
Incur debt through private activities	Yes	
Community Development Block Grant	Yes	
Other federal funding programs	Yes	
State funding programs	Yes	
Other		

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation? Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	Yes – Open Space initiatives and Meals on Wheels programs and other social programs administered by the County Health Department; VOAD
Ongoing public education or information program, e.g., responsible water use, fire safety, household preparedness, environmental education.	Yes	Yes – County Agencies providing public outreach – Flood Control, Planning and Development Services – Building Department, County Health Department, Business and Economic Development.
Natural disaster or safety related school programs	Yes	Cooperation with schools with the “Safe Neighborhoods Program”
StormReady certification	Yes	
Firewise Communities certification	Yes	
Public-private partnership initiatives addressing disaster-related issues	Yes	Yes – Participation with the Private Sector Coordinating Council

An overview of other existing capabilities, resources, and programs are listed below.

Be Ready Utah

Be Ready Utah is the state's official emergency preparedness campaign managed by the Utah Department of Public Safety's Division of Emergency Management (DEM). The Be Ready Utah campaign was officially launched in April 2005 at the annual League of Cities and Towns conference in St. George, Utah following the devastating floods in January 2005.

Be Ready Utah provides valuable information for individuals and families, communities, public safety professionals, business and civic leaders, school administrators and volunteers. We believe that preparedness leads to prosperity. Every community has the opportunity to provide resources to prepare its citizens and Be Ready Utah can help prepare Utah.

Hazard Mitigation Grant Program Administrative Plans

In the event of a presidential disaster declaration, a Hazard Mitigation Grant Program Administrative Plan is edited and updated. Edits may be extensive and may require new sections to be developed depending on the regulatory changes between disaster declarations. Administrative Plans document the process for the administration of HMGP and the project management of the mitigation measures to be funded under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. They set forth agency guidance for the eligibility, development, submission, review, and recommendation of HMGP applications relative to federal disaster declarations. Topics including responsibilities and staffing, identification and evaluation of mitigation projects, application procedures, and financial management are addressed. SLCo EM will also provide quarterly information sessions for municipal officials on the post-disaster grant funding application process.

Salt Lake County Emergency Coordination Center (ECC)

The County ECC is a technologically advanced facility staffed and operated 24-hours a day by highly trained personnel. Each of the Emergency Support Function (ESF) agencies is required to send a representative to the ECC during emergencies and exercises. During emergencies, personnel from other county agencies staff the ECC. At the county and local levels, ECCs are also the central coordination point for response and recovery efforts. These facilities range from large and highly sophisticated to small and simple.

Technical and Communication Tools

SLCo EM is capable of assisting all levels of government in post-disaster situations. The agency has both the technical expertise and the communication tools available to provide disaster-related coordination. For example, HAZUS, Geographic Information Systems (GIS), a 24-hour call center, WebEOC, and video telecommunication can all be used in post-disaster situations.

Public Safety Emergency Telephone Act

Act 78 (i.e. the Public Safety Emergency Telephone Act, 1990-78), as amended, is designed to provide a toll-free standard number (911) accessible from both land and cellular phones for any individual in the county to gain rapid, direct access to emergency services. The act places responsibility for developing a 911 system on county government. It provides for user contributions based on the number of lines of telephone service. These contributions are administered at the county level. Act 78 establishes technical, training and certification guidelines, and minimum standards to be met in developing the county 911 plan. It encourages the development of enhanced 911 systems and constant improvement of existing systems.

Post-Disaster Capability

Salt Lake County's post-disaster capability is built on staff and the training they receive to know and practice their post-disaster responsibilities. SLCo EM staff are cross-trained so that they can fulfill multiple roles in the post-disaster environment. Salt Lake County and SLCo EM staff have access to multiple technical and communication tools, including the Salt Lake County Emergency Operations Center, that supports their ability to respond effectively in post-disaster situations. The Public Safety Emergency Telephone Act supports identification of disaster needs to emergency responders and managers. The most prominent emerging policy or program impacting post-disaster capability is the program to regularly host training and exercises of post-disaster capability.

Repetitive Loss and Severe Repetitive Loss Capability

SLCo EM staff will have a continuous twelve-month approach to mitigating repetitive loss and severe repetitive loss properties. This continuous approach supports both pre- and post-disaster grant funding streams. Specifically in the post-disaster situation, mitigating both repetitive loss (RL) and severe repetitive loss (SRL) properties is a criterion used by the state committee that reviews the HMGP applications. For instance, if all items in an HMGP were equal, an application for an RL or SRL property would be prioritized over a non-RL or SRL property.

Development Management Capability

In Salt Lake County, local municipalities regulate development. They do this by adopting zoning ordinances, floodplain ordinances, and subdivision and land development ordinances—and grant building permits by verifying that development proposals are consistent with these documents. Local municipalities have several effective tools at their disposal to address development in hazard prone area. These tools are discussed below.

Zoning ordinances allow for local communities to regulate the use of land in order to protect the interest and safety of the general public. Zoning ordinances can be designed to address unique conditions or concerns within a given community. They may be used to create buffers between structures and high-risk areas, limit the type or density of development and/or require land development to consider specific hazard vulnerabilities.

Subdivision and land development ordinances are intended to regulate the development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Within these ordinances, guidelines on how land will be divided, the placement and size of roads and the location of infrastructure can reduce exposure of development to hazard events

To protect people and structures from flood hazards, FEMA administers the National Flood Insurance Program that has an objective to guide development away from high-flood risk areas. Local municipalities participate through ordinance adoption and floodplain regulation and as a condition of community participation in the NFIP structures built within the Special Flood Hazard Area must adhere to the floodplain management regulations.

Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether.

Municipalities can also participate in the NFIP's CRS program. Community participation in this program can provide premium reductions for properties located outside of Special Flood Hazard Areas of up to 10-percent and reductions for properties located in Special Flood Hazard Areas of up to 45-percent. These discounts can

be obtained by undertaking public information, mapping and regulations, flood damage reduction and flood preparedness activities.

The County also has policies to regulate construction standards for new construction and substantially renovated buildings. Building codes regulate construction standards for new construction and substantially renovated buildings. Standards can be adopted that require resistant or resilient building design practices to address hazard impacts common to a given community.

Local Capability Assessments

The capability assessments for each local, participating jurisdiction can be found within each jurisdiction's annex in Volume 2 of this Plan.

RISK ASSESSMENT

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, injury or disability, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation must be based on a sound risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people to all relevant hazards within the planning area.

Disaster Declarations

The following lists all of the major disaster or assistance declarations that have impacted Salt Lake County since 2010.

- Utah Severe Winter Storms and Flooding (DR-4311) Incident Period: February 07, 2017 to February 27, 2017. Major Disaster Declaration declared on April 21, 2017. Total Public Assistance Grants Dollars Obligated: $3,383,180.16
- Utah Severe Storm and Flooding (DR-4088) Incident Period: September 11, 2012. Major Disaster Declaration declared on November 03, 2012. Total Public Assistance Grants Dollars Obligated: $1,653,796.77
- Utah Rose Crest Fire (FM-2991) Incident Period: June 29, 2012 to June 30, 2012. Fire Management Assistance Declaration declared on June 29, 2012.
- Utah Severe Storm (DR-4053) Incident period: November 30, 2011 to December 1, 2011. Major Disaster Declaration declared on February 1, 2012. Total Public Assistance Grants Dollars Obligated: $2,564,683.72
- Utah Flooding (DR-4011) Incident period: April 18, 2011 to July 16, 2011. Major Disaster Declaration declared on August 8, 2011. Total Public Assistance Grants Dollars Obligated: $8,701,342.50
- Utah Machine Gun Fire (FM-2859) Incident period: September 19, 2010 to December 31, 1969. Fire Management Assistance Declaration declared on September 19, 2010.

The following represent incidents in which Salt Lake County supported but were not directly affected:

- Utah Bald Mountain Fire (FM-5277) Incident Period: September 21, 2018 to September 24, 2018. Fire Management Assistance Declaration declared on September 21, 2018.
- Utah Hilltop Fire (FM-5267) Incident Period: August 06, 2018 - August 11, 2018. Fire Management Assistance Declaration declared on August 06, 2018.

- Utah Dollar Ridge Fire (FM-5248) Incident Period: July 02, 2018 to July 22, 2018. Fire Management Assistance Declaration declared on July 02, 2018.
- Utah Uintah Fire (FM-5206) Incident Period: September 05, 2017 to September 08, 2017. Fire Management Assistance Declaration declared on September 05, 2017.
- Utah Brian Head Fire (FM-5185) Incident Period: June 17, 2017 to July 11, 2017. Fire Management Assistance Declaration declared on June 18, 2017.
- Utah Saddle Fire (FM-5130) Incident Period: June 21, 2016 to July 12, 2016. Fire Management Assistance Declaration declared on June 21, 2016.
- Utah Anaconda Fire (FM-5065) Incident Period: July 21, 2014 to July 22, 2014. Fire Management Assistance Declaration declared on July 21, 2014.
- Utah Rockport Five Fire (FM-5044) Incident Period: August 13, 2013 to August 19, 2013. Fire Management Assistance Declaration declared on August 13, 2013.
- Utah Shingle Fire (FM-2994) Incident Period: July 02, 2012 to July 09, 2012. Fire Management Assistance Declaration declared on July 02, 2012.
- Utah Clay Springs Fire (FM-2990) Incident Period: June 27, 2012 to July 07, 2012. Fire Management Assistance Declaration declared on June 27, 2012.
- Utah Wood Hollow Fire (FM-2986) Incident Period: June 24, 2012 to June 28, 2012. Fire Management Assistance Declaration declared on June 24, 2012.
- Utah Dump Fire (FM-2983) Incident Period: June 22, 2012 to June 24, 2012. Fire Management Assistance Declaration declared on June 22, 2012.

Hazard Profiles

Using existing natural hazards data and input gained through planning meetings, the Planning Team agreed upon a list of natural hazards that could affect Salt Lake County. Hazard data from the Utah State Department of Emergency Management and Mitigation, FEMA, the National Oceanic and Atmospheric Administration, and many other sources were examined to assess the significance of these hazards to the planning area. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries and property and economic damage. The natural hazards evaluated as part of this plan include those that occurred in the past or have the potential to cause significant human and/or monetary losses in the future.

The natural hazards identified and investigated as part of the Risk Assessment for the Salt Lake County Multi-Hazard Mitigation Plan include:

- Avalanche
- Dam Failure
- Drought
- Earthquake
- Flooding (Urban/Flash and Riverine Flooding)
- Landslide and Slope Failure
- Public Health Epidemic/Pandemic
- Radon
- Severe Weather
- Severe Winter Weather
- Tornado
- Wildfire

Other Hazards of interest were identified as having some potential to impact the planning area, but at a much lower risk level. These hazards included:

- Civil Disturbance
- Cyber Attack
- Hazardous Materials Incident (Transportation and Fixed Facility)
- Terrorism (Including Active Shooter Events)

Avalanche

A snow avalanche is the rapid down slope movement of a mass of snow, ice and debris. Snow avalanches occur in the mountains of Utah during the winter and spring as a result of snow accumulation and unstable snowpack conditions. Avalanches can be extremely destructive due to the forceful energy of rapidly moving snow and debris, and the burial of areas in the run out zones. Avalanches can cause damage to property, interruption of communications, blockage of transportation routes and streams and often result in injury and death (UNHH 2008). Avalanches have caused more fatalities than any other natural hazards in Utah. Over the past 20 years on average four people have been killed in the state each year.

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. Avalanches can occur naturally, or can be triggered artificially by explosives or by people such as snowmobilers, backcountry skiers, or other outdoor recreationists. Two main natural factors that affect avalanche activity are weather and terrain.

Weather events create a layered snowpack. When strong layers or slabs form on top of weak layers, the snowpack can become unstable. The amount of snow, rate of accumulation, wind speed and direction, moisture content and snow crystal type all contribute to snowpack stability conditions. Most natural avalanches occur during or within 24 hours after a storm. In Utah, the avalanche potential is greatest from December through April.

Terrain factors affecting avalanches include slope angle, elevation, aspect, shape and roughness. Slope angle is the primary factor of avalanche probability, with most occurring in the optimum angles between 30 and 45 degrees. Elevation and aspect dictate the depth, temperature and moisture characteristics of the snowpack. Slope shape and roughness contribute to stability. For example, bowl-shaped slopes are more prone to avalanches than ridges. Boulders, shrubs and trees contribute to the slope's roughness and provide some stability (UNHH 2008).

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).

Avalanche Hazard Profile

Potential Impact		High	**Probability**	X	High
		Medium			Medium
	X	Low			Low
		Minimal			Unlikely
Location	Occur in localized areas in canyons and foothills, primarily in the canyons of the Wasatch Mountains.				
Seasonal Conditions	Winter, spring				
Conditions	Vary based on weather conditions, slope, aspect, and landforms.				
Duration	Initial impact seconds, possibly days if avalanche impacts roads or structures				
Secondary Hazards	Traffic restrictions, limited access to and from canyon communities				
Analysis Used	National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historic events and scientific records.				

Range of Magnitude

Internationally, there is no firm consensus on the standard way to evaluate avalanche size and magnitude. Different scales that have been proposed use various measures like volume of snow transported relative to the avalanche path, potential or kinetic energy, depth of deposit, or measures of other observable factors like mass of the avalanche or water content of the debris.

Although all avalanche classification systems developed thus far have drawbacks, the Canadian system attempts to provide a compromise among the alternatives and still provide a practical tool for communication among most parties regarding avalanche magnitude.

Table: Canadian Snow Avalanche Size Classification System and Typical Factors

Size	Description	Typical Mass	Typical Path Length	Typical Impact Pressures
5	Largest snow avalanches known; could destroy a village or a forest of 40 hectares	10^5 t	3000 m	1000 kPa
4	Could destroy a railway car, large truck, several bldgs. or a forest with an area up to 4 hectares (40000 m^2)	10^4 t	2000 m	500 kPa
3	Could bury a car, destroy a small bldg. or break a few trees	10^3 t	1000 m	100 kPa
2	Could bury, injure or kill a person	10^2 t	100 m	10 kPa
1	Relatively harmless to people	<10 t	10 m	1 kPa

The North American Public Avalanche Danger Scale is another tool used by forecasters to communicate the potential for avalanches to cause harm or injury to backcountry travelers.

Table: North American Public Avalanche Danger Scale

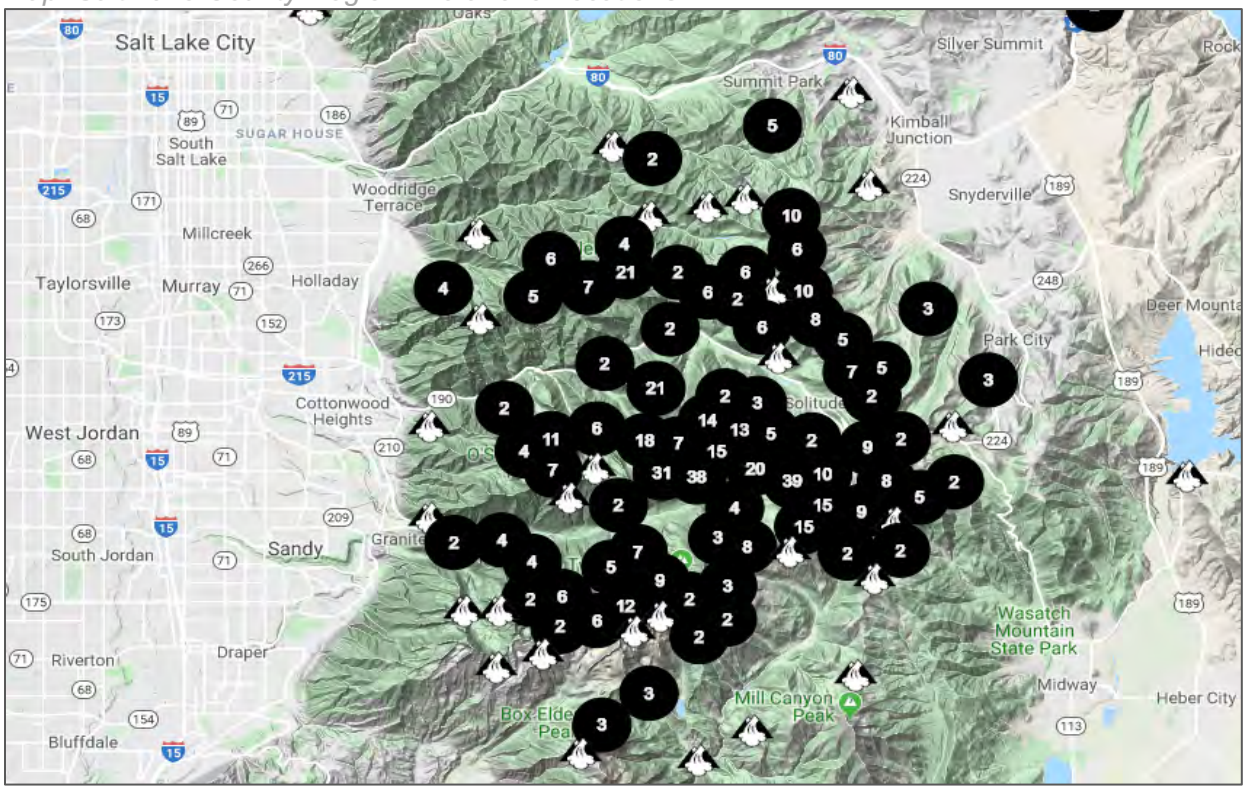
Danger Level	Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 - Extreme	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 - High	Very dangerous avalanche conditions. Travel in avalanche terrain not recommended.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
3 - Considerable	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 - Moderate	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 - Low	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Location

The risk for avalanches in Salt Lake County exists primarily in the Wasatch Range and Uinta mountains—due to their high recreation use and increasing development—although they occur throughout Utah's mountainous areas. Avalanche paths may not have a serious avalanche for years or even decades, but the potential is there especially during above average snowfall years (UNHH 2008). In Utah, 100 avalanche deaths have occurred from 1958-2010, and by comparison 61 deaths from lightning since 1950. Avalanche risk in Salt Lake County is particularly centered around the Big and Little Cottonwood Canyons. The Town of Alta is especially at risk to the impacts of avalanches.

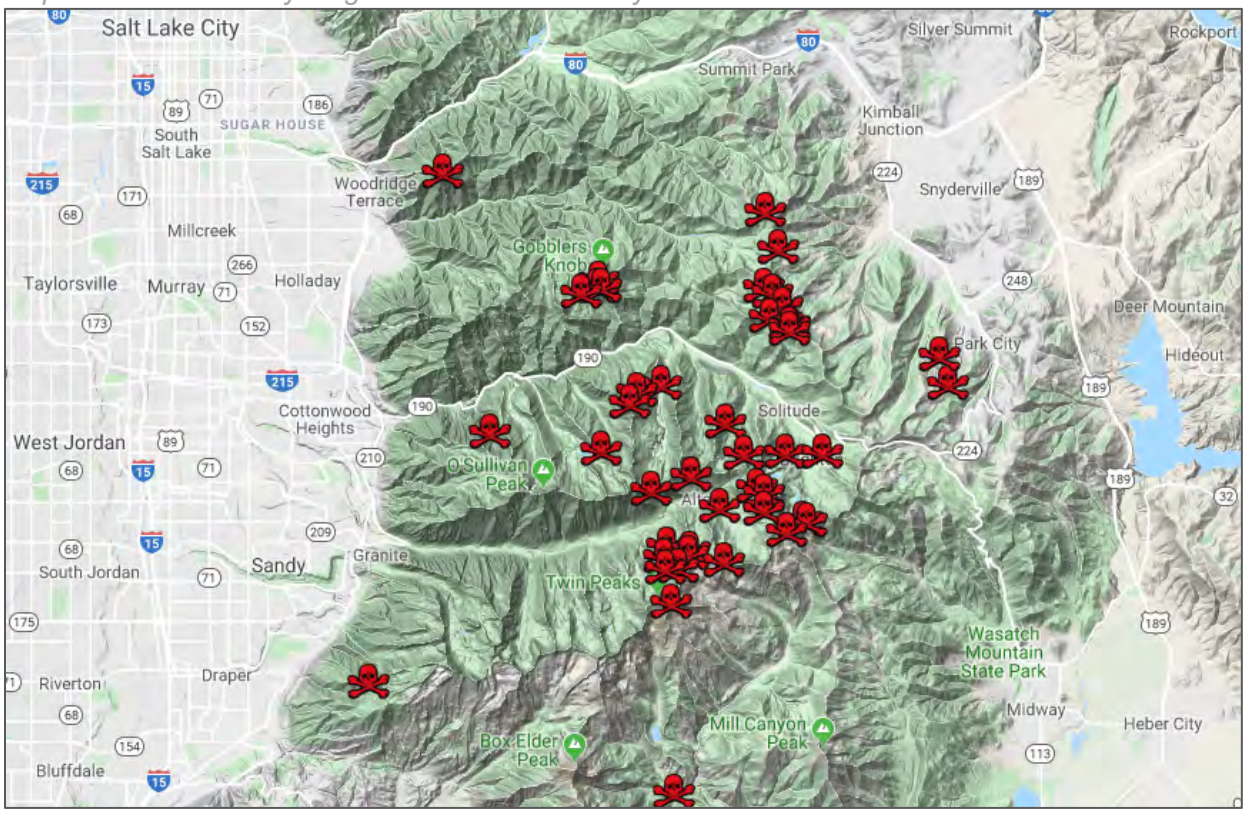
The following maps from the Utah Avalanche Center shows the locations of all reported avalanche events from 2015 to 2019, as well as the locations of all reported avalanche fatalities in the Salt Lake County Region.

Map: Salt Lake County Region Avalanche Locations



Source: https://utahavalanchecenter.org/avalanches

Map: Salt Lake County Region Avalanche Fatality Locations



Source: https://utahavalanchecenter.org/avalanches/fatalities/map

Highway 210 also has the highest avalanche hazard-rating index of any major roadway in the country. At times when UDOT and Alta agree that conditions are unsafe, the town goes into an Interlodge Alert, meaning all occupants of the town (including both visitors and residents) must remain indoors until conditions are deemed safe. During large storm cycles, an Interlodge can last days until the storm cycle is over and proper avalanche control work has been performed.

The Town's General Plan (dated November 2005, Updated 2013) covers Highway 210 access and possible mitigation activities to keep this critical road open. It also provides background on the Little Cottonwood Canyon Road Committee, a group consisting of representatives from Alta, Snowbird, Salt Lake County (including the Unified Fire Authority), UDOT, UTA, and USFS, that meet monthly to discuss access, usage, and safety and security issues related to the canyon road.

Historical Events and Probability of Future Occurrence

According to data from the Utah Avalanche Center (UAC) there have been 51 injuries and 57 deaths in the Salt Lake County region from all recorded avalanches since 1965. From 2009 to 2018 there were approximately 2,151 reported avalanches in the region as well, averaging approximately 215 reported events per year. According to NOAA data from 1996 to 2018, however, there have been only two events with significant recorded property damages, totaling $70,000.

On January 21, 2016, a group of skiers was skiing along Gobblers Knob, between Big Cottonwood and Millcreek Canyons. An avalanche, about 600 feet wide, was triggered, and two of the skiers were caught. One skier was partially buried and sustained minor injuries. The other skier, a 49-year-old male, was killed after being fully buried by the avalanche.

On December 23, 2007, an avalanche in-bounds at the Canyons Resort caught 4 skiers in it, leading to three injuries and one fatality. The avalanche was triggered by two men who were descending upper Red Pine Chute; one of the men was caught by the slide, but ended up on top of the snow. The other man was caught and died of head trauma after hitting a tree. A man and a child below were engulfed, with the man partially buried, and the child totally buried. The child was hospitalized for several days following the avalanche, but survived his injuries.

On March 14, 1998, the Little Cottonwood Canyon had 6 avalanches. Vehicles were swept from the road causing injuries to 5 people and $50,000 in property damages.

In 1983, a large avalanche completely covered Highway 210, buried a number of automobiles and wiped out the first floor of the Peruvian Lodge. A Salt Lake City motorist was seriously injured in a 1998 avalanche in Little Cottonwood Canyon.

The number and severity of avalanches each year is dependent upon a myriad of factors such as previous snow conditions, amount of new snowfall, wind speeds, wind direction, snow density, and avalanche control work success., with a majority occurring in the Wasatch Mountain range. It is reasonable to expect that frequencies of avalanche occurrence in the near future will continue to be in line with past events.

Secondary Hazards

Avalanches tend to be localized events causing immediate injury or death, but not having secondary impacts affecting the rest of the county. Nonetheless, it is possible avalanche events could damage roads and other transportation infrastructure, or cause traffic restrictions and limited access to and from canyon communities.

Vulnerability Assessment

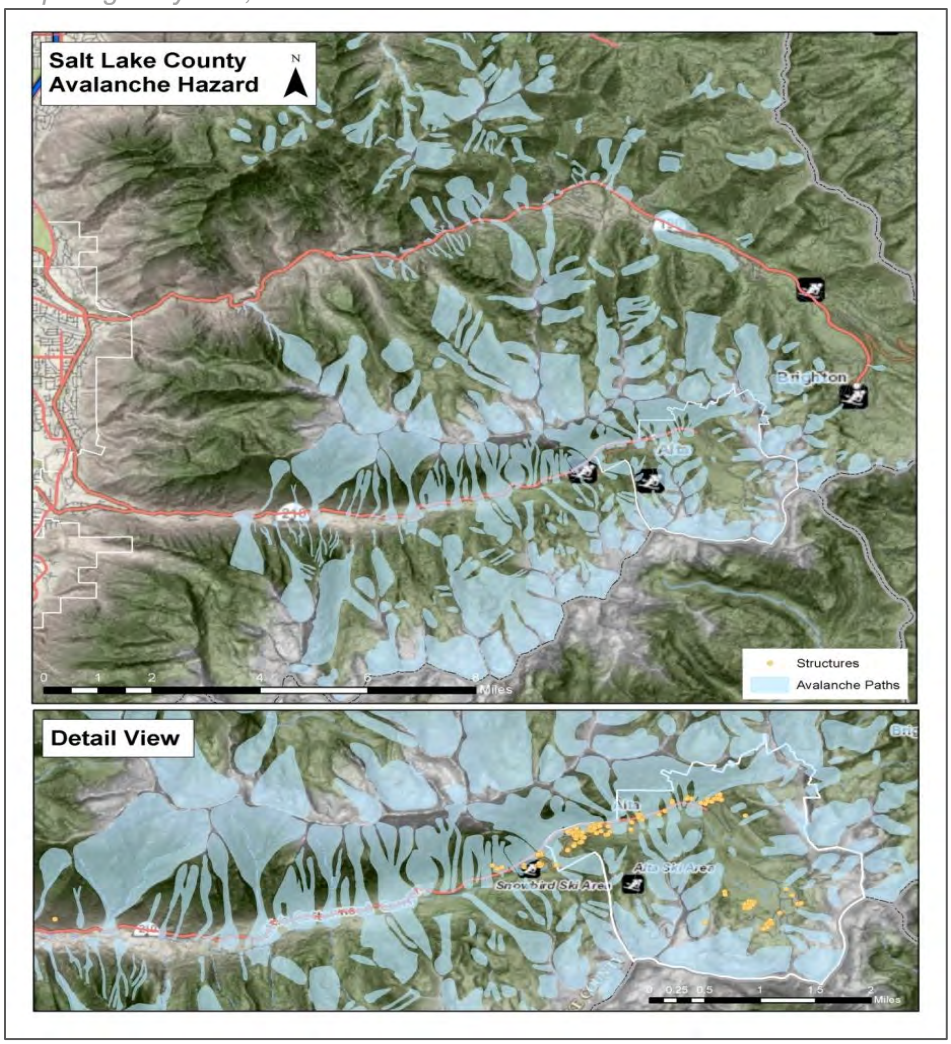
As previously mentioned, avalanche risk in Salt Lake County is primarily found in the Wasatch Mountains, particularly in Big and Little Cottonwood Canyons. The Town of Alta is particularly at risk to the impacts of avalanches. State Highway 210 follows Little Cottonwood Creek for the length of Little Cottonwood Canyon and serves as the primary access route to the town. Culvert blockages, bank erosion, landslides, and avalanches all have the potential to close down the town's only arterial connection with the rest of the county. Although the Town of Alta only has a population of 383 (per the town's website), it has a significant, fluctuating tourist population, which would be greatly impacted if Highway 210 is blocked by an avalanche.

According to the 2019 Utah State Hazard Mitigation Plan, the following structures are vulnerable to avalanche events, which can also be seen in the map below.

Community Assets:

95 Structures within Avalanche Paths
- 56 Commercial – $54,647,250
- 1 Government – $183,696
- 38 Residential – $2,869,264

Map: Highway 210, Ski Resort Infrastructure



Dam Failure

Dams are usually man-made, and therefore not inherently considered naturals hazards – however, dam failures can occur because of natural hazard loading events. The impacts of a dam failure can also be similar to natural flood events, although they are often more sudden and violent than normal stream floods (Living with Dams). Causes include breach from flooding, overtopping, ground shaking from earthquakes, settlement from liquefaction, slope failure and slumping, internal erosion from piping, failure of foundations and abutments, outlet leaks or failures, and internal weakening caused by vegetation and rodents. Possible effects include flooding, silting, loss of water resources, loss of property, and loss of life (UNHH 2008).

There are two types of dam failures – "rainy day" and "sunny day" failures. Rainy day failures occur because floodwaters overstress the dam, spillway, or outlet capacities. The floodwaters eventually flow over the top of the dam and erode the structure from the top down. The breach flows of the dam are added to the floodwaters from the rainstorm to produce a flood of large proportion and destructive power. Sunny day failure occurs from seepage and erosion inside the dam that removes fine material, creating a large void that can cause the dam to collapse or overtop and wash away. Sunny day failures can be the most dangerous because they can happen quickly with no warning to owners or downstream residents (UNHH 2008).

Dam Failure Hazard Profile

Potential Impact		High	**Probability**		High
	X	Medium			Medium
		Low		X	Low
		Minimal			Unlikely
Location	Dam locations are located throughout the county, with most of the high and moderate hazard dams in the eastern and southern portion of the County.				
Seasonal Conditions	Rainy Day Failure: Anytime Sunny Day Failure: Spring, late summer				
Conditions	Rainy Day Failure happens mainly during heavy precipitation events, can have some warning time. Sunny Day Failure can happen anytime without 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.				

Range of Magnitude

The severity of a dam or levee failure depends on the area protected by the dam or levee, the volume and velocity of water that breaches the structure, and the structures and population in the protected area. A dam or levee breach will result in flooding of normally protected areas, resulting in impacts similar to those seen in areas that are within the floodplain and not normally protected by a levee.

Table: CORPS of Engineers Hazard Potential Classification

Hazard Category (a)	**Direct Loss of Life** (b)	**Lifeline Losses** (c)	**Property Losses** (d)	**Environmental Losses** (e)
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers, 1995

Location

The 2019 Utah State Hazard Mitigation Plan gives an inventory of all dams in Utah:

Utah Dam Inventory

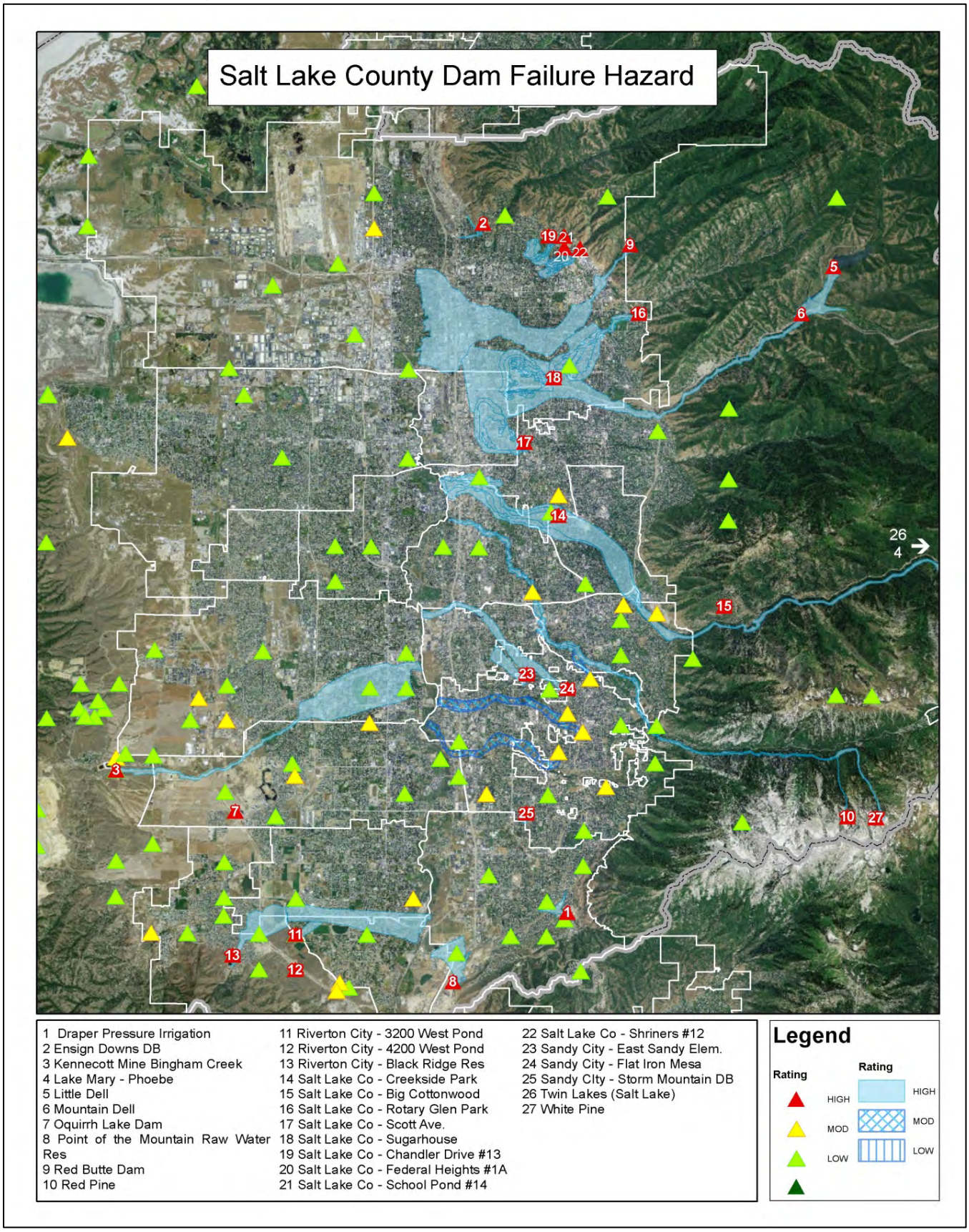
County	State Inspected (General)	State Inspected (Flood Control)	State Inspected (Industrial)	Federally Inspected	Inspected by Other Agencies	Uninspected	Inactive	Planned	Under Construction	Other	Total
Salt Lake	19	22	4	1	0	210	23	0	0	3	282

The National Inventory of Dams maps 66 of the total dams in Salt Lake County, listing an average age of 43 years since construction.

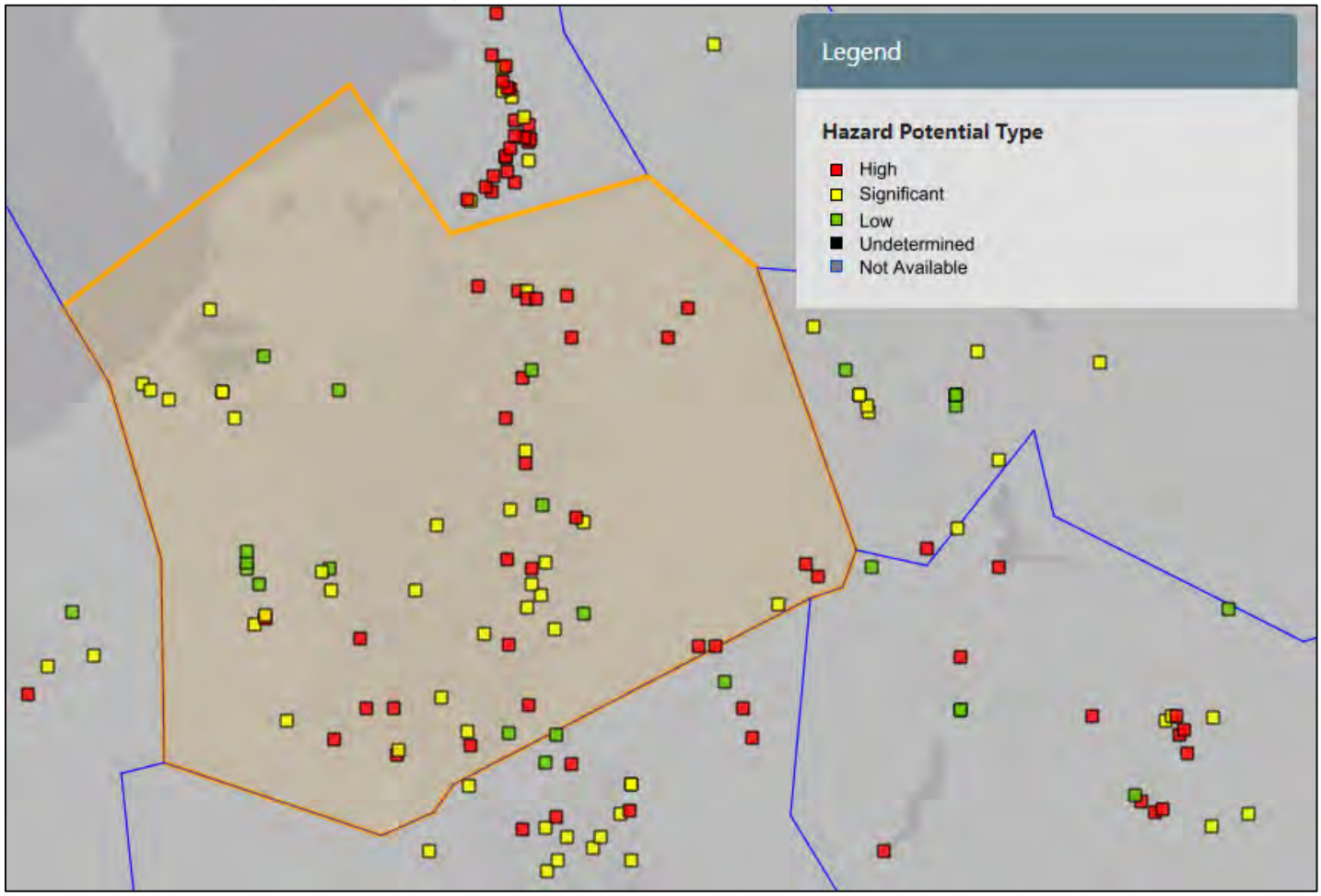
The NID consists of dams meeting at least one of the following criteria;

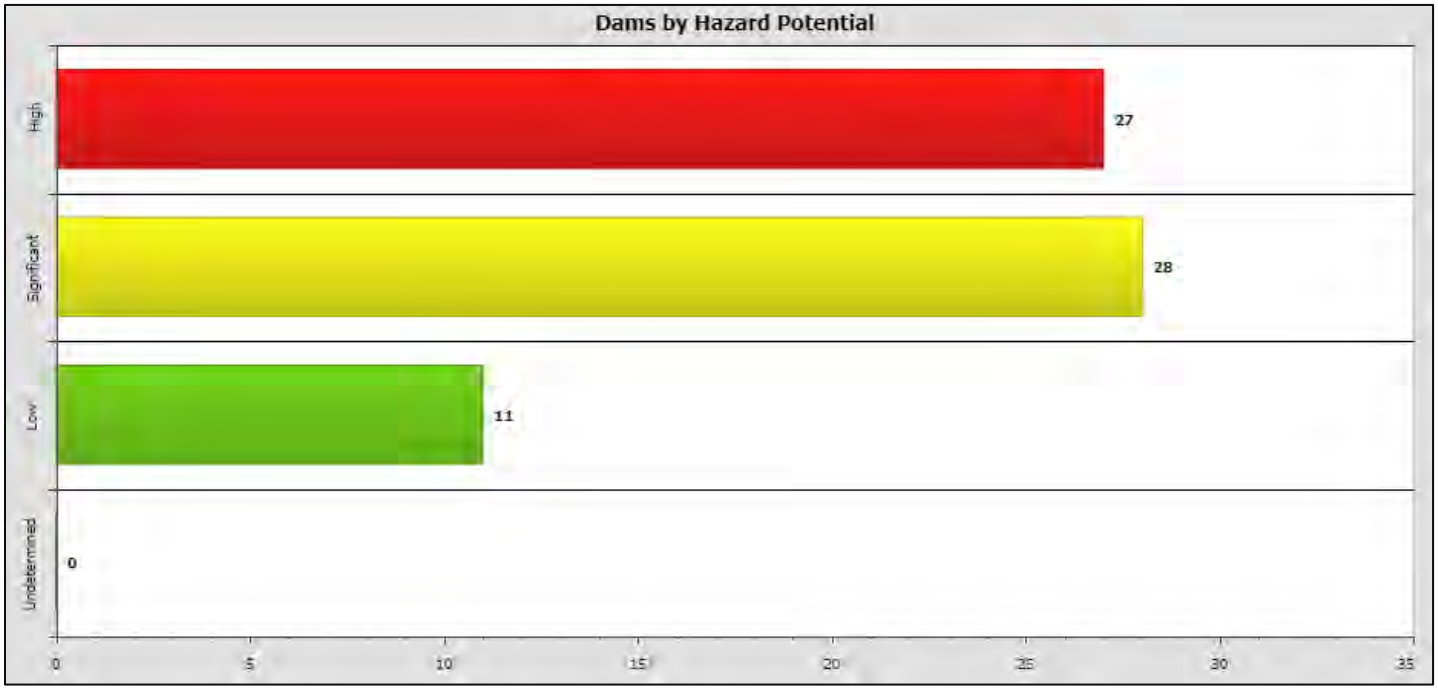
1. High hazard potential classification - loss of human life is likely if the dam fails,
2. Significant hazard potential classification - no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns,
3. Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
4. Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

Map: Salt Lake County Dam Failure Hazard



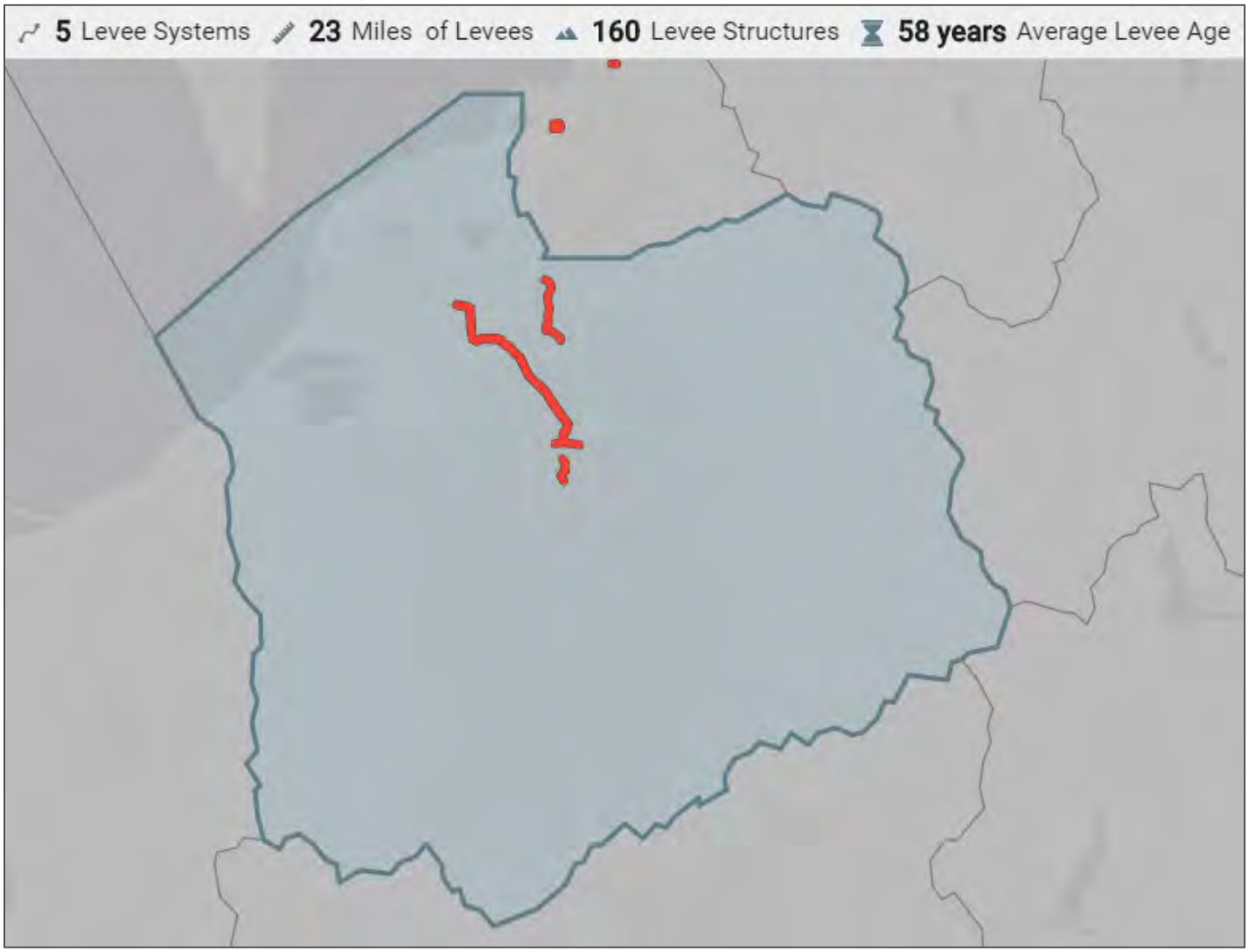
Map: National Inventory of Dams (NID) Locations in Salt Lake County





Source: https://nid.sec.usace.army.mil/

Map: Levees of Salt Lake County



Source: https://levees.sec.usace.army.mil/#/

Historical Events and Probability of Future Occurrence

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, flooding, excessive rainfall, and snowmelt. There is a "residual risk" associated with dams and levee failures. Residual risk is the risk that remains after safeguards have been implemented. For dams and levees, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam or levee failure in the planning area is low in today's regulatory environment. No record was found of any historical dam failure incidents within Salt Lake County either, however, incidents have occurred in other parts of Utah, according to the 2019 Utah State Hazard Mitigation Plan.

21 Mile Dam Failure

The 21 Mile Dam failed in Elko County, Nevada on February 8, 2017 due to heavy runoff and snowmelt. The water broke free from the earthen dam and flooded the community of Montello, Nevada, damaged Union Pacific property, and entered extreme northwestern Utah causing road damage.

Laub Detention Dam Failure

The Laub Detention Dam failed on September 11, 2012. A severe storm with heavy rainfall occurred prior to the failure. Numerous homes, businesses and roads were damaged. No lives were lost. A Presidential Disaster Declaration was declared for Washington County on November 3, 2012. The Dam was rebuilt in 2013 and was renamed “Tuacahn Wash Lower Detention Basin."

Quail Creek

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

Secondary Hazards

In addition to the direct damages and loss of life possible from a dam or levee failure, there are many secondary hazards that could arise as well. Disruption of a public water supply or wastewater treatment facility, could lead to water shortages, exposure to sewage, or other health hazards. Damage or disruption to major roads, railroads, public utilities, or other critical facilities could cause the delay of vital services and exacerbate conditions on the ground. Extensive damage to the environment could impact local agriculture affecting the food and supply chain for the region.

Vulnerability Assessment

The 2019 Utah State Hazard Mitigation Plan includes loss estimates for Salt Lake County, as can be seen in the tables below.

Table: Salt Lake County Dams by Hazard Rating

County	Low Hazard	Moderate Hazard	High Hazard
Salt Lake County	181	29	29

Source: 2019 Utah State Hazard Mitigation Plan

Due to having the highest population in the state, Salt Lake County is ranked first in Utah for population per high hazard dam, as can be seen in the table below.

Table: Rankings by County of Population per High Hazard Dam

Ranking	County	Population per High Hazard Dam	High Hazard Dams
1	Salt Lake County	38,906	29
2	Weber	24,884	10
3	Utah	24,709	25
4	Tooele	22,378	3
5	Cache	21,082	6
6	Davis	12,456	28

Source: 2019 Utah State Hazard Mitigation Plan

Table: Salt Lake County Potential Dam Inundation Area

County	Total Area (sq. miles)	Total Potential Inundation Area (sq. miles)	Potential Percent Inundation Area
Salt Lake County	805.18	38.67	4.80%

Source: 2019 Utah State Hazard Mitigation Plan

Table: Salt Lake County HAZUS Building Stock Exposure to Dam Inundation

County	HAZUS Number of Buildings	HAZUS Total Building Value	Estimated Buildings in Inundation Area	Estimated Building Value Exposure	Percent Building Value Exposure	Per Capita Hazard Exposure
Salt Lake County	310,571	$98,684,444,000	41,384	$13,353,268,953	13.33%	$11,758

Source: 2019 Utah State Hazard Mitigation Plan

Table: Salt Lake County Estimated Daytime and Nighttime Population in Inundation Areas

County	Estimated Daytime Population in Inundation Areas	Percent Daytime Population in Inundation Areas	Estimated Nighttime Population in Inundation Areas	Percent Nighttime Population in Inundation Areas
Salt Lake County	170,786	15.04%	137,641	12.12%

Source: 2019 Utah State Hazard Mitigation Plan

As can be seen in the table below, there are 66 critical facilities within Salt Lake County, a breakdown of which can also be seen below.

Critical Facilities

4 Fire (SLC Fire Stations 3, 6, 8, South Salt Lake Fire Department)
2 Hospitals (Jordan Valley Medical Center)
4 Police (Sandy Police Substation, Salt Lake County Sheriff's Office, South Salt Lake Police Dept., Fort Douglas Public Safety)
8 UTA Transportation Stations
48 Schools

Table: Dam Failure Vulnerability and Loss

County	Residential Units	Residential Unit Value	Commercial Units	Commercial Unit Value	Critical Facilities
Salt Lake County	51,009	$9,665,508,700	6,052	$3,719,874,395	66

Source: 2019 Utah State Hazard Mitigation Plan

The following table 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: Infrastructure Vulnerable to Dam Failure, Salt Lake County

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: Vulnerability Assessment for Dam Failure, Incorporated 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
Copperton	92	1	0	0
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
Emigration Canyon	0	0	0	0
Herriman	0	0	0	0
Holladay	1,159	7,369	3,080 $630,168,000	371 $232,693,583
Kearns	0	0	0	0
Magna	0	0	0	0
Midvale	323	3,714	1,546 $316,311,600	49 $33,150,823
Millcreek	640	6,428	3,153 $645,103,800	282 $180,987,936
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

Note: At the time the plan was updated, Brighton, was not considered an incorporated community. Information related Brighton is captured under Big Cottonwood Canyon.

Table: Vulnerability Assessment for Dam Failure, Unincorporated 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
Granite	328	269	80 $16,368,000	1 $27,753
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

Community Assets:

Additional significant community assets with potential impacts by dam failure hazards were identified by the Mitigation Planning Team. These include areas of particular concern, critical facilities, critical infrastructure, areas of future development, major employers or economic sectors, cultural or historic facilities, and significant populations or significant natural resources. More detailed information on jurisdictional assets is listed in their individual annex in Volume 2.

Murray:
Previous events: None, but similar to other flooding events. Many residential homes would be impacted near Little Cottonwood Creek, Murray Park, State St and Vine St. Some roads would also be impassable.
Growth: Birkhill Apartment complex
Structures: Fire Station #82
Population: Nighttime residential and apartment complexes near Little Cottonwood Creek
Economic: Some business impacts in north end of city
Natural: Jordan River Conservatory

South Salt Lake
Areas of concern: Scott Ave., Little Dell and Mountain Dell, Sugarhouse, Jordan River
Previous events: None, but similar areas to other flood events. Scott Ave Millcreek Damage, flooding in Jordan River area
Growth: 2100 S-2400 S, State St – 400 W
Structures: County EOC, Jails, Metro, Oxbow, Youth, Sewer Treatment Facility, Transportation corridors, I-15, I-80, railroad, Trax, Schools
Population: Larger daytime population, prisoner population, Non-English speakers

Taylorsville
Areas of concern: All tributaries coming into Jordan River
Previous events: Flooding near 3900 S and 4800 S along Jordan River in 2011.High-density housing affected, Calloway Apts. and Bridgesite Apts.

Growth Structures: High density housing along rivers, Sorenson Research Park, businesses
Population: Residential and business population along river/drainage area
Economic: Sorenson Research Park, Golf Course 3900-4300 S and river
Natural: Possibly along the river

Drought

According to the National Drought Mitigation Center, drought is a "deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector." Although variation in the amount of precipitation recorded each year is normal, a drought is beyond these norms in terms of low precipitation for an extended period or over a large area. While most natural hazards are sudden and result in immediate impacts, droughts "sneak up on us quietly disguised as lovely sunny weather" (McKee, Doesken, and Kleist 2005) and can last a long time resulting in significant socioeconomic impacts. Drought can be categorized according to unique characteristics and may be thought of as phases of the same drought (UNHH 2008).

- Meteorological drought: a measure of departure of precipitation from normal for a particular location.
- Agricultural drought: where the amount of moisture in the soil no longer meets the needs of a particular crop.
- Hydrological drought: when surface and subsurface water supplies are below normal.
- Socioeconomic drought: when dry conditions persist long enough and are severe enough to impact sectors beyond the agricultural community, such as community drinking supply and other social and economic enterprises.

Although the agricultural community is usually the most heavily impacted by drought, times of extended drought can have direct and indirect impacts into economic, social, or environmental sectors as well. When this occurs and drought begins to effect the general population, reservoirs, wells, and aquifers are often 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.

Drought Hazard Profile

Potential Impact		High	**Probability**		High
		Medium		X	Medium
	X	Low			Low
		Minimal			Unlikely
Location	Countywide				
Seasonal Conditions	Impacts typically noticeable in summer, conditions can be year round.				
Conditions	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				
Duration	Months, Years				
Secondary Hazards	Wildfire, dust storms, air quality.				
Analysis Used	National Weather Service, Utah Climate Center, Utah Division of Water Resources, Newspapers, Local input.				

Range of Magnitude

The United States Drought Monitor has a map that identifies areas of drought and labels them by intensity. D1 is the least intense level and D4 the most intense. Drought is defined as a moisture deficit bad enough to have social, environmental or economic effects. D0 areas are not in a drought, but are experiencing abnormally dry conditions that could turn into drought or are recovering from drought but are not yet back to normal.

			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Source: https://droughtmonitor.unl.edu/AboutUSDM/AbouttheData/DroughtClassification.aspx

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 (NDMC 2006)

Table: Palmer Drought Severity Index (NDMC 2006)

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

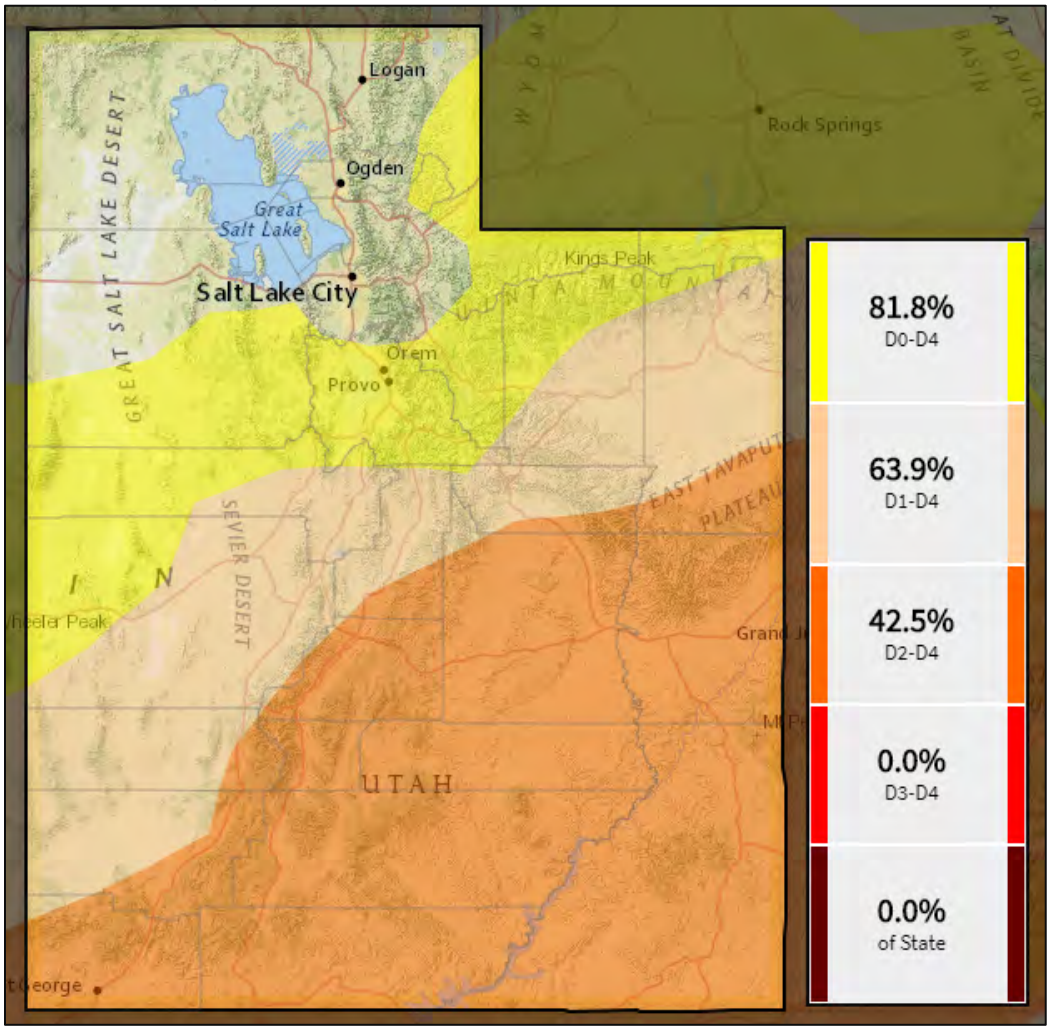
Location

Utah is the second driest state in the nation. 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.

Salt Lake County falls within two climatic regions: the North Central Region and the Northern Mountains Region. Each of these regions has differing characteristics, but often experience similar drought periods. The two 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 Northern Mountain Region typically experiences droughts less frequently (Utah Division of Water Resources 2007a). Conversely, the Northern Mountain Region averages more severe drought conditions at its peak than the Western Region. It may be Northern Mountains Region simply has more water to lose as the Wasatch and Uinta Mountains receive much more precipitation on average.

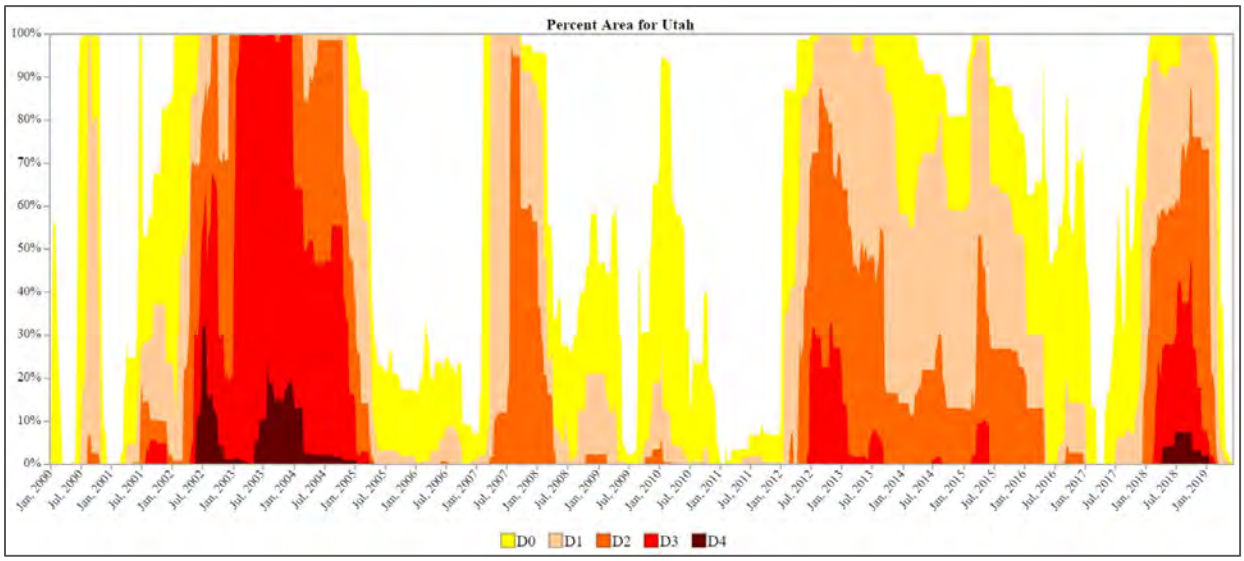
The map below is a snapshot of the drought extent as of November, 2019.

Map: Utah Drought Extent, November, 2019



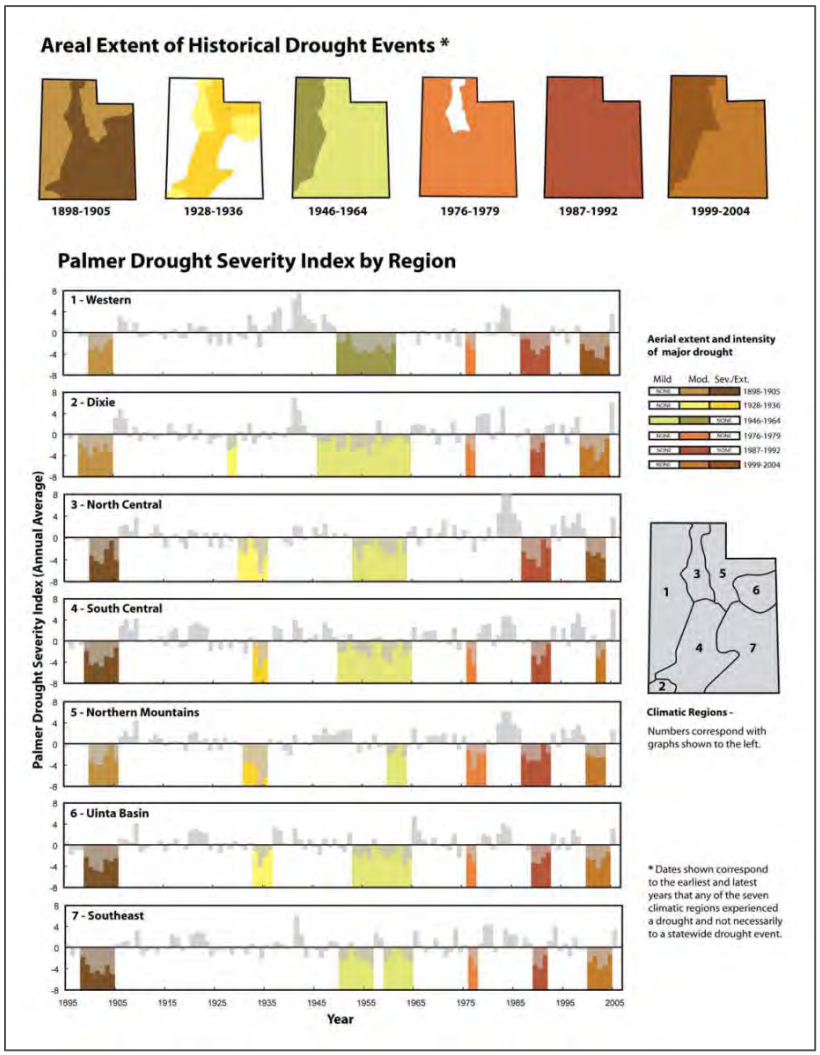
Source: https://www.drought.gov/drought/states/utah

The figures below show a recent snapshot in time for drought extent in the State of Utah.



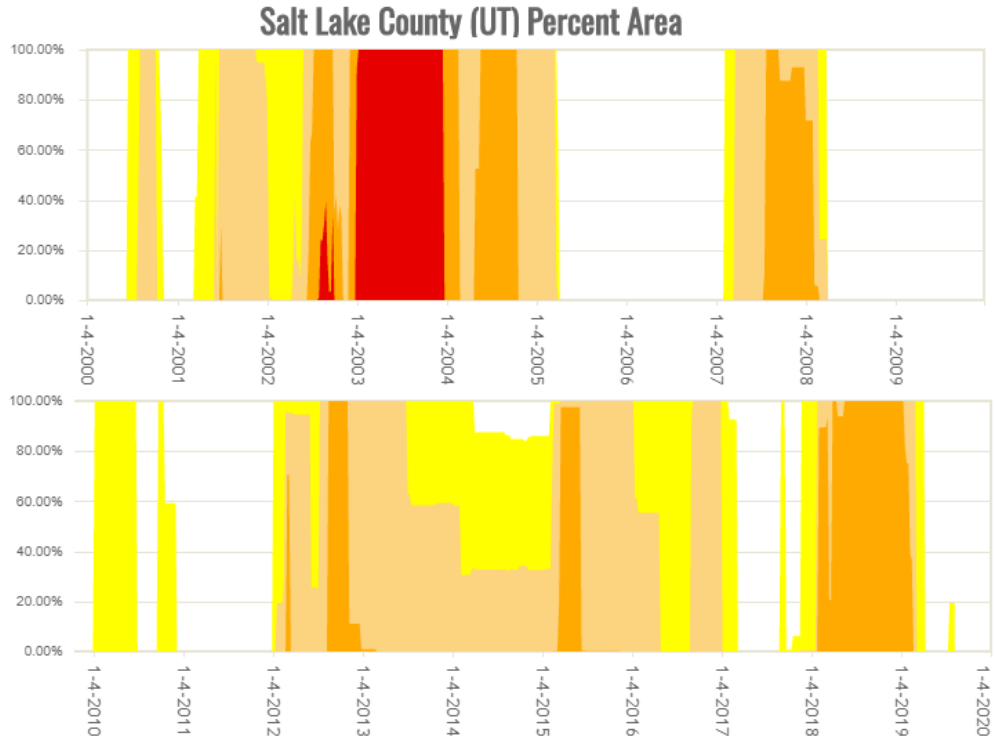
Source: https://www.drought.gov/drought/states/utah

Figure: Utah Historical Droughts

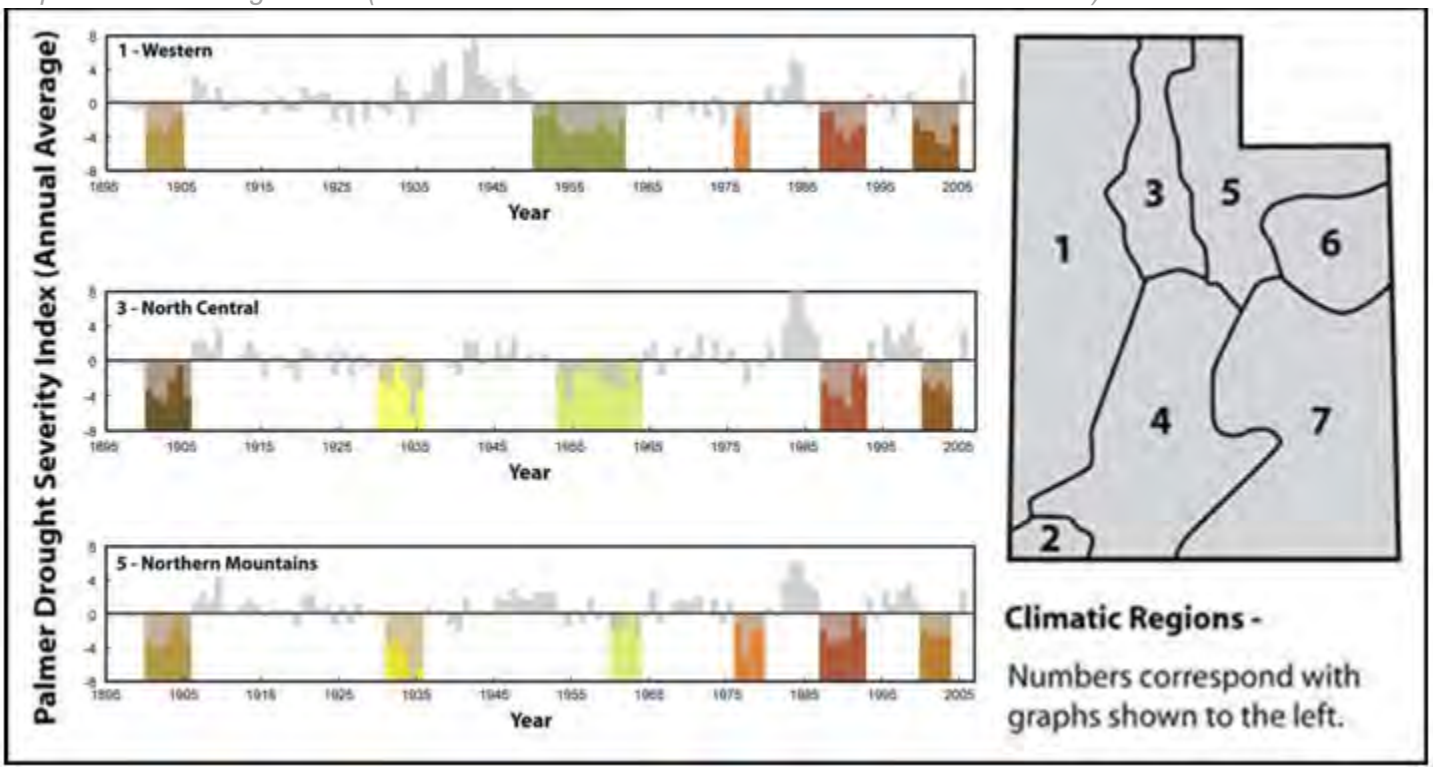


Historical Events and Probability of Future Occurrence

The following image from the United States Drought Monitor shows recent drought frequency and severity, as well as the total percentage of the land area in Salt Lake County impacted.



Map: Annual Average PDSI (Modified from Utah Division of Water Resources 2007a)



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 and during the same drought period (1930 to 1936) that caused the "Dust Bowl" on the Great Plains. The longest drought period varies from 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). In 2018 a severe drought caused virtually all of the state to be in a moderate drought with many areas in extreme drought. This drought peaked in September 2018 and reached -6.16 on the Palmer Drought Severity Index scale (NCDC, 2019).

There is no doubt that droughts or water shortages will continue to be a factor in Salt Lake County's future, particularly as public demands for water usage increase. The expectation of a population doubling in the next 20 years creates an absolute certainty for increasing water shortages. Future zoning ordinances, use of secondary water for irrigation, and mandatory no watering days are already an every year occurrence.

Figure: Annual water usages by category for Salt Lake County (based on USGS data).

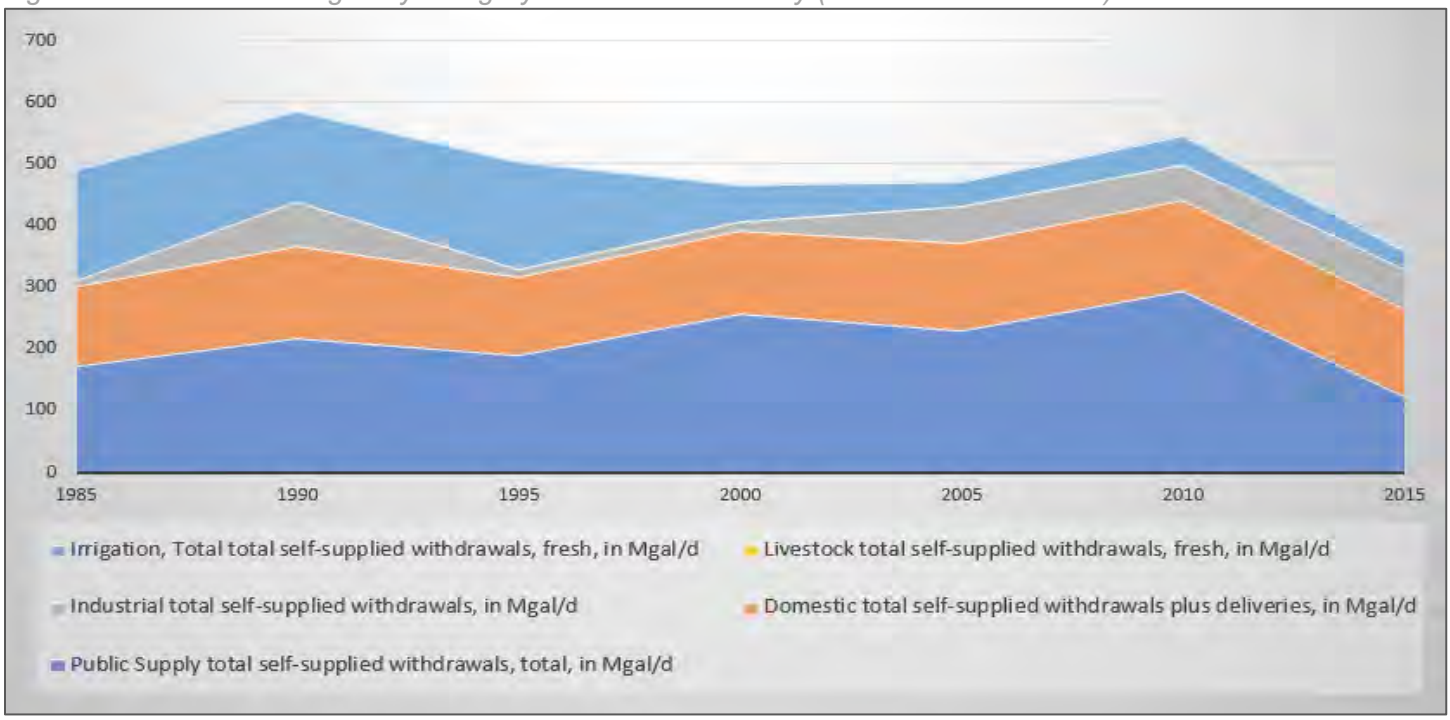


Table: Annual water usages by category for Salt Lake County (based on USGS data).

Year	Public Supply total self-supplied withdrawals, total, in Mgal/d	Domestic total self-supplied withdrawals plus deliveries, in Mgal/d	Industrial total self-supplied withdrawals, in Mgal/d	Livestock total self-supplied withdrawals, fresh, in Mgal/d	Irrigation, Total self-supplied withdrawals, fresh, in Mgal/d
1985	172.9	129.27	10.68	0.21	180.28
1990	218.54	149	72.19	0.15	146.41
1995	189.95	127.73	11.7	0.43	173.7
2000	258.39	134.125*	15.13	0.19	59.78
2005	231.12	140.52	61.77	0.15	37.83
2010	295.7	146.83	56.08	0.09	47.58
2015	123.69	141.33	65.82	0.09	28.77

**Data was not available for this entry, so the average between the 1995 and 2005 amounts was inserted as the best approximate value*

Source: https://waterdata.usgs.gov/ut/nwis/water_use/

Salt Lake Valley is a largely urban area with a growing population. Most of the development in Salt Lake Valley uses municipal water sources, principally wells completed in the basin-fill aquifer system. The population growth and concomitant increase in municipal ground-water pumping could significantly decrease the amount of ground water discharged from the principal aquifer system (where most wells are completed) to the shallow unconfined aquifer system.

The shallow unconfined aquifer overlies confining beds above the principal aquifer system in the central and northern parts of the valley, and provides water to springs and approximately 58,000 acres (23,500 hm2) of wetlands in ground-water discharge areas. Decreased recharge to the shallow unconfined aquifer from the principal aquifer due to increased ground-water pumping could reduce water supply to these springs and wetlands. Also, water supply to the springs and wetlands is affected by climatic conditions and Great Salt Lake level. Drought conditions during 1999–2004 reduced the amount of recharge to ground-water aquifers across the state, including the Great Salt Lake area, negatively impacting the Salt Lake Valley wetlands. In 2005 and 2008, the elevation of Great Salt Lake declined to near its historic low stand reached in 1963, allowing some parts of the Salt Lake Valley wetlands to de-water.

To evaluate the potential impacts of drought and increased development on the Salt Lake Valley wetlands, researchers used existing data to estimate a water budget and develop regional, three-dimensional, steady-state and transient MODFLOW models to evaluate water-budget changes for the wetland areas; these efforts focused on wetlands around the margins of Great Salt Lake, although the results may apply to all of the wetlands in Salt Lake Valley. The modeling suggests that subsurface inflow into the wetland areas would be most affected by decreased subsurface inflow due to long-term (20-year) drought conditions, which would also cause changes in Great Salt Lake levels, but subsurface inflow would also decrease due to increased municipal and industrial well withdrawals over the same time period. Therefore, the worst-case scenario for the wetlands would be a combination of both conditions. If the U.S. Environmental Protection Agency's goal on no net loss of wetlands is to be met, the Salt Lake Valley wetland areas should be managed to maintain their current budget of water (estimated at about 52,420 acre-feet per year [65 hm3/yr] of recharge in 2010) (Yidana, Lowe, and Emerson).

Secondary Hazards

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Crops can obviously be vulnerable, as well. Loss of forests and trees increases erosion, causing severe damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers. Droughts can also create the conditions for dust storms which decrease the air quality humans and animals breathe. Low stream flows can create high temperatures, oxygen depletion, disease, and lack of spawning areas for fish resources. Often, drought is accompanied by extreme heat. When temperatures reach 90ºF and above, people are vulnerable to sunstroke, heat cramps, and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries.

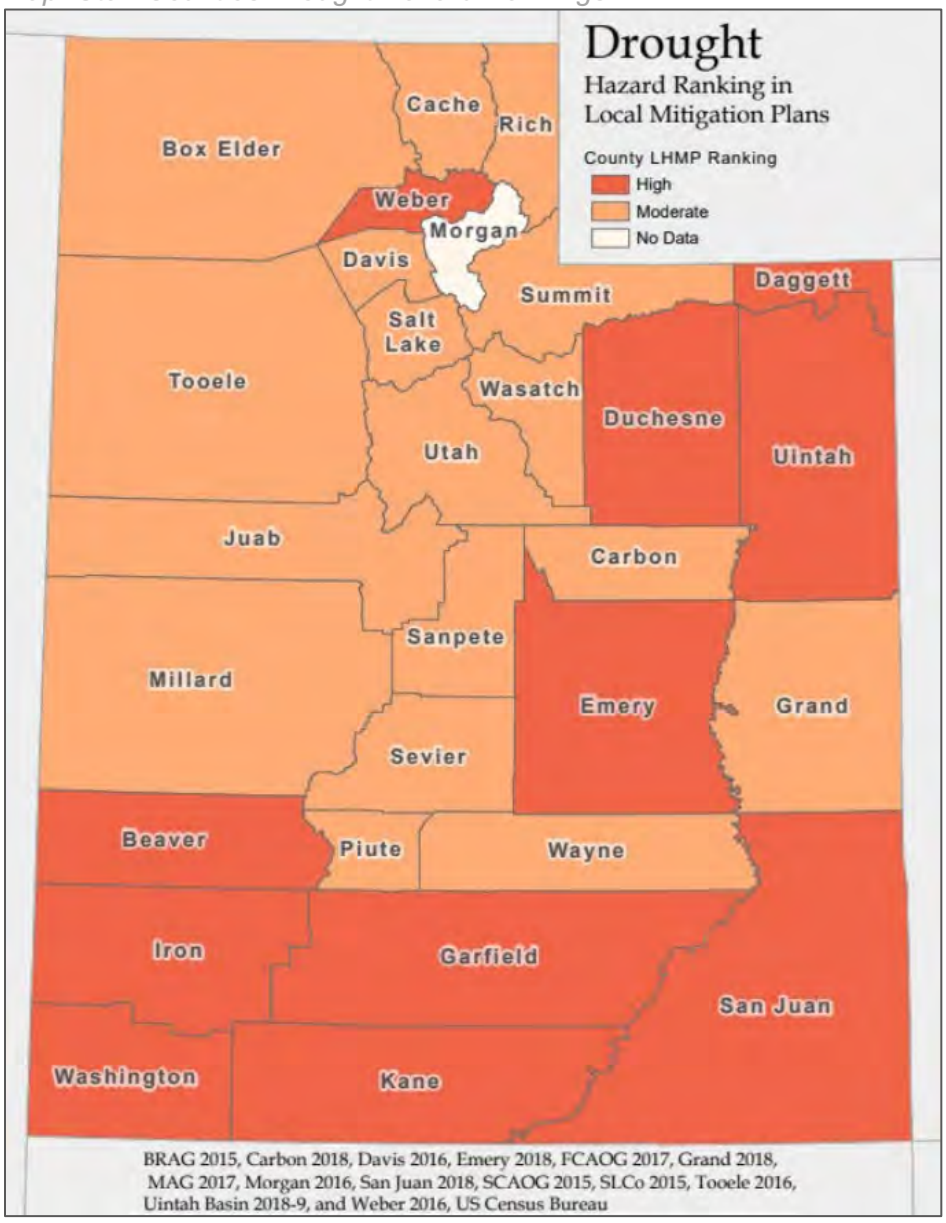
Vulnerability Assessment

Due to the unpredictability of drought, it is difficult to identify the areas most threatened and to provide loss estimate values. However, historical drought records demonstrate that agriculture is typically the economic sector most impacted by drought (UHMP). For example, the hardest hit sector during 2002 drought was agriculture, where 2,600 jobs and almost $40 million in income were lost. Livestock sales were estimated as down $100 million and hay sales down $50 million due to the drought. The 2003 Economic Report to the Governor suggests the drought also contributed to job change. "During 2002, job change was -1.0%. Without the drought, job change might have been -0.6%, 0.4% higher than what actually occurred." Drought related fires are also believed to contribute to a decline in tourism sales, which were down $50 million. The combined effects of the drought in these three sectors resulted in a loss of over 6,100 jobs and $120 million in lost income during

2002. Construction, manufacturing, and wholesale trade were also impacted by drought. The Utah Division of Water Resources mentions in their drought report that large and significant data gaps hinder the quantification of drought impacts in all sectors of the economy and society. They suggest that tax revenues and other potential economic indicators of drought impacts be monitored at all levels of government in order to improve evaluation methods and to better understand drought impacts (UHMP).

The 2019 Utah State Hazard Mitigation Plan conducted drought vulnerability rankings for each county in the state, based on local hazard mitigation plans (LHMPs). Each LHMP was reviewed to gather data on how each jurisdiction viewed their vulnerability to drought. The frequency of drought and severity of drought as reported in the LHMPs were gathered to determine a hazard ranking for drought. The hazard ranking is calculated from a combination of severity (categorized from 0-4) and probability/frequency (categorized from 0-4). The numbers were then combined to allow for a ranking from 0-8 to be scored. The map below was also created that shows the hazard ranking of drought for each county as reported in the LHMPs.

Map: Utah Counties Drought Hazard Rankings



Source: 2019 Utah State Hazard Mitigation Plan

The table below lists the agriculture statistics for Salt Lake County from the 2017 Agriculture Census, which is the most current agriculture census data available to date.

Table: Salt Lake County Agriculture Statistics

Farms	Total Acres	Market Value of Products Sold	Estimated Market Value of Land and Buildings (Avg. per farm)
592	61,965	19,901,000	1,013,467

Source: U.S. Department of Agriculture 2017 Census

The 2019 Utah State Hazard Mitigation Plan also lists 1,463 state-owned facilities within Salt Lake County that are vulnerable to the effects of drought, with a total insured value of $7,274,528,270.

Earthquake

The Utah Geologic Survey defines an earthquake as the "abrupt, rapid shaking of the Earth caused by sudden breakage of rocks that can no longer withstand the stresses that build up deep beneath the earth's surface". The rocks break along zones of weakness, called faults. Seismic waves are then transmitted outward and also produce ground shaking or vibrations in the earth (Utah Natural Hazards Handbook. 2008).

The Richter scale measures the magnitude of earthquakes on a seismograph. Generally an earthquake needs to be at least a magnitude 2.0 to be felt by humans, and about magnitude 5.5 before significant damage occurs. 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.

Ground Shaking:

Ground shaking is caused by the passage of seismic waves generated by an earthquake. Shaking can vary in intensity but is the greatest secondary hazard because it affects large areas and stimulates many of the other hazards associated with earthquakes. 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.

The waves move the earth's surface laterally and vertically 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 (UNHH 2008).

Surface Fault Rupture and Tectonic Subsidence:

Surface fault rupture is the result from relative movement between blocks in the Earth's crust. 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. Earthquakes having a magnitude of 6.5 or greater could result in surface faulting 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 and can cause severe damage to building foundations or lifelines (roads, pipelines, communication lines) that cross the fault. Tectonic subsidence, or down dropping and tilting of the valley floor, generally depends on the amount of surface fault rupture, and can cause

flooding by tilting lakebeds or dropping ground surface below the water table. The greatest amount of subsidence will be in the fault zone and will gradually diminish out into the valley (UDCEM 1991).

Earthquake Hazard Profile

Potential Impact	X	High	**Probability**		High
		Medium		X	Medium
		Low			Low
		Minimal			Unlikely
Location	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.				
Seasonal Pattern	None.				
Conditions	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.				
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, hazardous material release, transportation and infrastructure disruptions, essential service disruptions (communications, utilities).				
Analysis Used	Review of hazard analysis plans and other information provided by the University of Utah Seismograph Station, UGS, USGS, FEMA, UDEM, AGRC.				

Range of Magnitude

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (Mw) scale, with the following classifications of magnitude:

- Great—Mw $\geq$ 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

The ISB contains the Wasatch Fault—one of the longest and most active normal faults in the world—with a potential for earthquake with a magnitude up to 7.5. The largest earthquakes in Utah occur in the ISB, where at least 35 earthquakes of magnitude 5.0 or greater have occurred since 1850 (UNHH 2008).

The range of earthquake magnitude experienced in Salt Lake County since 1962, according to the USGS, is .01 to 5.7.

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (USGS, 1989):

- I. Not felt except by a very few under especially favorable conditions.
- II. Felt only by a few persons at rest, especially on upper floors of buildings.
- III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
- IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
- V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
- VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
- VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
- VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
- XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
- XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Location

Utah's earthquake hazard is greatest within the Intermountain Seismic Belt (ISB), which extends 800 miles from Montana to Nevada and Arizona, and trends from North to South through the center of Utah (The Wasatch Fault, UGS PIS 40).

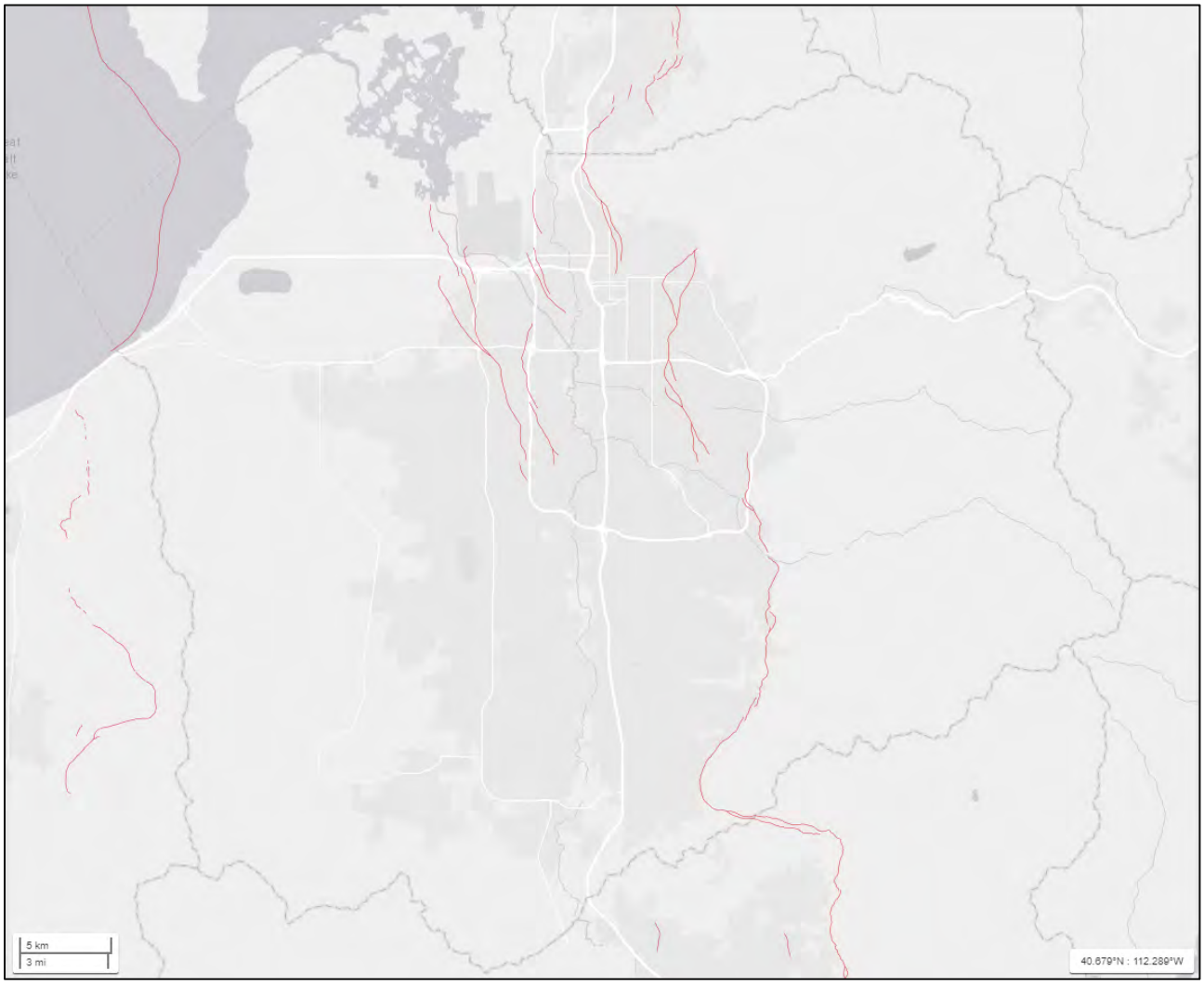
The Wasatch Fault traces along the base of the Wasatch Mountain Range. It is made up of 10 segments that act independently, meaning that a part of the fault ruptures separately as a unit during an earthquake. The Salt Lake City Segment traverses Salt Lake County from North to South, roughly along the Eastern foothills of the Wasatch Mountains. Within the Salt Lake City Segment of the Wasatch Fault are three smaller segments from North to South known as the Warm Springs Fault, the Virginia Street Fault and the East Bench Fault.

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.

Table: Quaternary Faults, Salt Lake County (UGS 2002, UGS 2006)

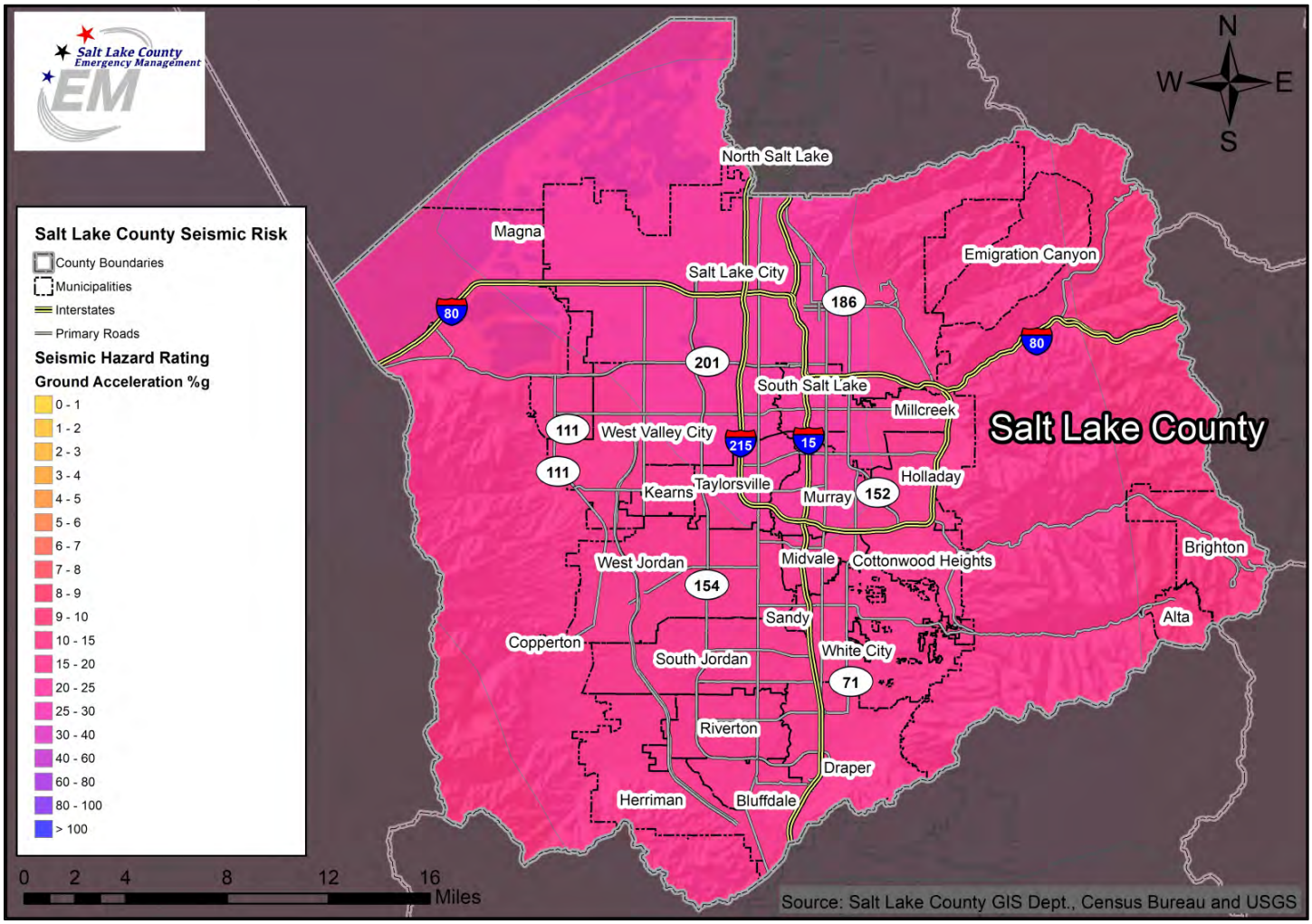
Name	Fault Type	Length (km)	Time of Most Recent Deformation	Recurrence Interval
East Great Salt Lake fault zone, Antelope Island section	Normal	35	586 201/-241 cal yr B.P.	4,200 years
Wasatch fault zone, Salt Lake segment	Normal	43	1,300 ± 650 cal yr B.P.	1,300 years
West Valley fault zone, Granger segment	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
Cal yr B.P.=calendar years before present				

Map: Salt Lake County Fault Line

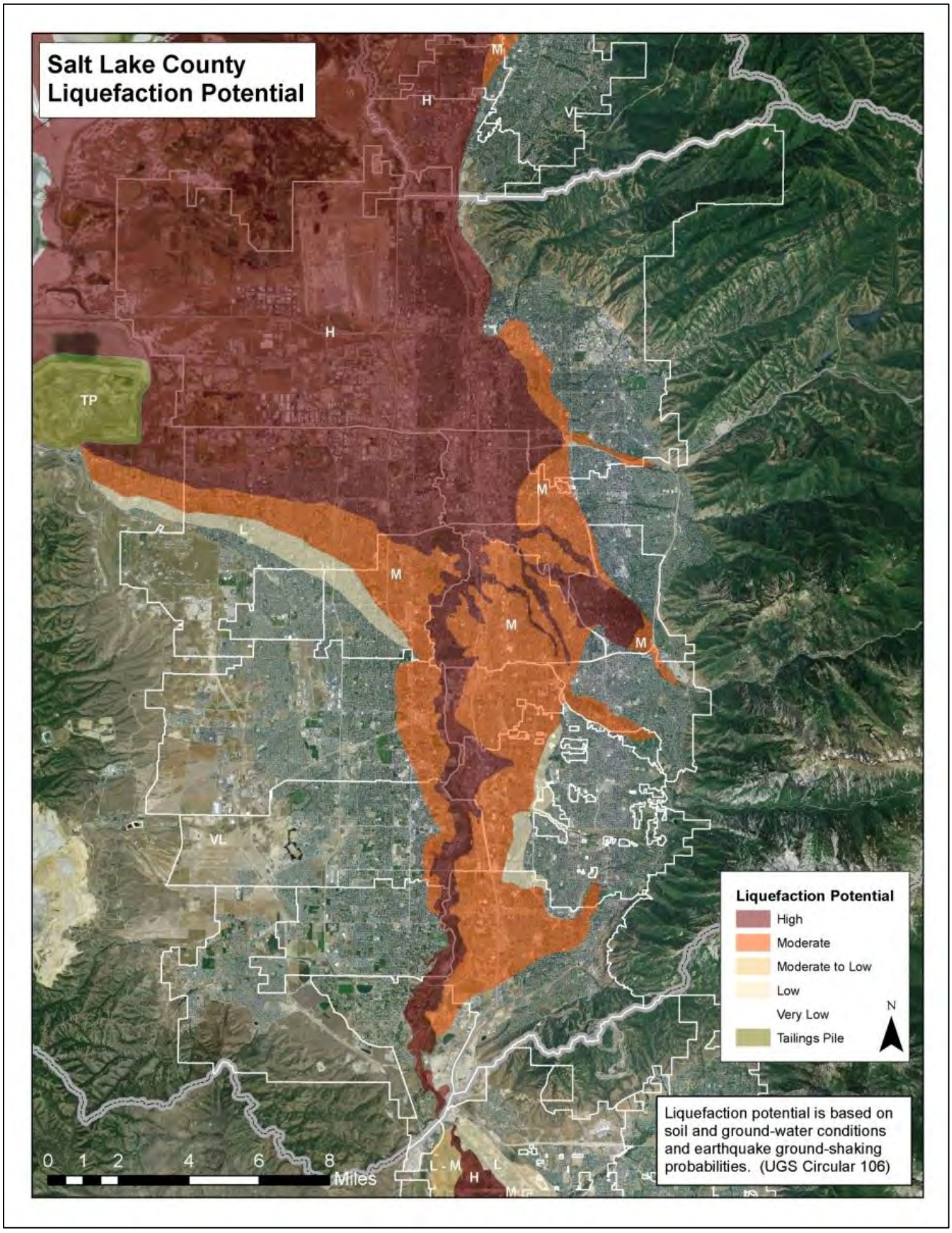


Source: USGS Earthquake Catalogue

Map: Salt Lake County Seismic Hazard Rating



Map: Salt Lake County Liquefaction Potential

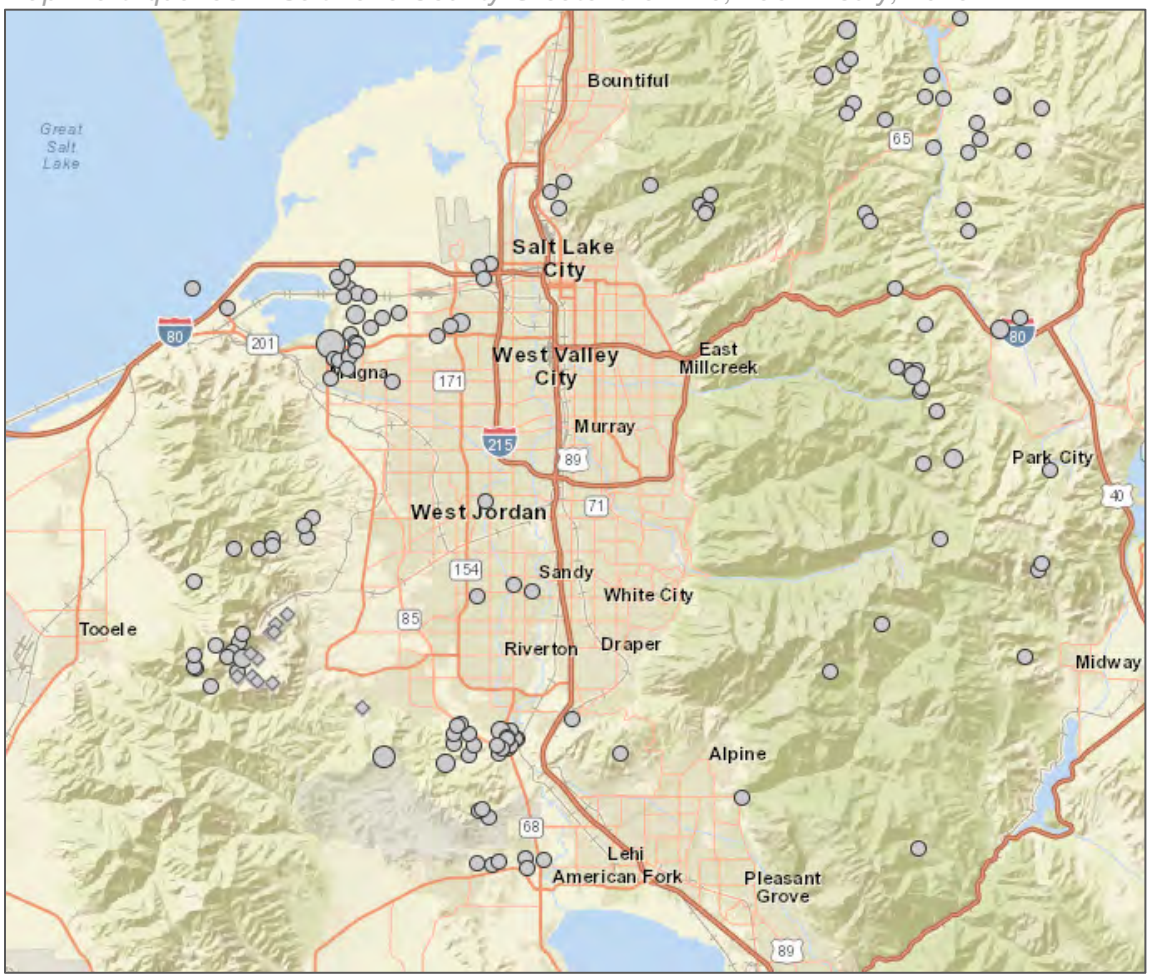


Historical Events and Probability of Future Occurrence

Although no surface-faulting earthquakes have occurred on the Wasatch fault in recent history, evidence of numerous prehistoric events exists in the geologic record (The Wasatch Fault, UGS PIS 40). The segments between Brigham City and Nephi have a composite recurrence interval (average time between earthquake events) for large surface-faulting earthquakes (magnitude 7.0-7.5) of 300-400 years. The average repeat time on an individual segment is 1,200-2,600 years. The most recent surface-faulting earthquakes occurred about 500 years ago in the Provo and Weber segments, and about 350 years ago in the Nephi segment (UNHH 2008).

According to USGS records, there have been 152 recorded earthquakes of 2.0 magnitude or greater that occurred in or immediately around Salt Lake County from 1962 through July 2019. These can be seen on the map below.

Map: Earthquakes in Salt Lake County Greater than 2.0, 1962 – July, 2019



Source: www.earthquake.usgs.gov

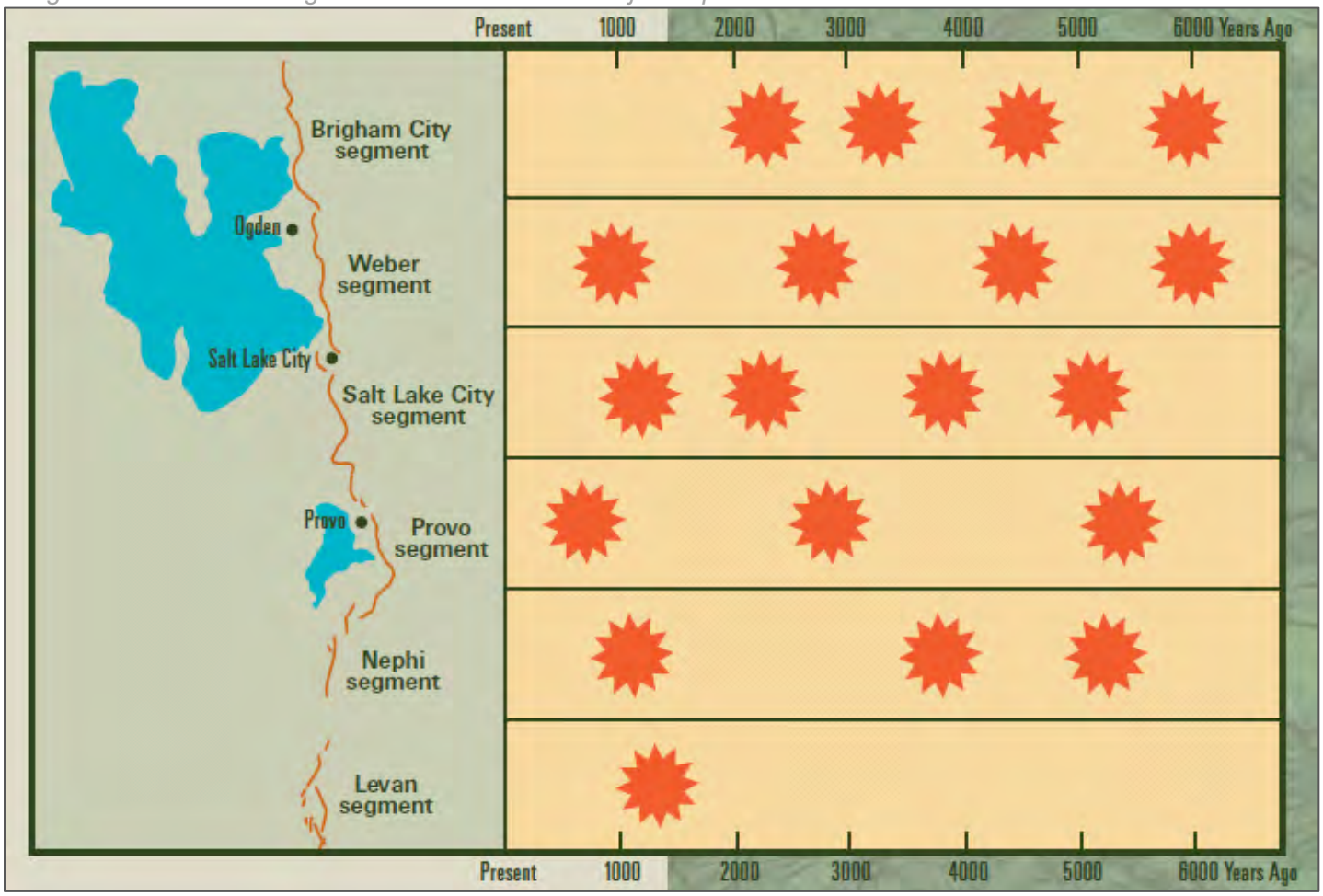
The two largest measured earthquakes to occur in Utah were the Richfield earthquake of 1901, with a magnitude of 6.5 and the Hansel Valley earthquake of 1934 with a magnitude of 6.6. The Hansel Valley earthquake produced MM intensities of VIII in Salt Lake City, with numerous reports of broken windows, 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 was about $1 million (in 1962), or with inflation accounted for, $7,768,300 today (UNHH 2008).

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.

Utah experiences approximately 700 earthquakes each year, and approximately six of those have a magnitude 3.0 or greater. On average, a moderate, potentially damaging earthquake (magnitude 5.5 to 6.5) occurs within the State every 10 years. Large earthquakes (magnitude 6.5-7.5) occur on average every 50 years (UNHH 2008). 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. The probability of a large earthquake occurring along the central segments of the Wasatch Front is 13 percent in 50 years, or 25 percent in 100 years (The Wasatch Fault, UGS PIS 40).

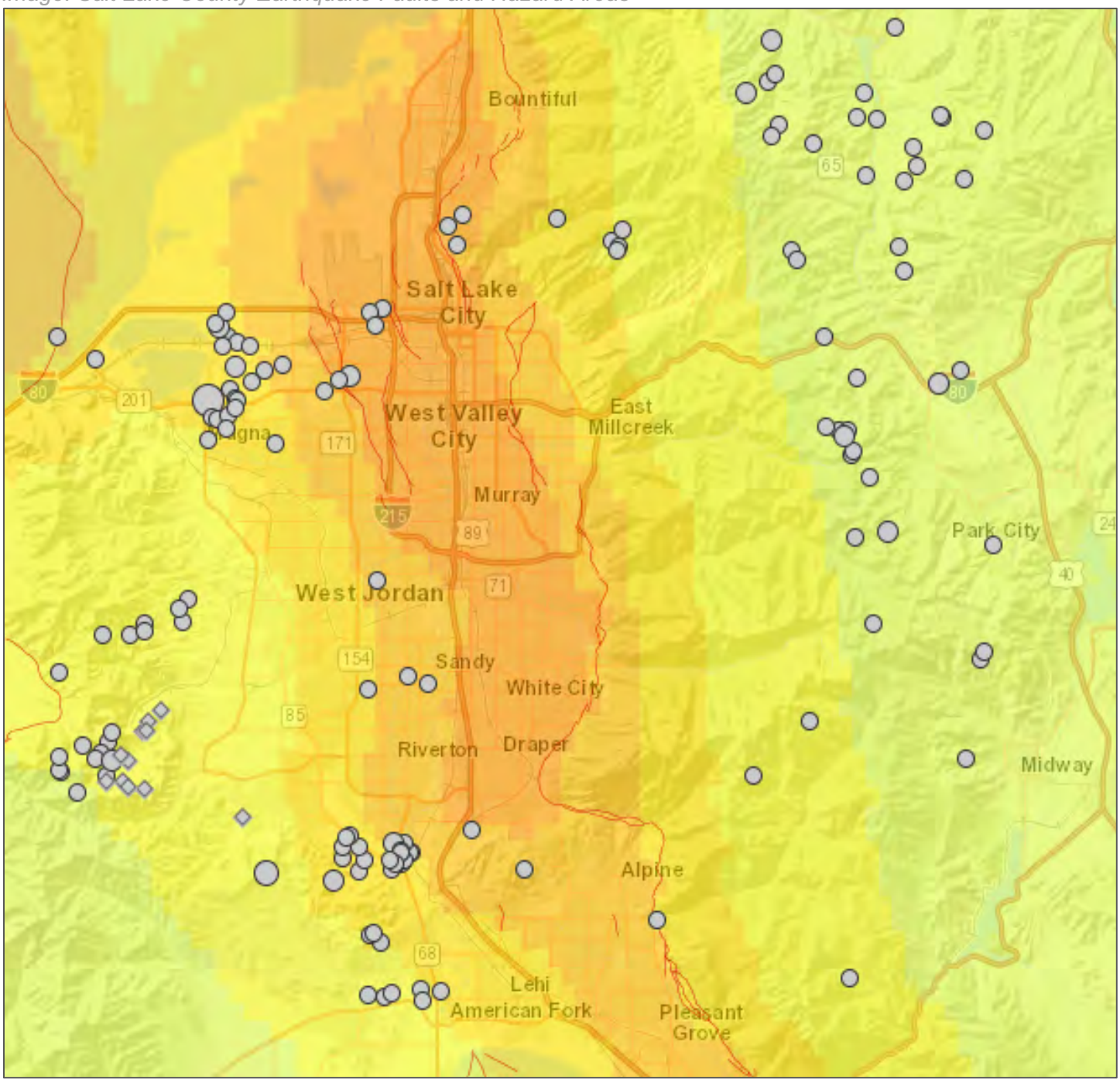
Image: Wasatch Fault Segments and Timeline of Major Ruptures



Source: "The Wasatch Fault", Utah Geological Survey Public Information Series 40

The image below shows the areas in and around Salt Lake County where the earthquake hazard is highest. Fault lines and previous earthquake locations are also shown.

Image: Salt Lake County Earthquake Faults and Hazard Areas



Source: www.earthquake.usgs.gov

Secondary Hazards

Secondary hazards of earthquake events can include liquefaction, slope failure, flooding, avalanches, sensitive clays, subsidence, and valley fever. 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.

Soil Liquefaction:

Liquefaction can occur when water-saturated, cohesionless, sandy soils are subjected to ground shaking. The soils "liquefy" or become like quicksand, lose bearing capacity and shear strength, and readily flow on the gentlest of slopes. Liquefaction is common in areas of shallow ground water and sandy or silty sediments. Liquefaction can produce lateral spreading and flows, where surface soil layers break up and move independently. Displacement of up to 3 feet may occur, accompanied by ground cracking and differential vertical displacement. Soil may move downhill, pulling apart roads, buildings, pipelines and buried utilities. Bearing capacity will lessen and can cause buildings to settle or tip, while lightweight buoyant structures such as empty storage tanks may "float" upward. Liquefaction can also cause foundation materials beneath earthfill dams to liquefy and fail, flooding by ground water in low-lying areas, back up of gravity fed systems, 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 (UNHH 2008).

Slope Failure:

Ground shaking can cause rock falls and landslides in mountainous or canyon areas. Rock falls are the most common slope failure and can occur up to 50 miles away from a 6.0 magnitude earthquake. Landslides occur along steep slopes and benches in wet, unconsolidated materials. During a 6.0 magnitude earthquake, landslides typically occur within 25 miles of the source (UNHH 2008).

Flooding:

"Flooding can happen due to tectonic subsidence and tilting, dam failure, seiches (waves generated in standing bodies of water) in lakes and reservoirs, surface-water diversion or disruption, and increased ground-water discharge." (UNHH 2008).

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, and heavy backcountry use (UNHH 2008).

Sensitive Clays:

Sensitive clays are a soil type that loose strength and are subject to collapse when shaken. The resulting type of ground failure is similar to liquefaction (UNHH 2008).

Subsidence:

A settling or sinking of loose granular materials such as sand and gravel that do not contain clay. Western Utah is subject to this type of ground settlement (UNHH 2008).

Valley Fever:

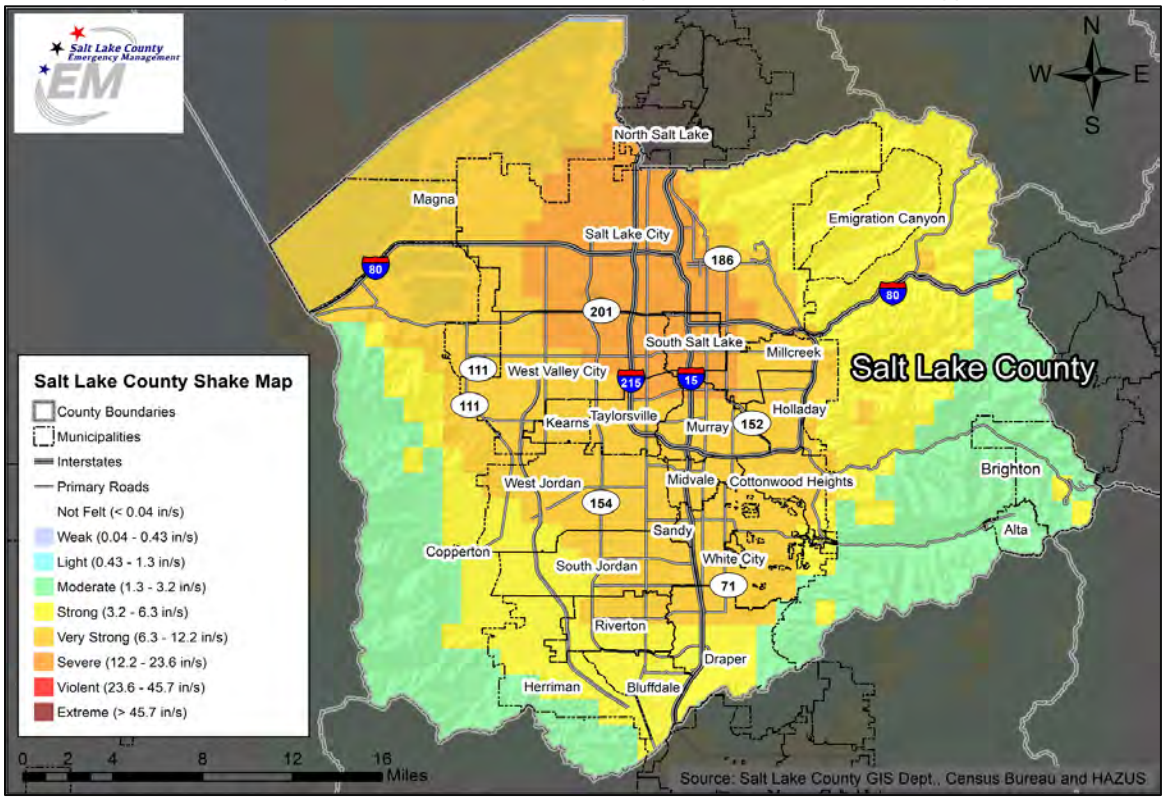
Valley Fever is an illness caused by the fungus Coccidioides, which grows in soils in areas, such as the project site, that have low rainfall, high summer temperatures, and moderate winter temperatures. It is found most often in the southwestern United States (especially Arizona, Utah, Texas and California). Valley Fever infection rates are the highest from June to November, when soils are typically very dry.

Valley Fever is not known to spread from person to person or between people and animals. Exposure typically occurs in connection with ground disturbing activities that release fungal spores which are then inhaled. Earthquakes disturb soil enabling spores to spread into the air. Most people who are exposed to the fungus do not develop symptoms, or have relatively mild flu-like symptoms. Others, however, can experience more severe symptoms, particularly individuals with a weakened immune system, who are of African-American or Filipino descent, or who are pregnant. The elderly may also be prone to more severe cases. Common symptoms include fever, cough, headache, rash, muscle aches, and joint pain. Symptoms of advanced coccidioidomycosis may include skin lesions, chronic pneumonia, meningitis, bone or joint infection. Symptoms may appear between one (1) and three (3) weeks after exposure. Some patients have reported having symptoms for six months or longer, especially if the infection is not diagnosed early.

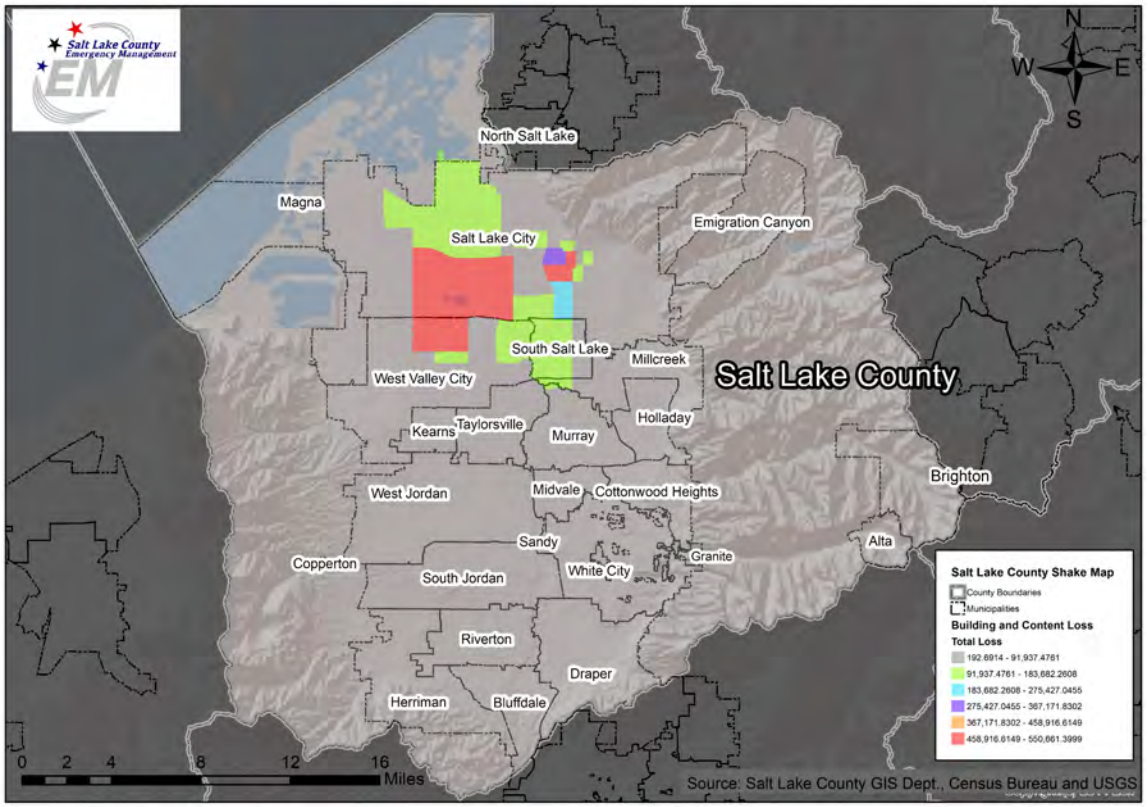
Vulnerability Assessment

Vulnerability of people and infrastructure to earthquake hazards in Salt Lake County was obtained from the modeling program HAZUS-MH using 2010 Census Data. The Hazus earthquake scenario entails a magnitude 7.0 earthquake occurring within Salt Lake County (epicenter Salt Lake City), which is the basis for the vulnerability and loss estimates provided in this section. An additional scenario based on the Great Shakeout was also developed, and the building and content loss map is provided below for comparison.

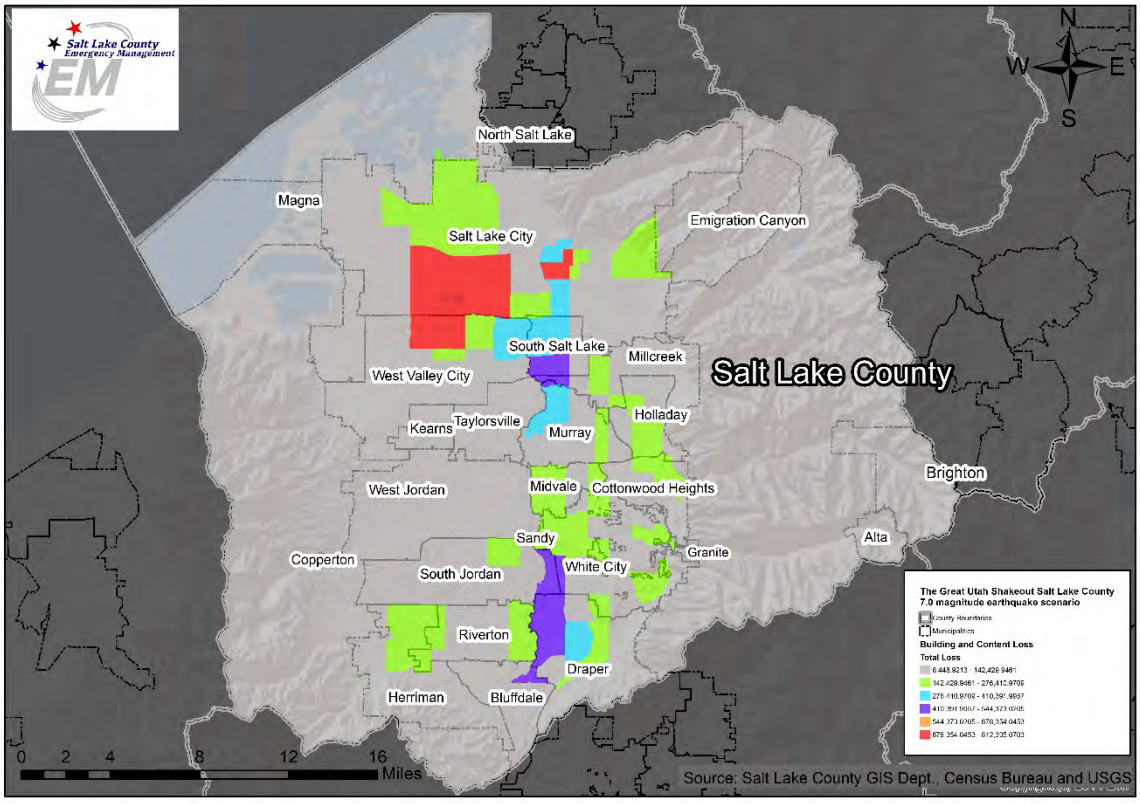
Map: Salt Lake County Shake Map for M7 Event (epicenter Salt Lake City)



Map: Salt Lake County Shake Map for M7 Event: Building and Content Loss (epicenter Salt Lake City)



Map: Salt Lake County Shake Map for M7 Event: Building and Content Loss (Great Shakeout)



Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can be life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The table below provides a summary of the casualties estimated for this earthquake. The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table: Salt Lake County Earthquake Casualty Estimates

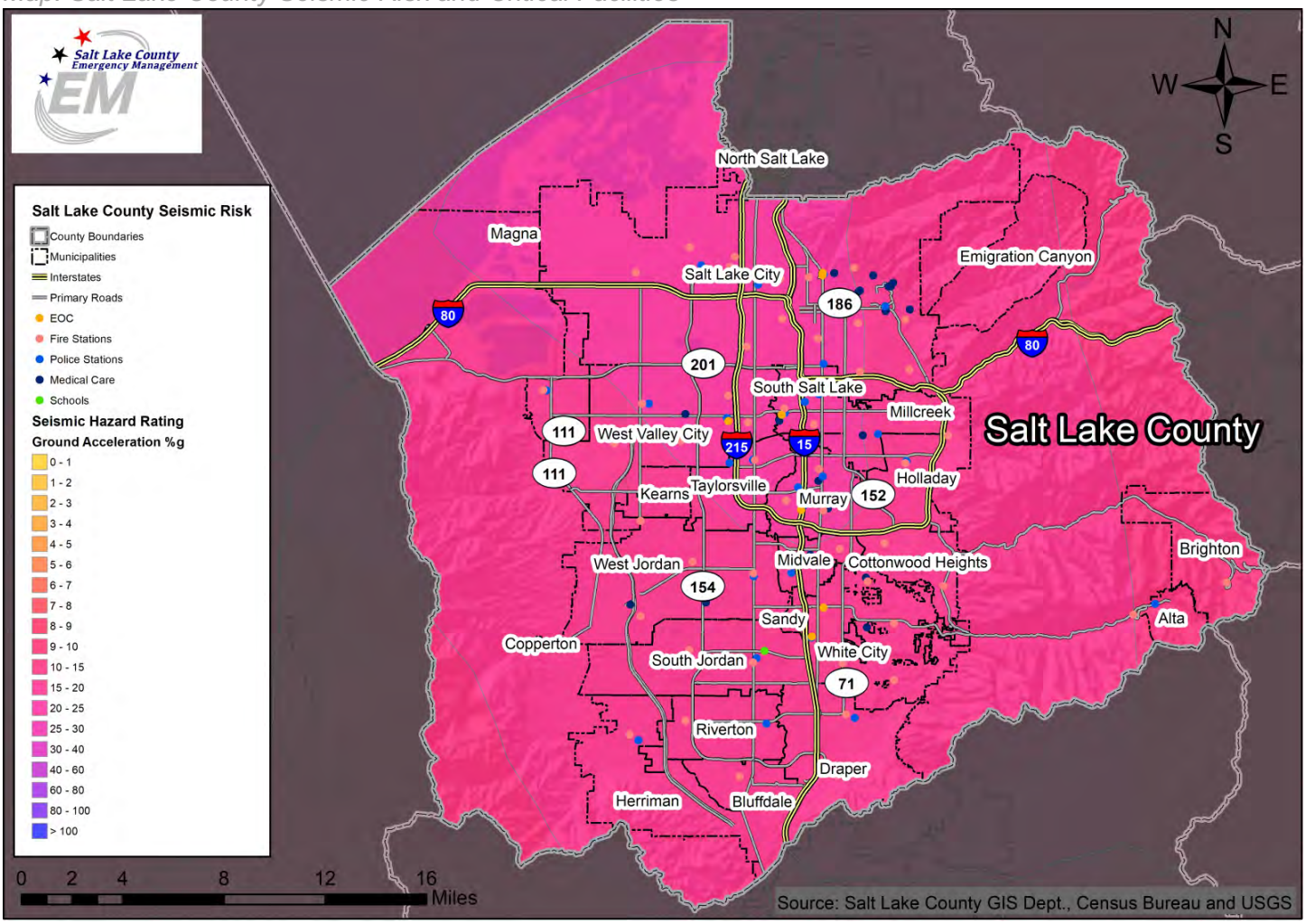
		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	29.43	7.78	1.21	2.39
	Commuting	0.21	0.25	0.46	0.09
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	33.23	8.52	1.28	2.52
	Other-Residential	523.31	119.75	14.29	27.44
	Single Family	635.36	134.14	18.05	35.42
	Total	**1,222**	**270**	**35**	**68**
2 PM	Commercial	1657.91	438.77	68.36	134.36
	Commuting	1.88	2.24	4.11	0.78
	Educational	395.12	101.81	15.79	30.80
	Hotels	0.00	0.00	0.00	0.00
	Industrial	244.90	62.77	9.46	18.44
	Other-Residential	96.85	22.48	2.78	5.17
	Single Family	115.46	24.93	3.47	6.50
	Total	**2,512**	**653**	**104**	**196**
5 PM	Commercial	1168.71	309.43	48.46	93.98
	Commuting	34.16	40.71	74.59	14.15
	Educational	49.56	12.95	2.02	3.95
	Hotels	0.00	0.00	0.00	0.00
	Industrial	153.06	39.23	5.91	11.53
	Other-Residential	197.75	45.85	5.67	10.56
	Single Family	247.88	53.27	7.38	13.85
	Total	**1,851**	**501**	**144**	**148**

Essential Facility Damage

Table: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	25	4	0	14
Schools	389	36	0	284
EOCs	8	2	0	3
Police Stations	30	0	0	19
Fire Stations	60	0	0	40

Map: Salt Lake County Seismic Risk and Critical Facilities



Economic Loss

The total economic loss estimated for the earthquake is 7,093.67 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following sections provide more detailed information about these losses, which can be broadly grouped into three categories: direct building, business interruption, and transportation and utility lifeline losses.

Building-Related Losses

The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Hazus estimates that about 36,629 buildings will be at least moderately damaged. This is over 12.00% of the buildings in the region. There are an estimated 2,531 buildings that will be damaged beyond repair. The tables below summarize the expected damage and loss. The total building-related losses were 6,782.33 (millions of dollars); 23% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancy category which made up over 40% of the total loss.

Table: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	523.15	0.24	143.90	0.24	101.70	0.38	38.98	0.53	15.27	0.60
Commercial	10,648.63	4.96	3,402.34	5.72	3,241.15	12.13	1,433.28	19.42	588.60	23.25
Education	323.19	0.15	92.26	0.16	76.45	0.29	33.96	0.46	13.14	0.52
Government	296.01	0.14	110.26	0.19	131.27	0.49	78.41	1.06	39.05	1.54
Industrial	3,054.62	1.42	931.88	1.57	952.74	3.57	438.31	5.94	175.43	6.93
Other Residential	10,495.66	4.89	5,490.63	9.24	4,415.02	16.53	2,058.56	27.89	674.12	26.62
Religion	723.44	0.34	238.28	0.40	201.20	0.75	91.78	1.24	36.30	1.43
Single Family	188,431.06	87.85	49,035.75	82.49	17,596.85	65.87	3,208.26	43.46	990.07	39.10
Total	**214,496**		**59,445**		**26,716**		**7,382**		**2,532**	

Table: Building-Related Economic Loss Estimates

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	20.1901	289.2409	13.1964	20.1692	342.7966
	Capital-Related	0.0000	8.6027	261.4721	8.1902	3.1692	281.4342
	Rental	48.7253	78.1877	169.3044	5.4315	13.8295	315.4784
	Relocation	170.8302	56.6410	264.0967	28.4588	67.1917	587.2184
	Subtotal	**219.5555**	**163.6215**	**984.1141**	**55.2769**	**104.3596**	**1526.9276**
Capital Stock Losses							
	Structural	249.6381	133.7350	413.6649	91.2331	64.6952	952.9663
	Non Structural	891.8710	673.3223	1071.6538	286.3120	195.0177	3,118.1768
	Content	248.4333	144.3726	479.9086	181.2167	83.3172	1,137.2484
	Inventory	0.0000	0.0000	15.5317	31.0296	0.4486	47.0099
	Subtotal	**1389.9424**	**951.4299**	**1980.7590**	**589.7914**	**343.4787**	**5255.4014**
Total		**1609.50**	**1115.05**	**2964.87**	**645.07**	**447.84**	**6782.33**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. The losses for the transportation and utility systems are displayed separately below.

Transportation System Damage and Losses

Table: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	370	0	0	370	370
	Bridges	698	165	6	537	583
	Tunnels	0	0	0	0	0
Railways	Segments	182	0	0	182	182
	Bridges	17	0	0	17	17
	Tunnels	0	0	0	0	0
	Facilities	6	0	0	6	6
Light Rail	Segments	24	0	0	24	24
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	24	0	0	24	24
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	5	0	0	5	5

Table: Transportation System Economic Losses (Millions of Dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	4634.8229	0.0000	0.00
	Bridges	1383.4012	153.3494	11.08
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**6018.2241**	**153.3494**	
Railways	Segments	253.5243	0.0000	0.00
	Bridges	2.2755	0.0043	0.19
	Tunnels	0.0000	0.0000	0.00
	Facilities	15.9780	4.5613	28.55
	Subtotal	**271.7778**	**4.5656**	
Light Rail	Segments	37.1528	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	63.9120	14.4103	22.55
	Subtotal	**101.0648**	**14.4103**	
Bus	Facilities	2.1364	0.2143	10.03
	Subtotal	2.1364	0.2143	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	21.3020	3.8683	18.16
	Runways	189.8200	0.0000	0.00
	Subtotal	**211.1220**	**3.8683**	
Total (Millions of Dollars)		**6,604.33**		**176.41**

Utility System Damage and Losses

Table: Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	With Functionality > 50%	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Wastewater	5	1	0	1	5
Natural Gas	1	0	0	1	1
Oil Systems	2	1	0	1	2
Electrical Power	7	4	0	3	7
Communication	42	3	0	42	42

Table: Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	10,482	1204	301
Wastewater	6,289	605	151
Natural Gas	4,193	207	52
Oil	0	0	0

Table: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	342,622	5,720	3,124	424	0	0
Electric Power		1,065	569	188	29	2

Table: Utility System Economic Losses (Millions of Dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	337.3820	5.4179	1.61
	Subtotal	**337.3820**	**5.4179**	
Wastewater	Pipelines	0.0000	0.0000	0.00
	Facilities	326.3400	34.2154	10.48
	Distribution Lines	202.4292	2.7215	1.34
	Subtotal	**528.7692**	**36.9369**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.0682	0.0891	8.34
	Distribution Lines	134.9528	0.9324	0.69
	Subtotal	**136.0210**	**1.0215**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.1960	0.0279	14.23
	Subtotal	**0.1960**	**0.0279**	
Electrical Power	Facilities	754.6000	91.3465	12.11
	Subtotal	**754.6000**	**91.3465**	
Communication	Facilities	4.1160	0.1818	4.42
	Subtotal	**4.1160**	**0.1818**	
Total (Millions of Dollars)		**1,761.08**	**134.93**	

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 5 ignitions that will burn about 0.02 sq. miles of the region's total area. The model also estimates that the fires will displace about 157 people and burn about 8 million of dollars of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris. The model estimates that a total of 2,258,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 30.00% of the total, with the remaining 70.00% being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 90,320 truckloads (25 tons/truck) to remove the debris generated by the earthquake.

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 6,735 households to be displaced due to the earthquake. Of these, 4,458 people will seek temporary shelter in public shelters.

Flooding (Urban/Flash Flooding and Riverine Flooding)

Floods are related to fast snowmelt, heavy rainfall, or failure of natural or engineered impoundments onto riverbanks and adjacent floodplains. Floodplains are lowland areas near rivers, lakes, reservoirs, oceans and low terrain urban areas that are subject to recurring floods. Stream flooding occurs when the peak discharge, or rate of flow in cubic feet per second (cfs), is larger than the channel of the river or storm sewer capacity. In Salt Lake County, floods are typically localized events running out of mountain canyons. Urban areas are also prone to flooding because urban development such as buildings, streets, and parking lots prevent water infiltration into the soil and greatly increase runoff. Undersized piping, manmade drainage channels, or debris that obstructs passageways may further contribute to flooding. Flood damage includes saturation of land and property, erosion, deposition of mud and debris, and fast flowing water. Most injuries and deaths occur from fast moving floodwaters, while most property damage results from inundation by sediment-filled water.

Snowmelt Floods

These are caused by rapid spring snowmelt of mountain snowpack. Most times, intense spring rainfall assists the flood scenario, causing additional rapid river rises. These events can last for weeks during the spring (generally April-June) and may result in loss of life and extensive damage affecting property owners and municipalities. More damage is occurring over the years as a result of increased development near the riverbanks of mountain streams (UNHH 2008). Snowmelt risk is greatest when snowpack is at or above normal and/or accompanied by an abrupt warming trend.

Flash-Flooding

These are caused by intense thunderstorms and resultant intense rainfall. Intense rainfall may fall on areas of sparse vegetation, steep slopes, and impervious surfaces, and is then channeled into smaller waterways or conduits. Once the large volume of runoff begins to accumulate across the basin, it typically increases in volume and speed in a short time. Events are often short-lived, but very dangerous for those caught in a confined area, such as a canyon, during the time of the flood (UNHH 2008). Flash flooding has caused 34 fatalities in Utah since 1950 (NOAA). In 2015 there were 20 fatalities including 7 at Zion National Park.

Areas of localized flooding may occur in urban areas not associated with existing waterways. Rain from high intensity thunderstorms may accumulate in low-lying areas with no outlet or where storm drains have become

overwhelmed. These types of flood and the resulting impacts are difficult to anticipate due to the uncertainty of when and where such storms will occur.

Long-term Rainfall Events

These rain events occur mostly in the fall or winter months and are produced by large synoptic weather systems originating out of the South, Southwest or West that produce rainfall for an extended period. Some melting of snow may occur as a result of the rainfall. This occurs mainly in the southern half of the state (UNHH 2008).

Post-fire Debris Flow Flooding

Enhanced runoff conditions from a fire-damaged watershed can result in debris flow flooding. As fires burn, they destroy vegetation and leave soils in a hydrophobic state, resulting in greater peak flows (UNHH 2008). This issue will be discussed further in the landslide section.

Flooding Hazard Profile

Potential Magnitude		High	**Probability**	X	High
	X	Medium			Medium
		Low			Low
		Minimal			Unlikely
Location	Largely in and along floodplains; 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.				

Range of Magnitude

Floods can range in magnitude from minor to catastrophic. The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability.

1% Special Flood Hazard Area (100-year flood):

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

0.2% Special Flood Hazard Area (500-year flood):

A 0.2 percent (500-year) floodplain is an area at risk for flooding from a bayou, creek or other waterway overflowing during a 0.2 percent (500-year) flood. Structures located in a 0.2 percent (500-year) floodplain have a minimum of a 0.2 percent chance of flooding in any given year

Location

Flooding in Salt Lake County 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 April through June, and occurs along the major existing streams and waterways. Thunderstorms can produce high intensity, short duration heavy rainfall that occurs over a relatively small area in the summer months. However, flooding can also occur from non-thunderstorm rainfall events.

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, and Millcreek. Smaller waterways include Bingham Creek, Midas Creek, Rose Creek, Corner Canyon Creek, Dry Creek, Wood Hollow, Willow Creek, and Barney's Creek. All have the potential to flood. However, significant flood mitigation measures were implemented following the major floods of 1983-84 that greatly reduced the flood threat.

The flows of the Jordan River from Utah Lake into Salt Lake County are controlled and the flood potential from is somewhat reduced upstream of the major Jordan River tributaries. 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 have a number of smaller flood storage lakes and ponds providing some flood protection, such as Wheeler Historic Farm. In Salt Lake City, Emigration Creek and Red Butte Creek come together at 700 East and 1300 South and can be discharged in or bypass Liberty Park pond. Parley's Creek discharges to the 1300 South drain at State Street.

Areas to monitor include 1300 South between 700 East and State Street, 700 West and North Temple Streets. Retention ponds are also used to store runoff from commercial and residential development areas.

Maps visually showing the probable boundaries of a 100 and 500-year flood event can be found in the Vulnerability Assessment portion of this hazard profile.

Historical Events and Probability of Future Occurrence

According to NOAA data, there have been 32 Flood/Flash Flood events in Salt Lake County since 1996. Total property damages were approximately 13.235 million with an additional $1,000 in crop damages.

The following flood events are of notable significance:

- **2017** - Thunderstorms producing heavy rainfall moved into the Salt Lake Valley in the early morning hours of July 26 and generally persisted for 3-4 hours, producing widespread flash flooding.
- **2015** - Heavy rain brought road, parking lot, and basement flooding to the Sugarhouse and Foothill areas of Salt Lake City.
- **2014** - Heavy rain during the early morning hours of August 20 led to flooding in West Jordan and Murray
- **2011** - Large snowpack meant larger resulting spring runoff flows
- **2010** - Spring snowmelt combined with heavy rains caused several streams to overtop their banks
- **1987** - Great Salt Lake reached its all-time maximum water level (4211.6 feet)
- **1983** - Large snowpack was coupled with a rain-on-snow event, (City Creek diverted down State Street)
- **1983/1984** - Large snowpack overwhelmed Utah Lake and affected Jordan River downstream
- **1952** - Rapid melt of a large snowpack

Utah has received seven Presidential disaster declarations related to flooding: in 1983, 1984, two in 2005 in (Southern Utah), two in 2012 and one in 2017. Following the events of 1983-84, an enormous amount of mitigation was completed along the urban areas of the Wasatch Front. The State of Utah constructed a county flood control project in which pumps were installed on the Great Salt Lake to pump excess water into the west desert. An advanced water-monitoring network of stream gauges, SNOTEL sites, and automated stream flow gates give warning of elevated flows (UHNN 2008).

During the past 149 years, the Great Salt Lake has three times peaked over 4,211 feet above sea level: to 4,211.60 feet in June 1873, to 4,211.50 feet in June 1986 and to 4,211.60 feet in June 1987.

Image: Salt Lake County, June 2010 Flooding

Source: Salt Lake County Engineering

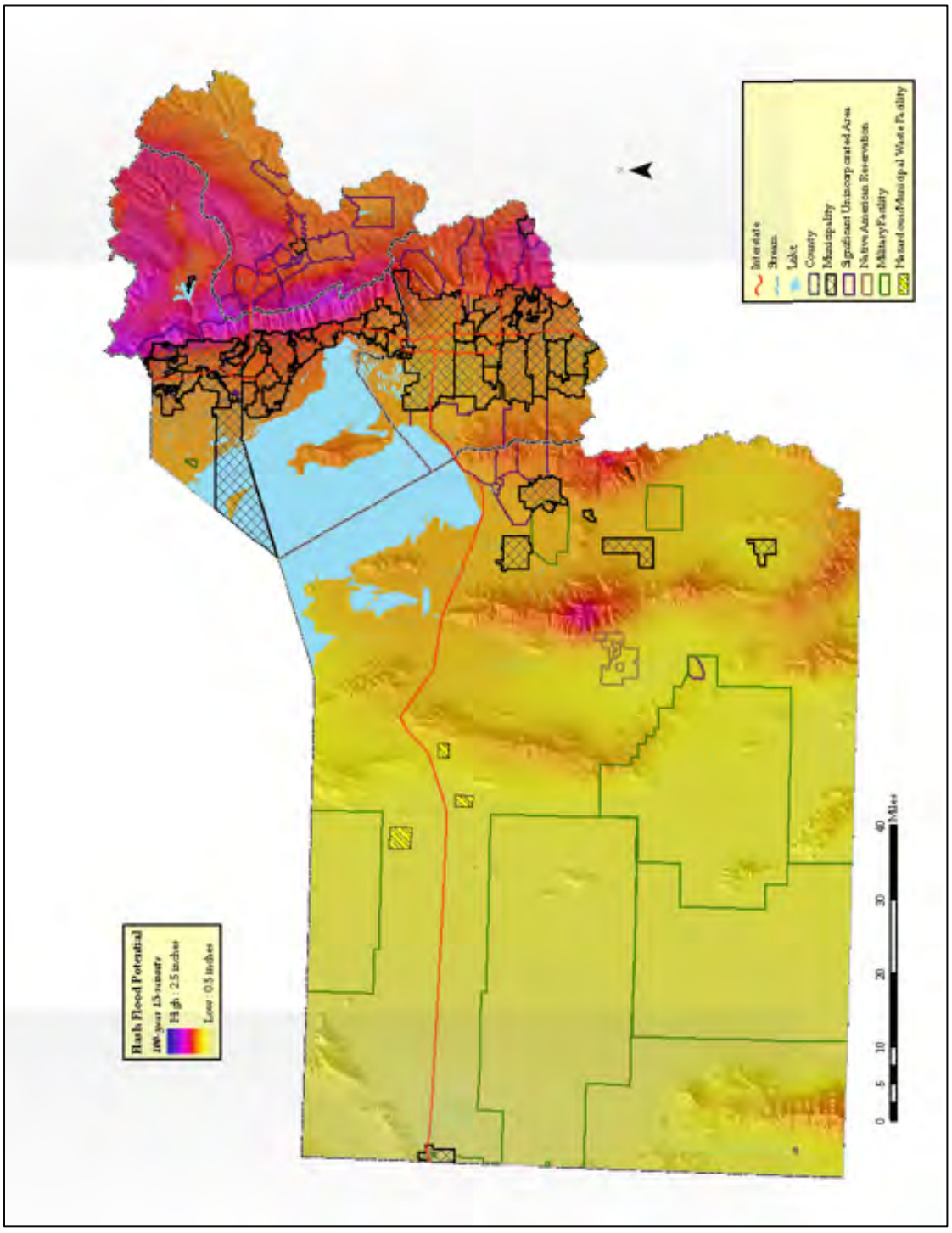
This picture of the Salt Air Resort on the southeast shore of the Great Salt Lake was taken during the flood years of the 1980s. Large pumps were installed on the West side of the Great Salt Lake (at a cost of $60 million) and began pumping water into the West Desert in 1987. These pumps are currently not in operation, but could be reactivated if necessary (Utah Department of Water Resources 2007b).

Image: Great Salt Lake Flooding, Salt Air Resort
(Photo courtesy of the National Weather Service)

Source: http://www.utahweather.org/

Depending upon the amount of snowfall in the winter and the speed with which it melts, flows can vary dramatically from year to year. Nevertheless, flood mitigation is on every jurisdiction's mind each spring and a myriad of mitigation plans are in place to prevent damage. There is no question that flooding will continue to occur in the future. As previously stated, NOAA data records 32 flooding events from 1996 to 2018. This results in an average of approximately 1.4 flooding events per year. Salt Lake County will likely experience at least this average amount of flooding, going forward.

Map: 7-FF Regional Flash Flood Hazard



Source: NWS Hydrometeorological Design Studies Center

Map: Salt Lake County Flood Risk

Secondary Hazards

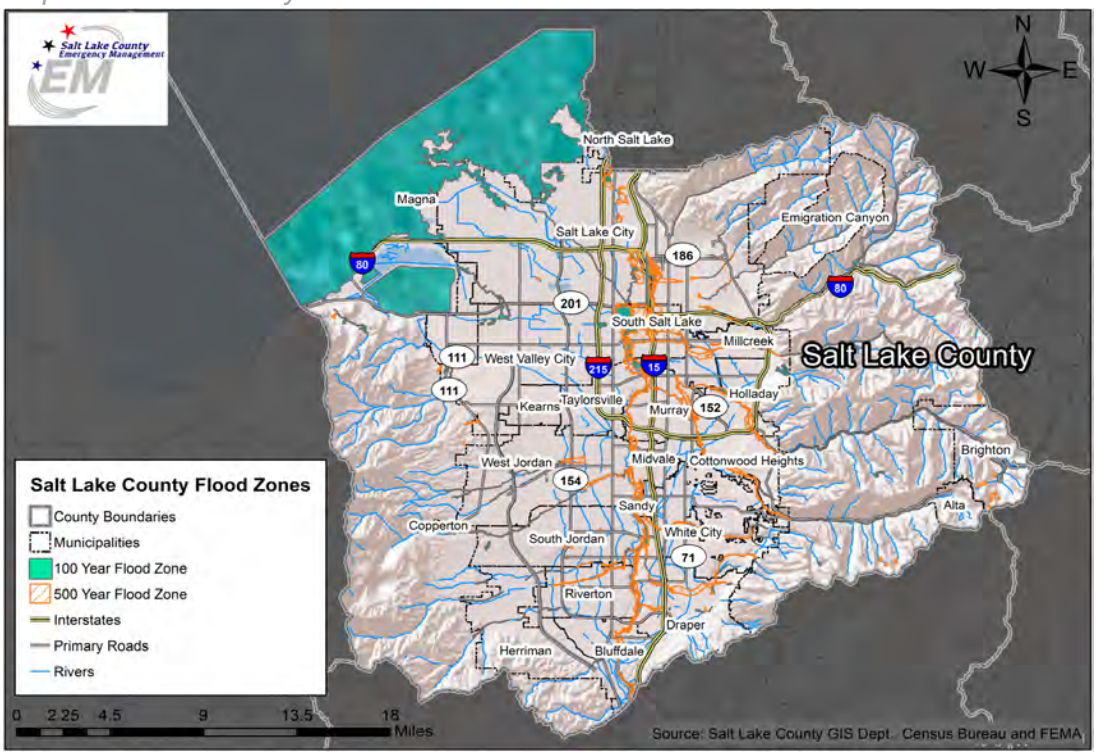
One of the most problematic secondary hazards for flooding is bank erosion, which in some cases can be more harmful than the actual flooding itself. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. This may also happen in areas with soft soils that are prone to erosion. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers. If flooding is severe enough, infrastructure failure can occur, delaying the delivery of vital services. If enough residential structures are impacted, there may also be extreme stress on the emergency housing and shelter capabilities, not to mention the social fabric of the community.

Vulnerability Assessment

Vulnerability of people and infrastructure to flooding hazards in Salt Lake County was obtained from the modeling program HAZUS-MH. The Hazus flooding scenarios, which are the basis for the vulnerability and loss estimates provided in this section, entails both a 100 and 500-year flood occurring within Salt Lake County (1% and 0.2% annual risk, respectively).

Portions of the following vulnerability assessment data are also sourced from the 2019 Utah State Hazard Mitigation plan. The State Plan also assessed vulnerability for both 100-year (NFIP Zone A) and 500-year flood events in Salt Lake County. Analysis in the State Plan was completed using Digital Flood Insurance Rate Maps (DFIRM). Only streams that contained detailed flood cross-section data could be used and flooding from the Great Salt Lake was not included. Consequently, the portion of analysis below incorporated from the State Plan should be considered conservative. Overall, the 2019 Utah State Hazard Mitigation Plan reflects that vulnerability to flooding is ranked as "Moderate" for Salt Lake County, based on frequency and severity of past events and future probabilities.

Map: Salt Lake County Flood Zones



Map: Salt Lake County Population Density in Flood Zones

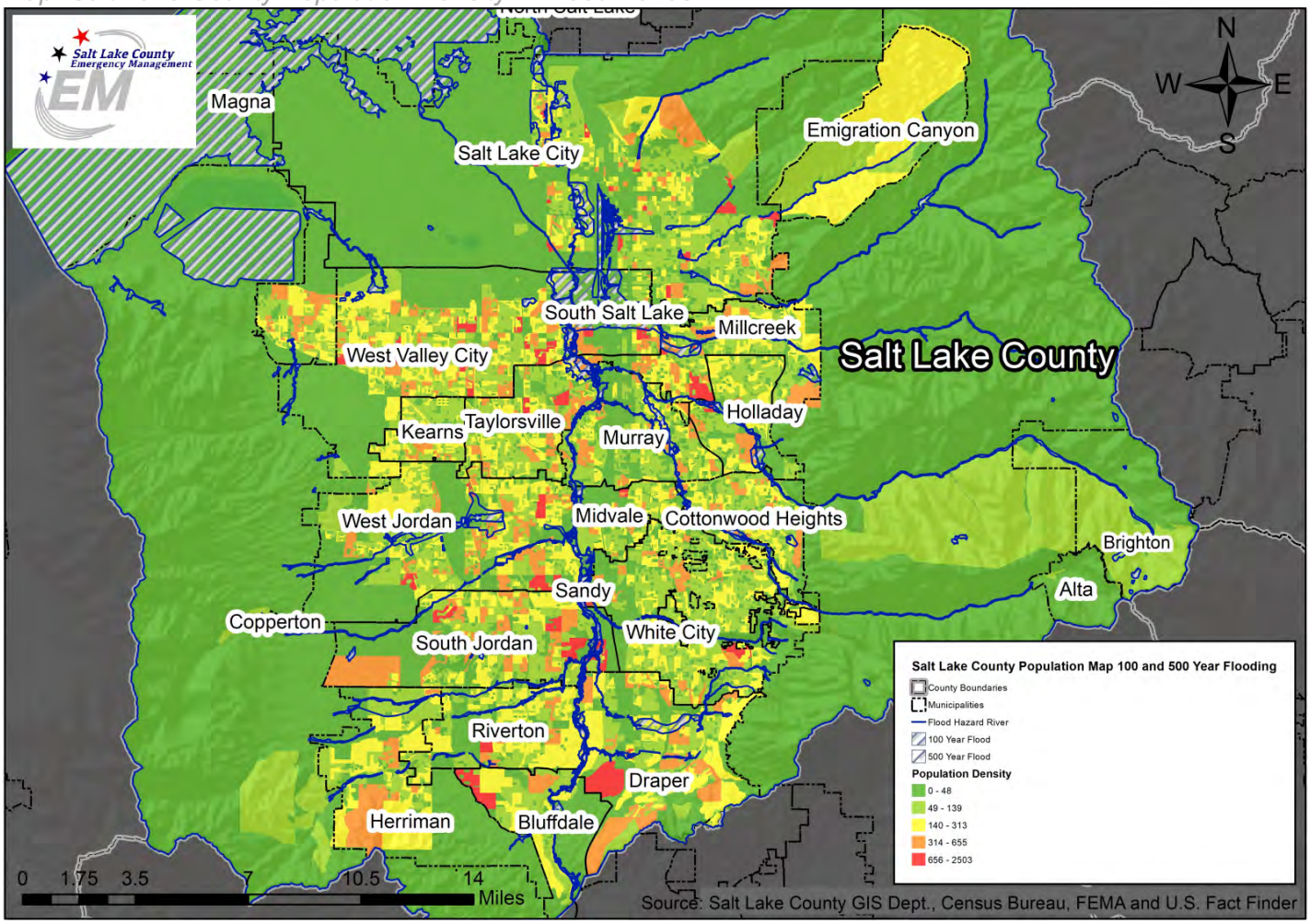


Table: Salt Lake County Flood Vulnerabilities and Loss Estimates

County	Acres Flooded	People
100-year Flood	2,588.7	13,777
500-year Flood	8,346.4	14,613

Source: 2019 Utah State Hazard Mitigation Plan

Economic Loss

For a 100-year event, the total economic loss estimated for the flood is 181.26 million dollars, which represents 7.20% of the total replacement value of the scenario buildings. For a 500-year event, the total estimated economic loss is 561.23 million dollars, which represents 6.44% of the total replacement value of the scenario buildings. Economic loss is measured by building losses, which can be broken up into two categories: direct building loss and business interruption loss.

The table below shows the exposure for each category of building use in Salt Lake County to each flood scenario.

Table: Building Exposure by Occupancy Type for Flood Scenario

	100-Year Flood		500-Year Flood	
Occupancy	**Exposure ($1,000)**	**Percent of Total**	**Exposure ($1,000)**	**Percent of Total**
Residential	1,786,736	71.0%	5,830,834	66.9%
Commercial	472,720	18.8%	1,898,747	21.8%
Industrial	210,144	8.3%	541,625	6.2%
Agricultural	5,172	0.2%	19,869	0.2%
Religion	29,147	1.2%	268,081	3.1%
Government	8,951	0.4%	120,419	1.4%
Education	4,082	0.2%	37,328	0.4%
Total	**2,516,952**	**100%**	**8,716,903**	**100%**

Direct Building Damage and Loss

For a 100-year flood scenario, Hazus estimates that about 236 buildings will be at least moderately damaged. This is over 61% of the total number of buildings in the scenario. It is estimated that only 1 building will be completely destroyed. For a 500-year flood scenario, Hazus estimates that about 452 buildings will be at least moderately damaged, which is over 57% of the total number of buildings in the scenario. It is also estimated that about 6 buildings will be completely destroyed.

Table: Expected Building Damage by Occupancy for 100-Year Flood Event

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	173	42	178	44	38	9	13	3	6	1	1	0
Total	**173**		**178**		**38**		**13**		**6**		**1**	

Table: Expected Building Damage by Occupancy for a 500-Year Flood Event

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	9	53	7	41	1	6	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	504	53	341	36	68	7	21	2	8	1	6	1
Total	**513**		**348**		**69**		**21**		**8**		**6**	

As can be seen in the tables below, the total building-related losses for a 100-year flood event were 81.22 million dollars. About 55% of the total estimated losses were related to the business interruption of the region. The residential occupancies made up 39.74% of the total loss. For a 500-year event, the total building-related losses were 227.77 million dollars. About 59% of the total estimated losses were related to the business interruption of the region and residential occupancies made up 36.39% of the total loss.

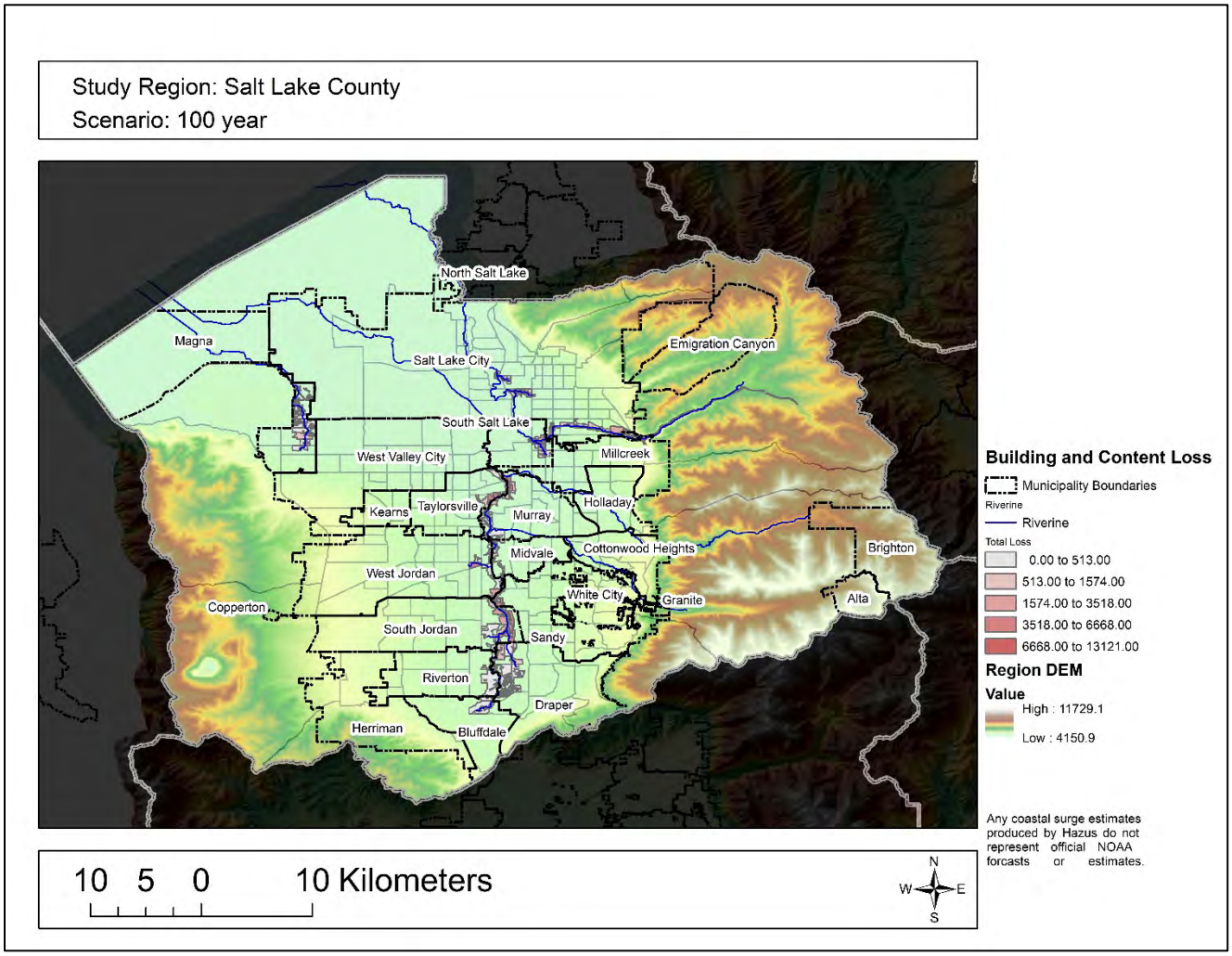
Table: Building-Related Economic Loss Estimates for 100-Year Flood Event (In Millions of Dollars)

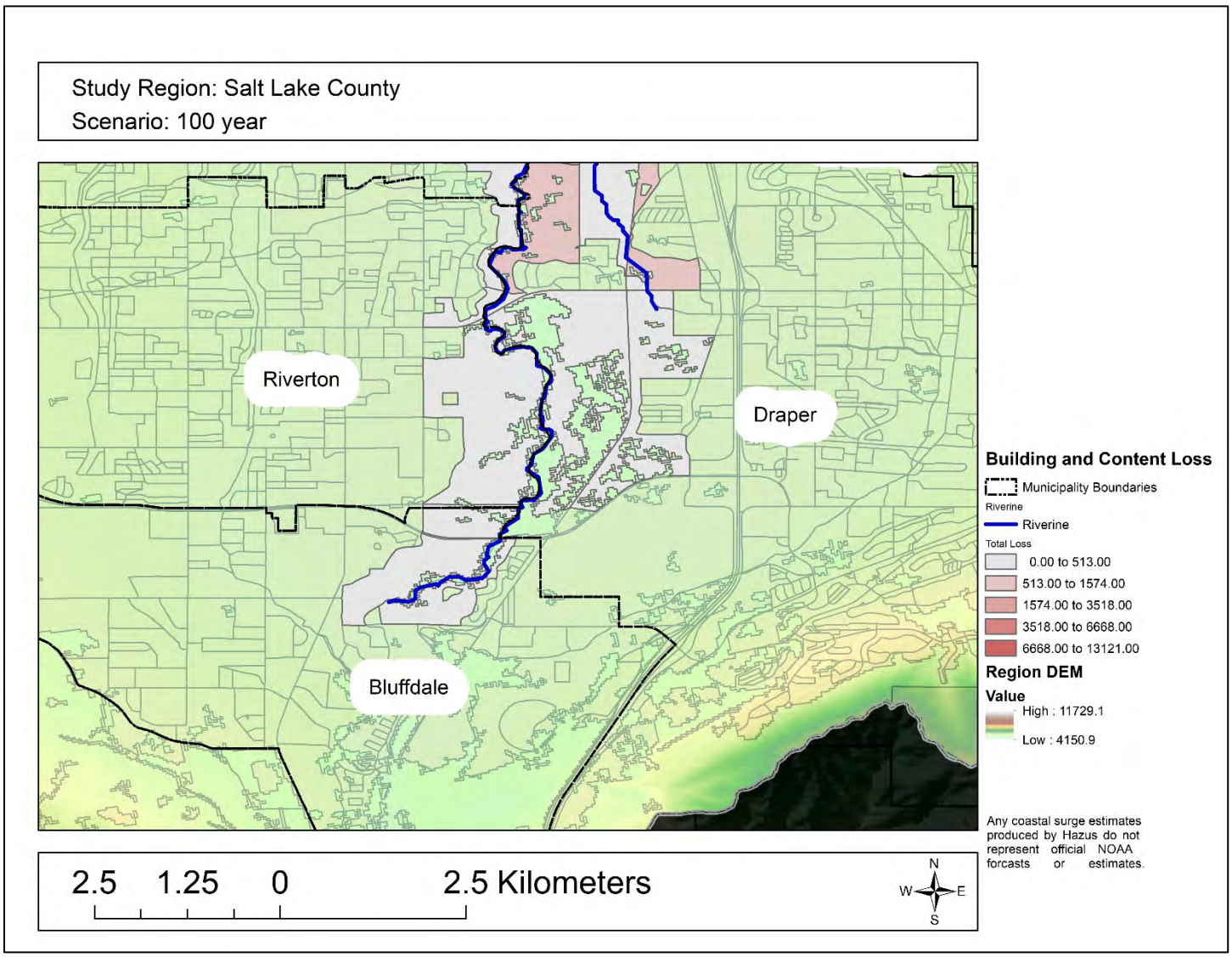
Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss	Building	30.43	6.27	2.08	0.40	39.18
	Content	16.87	17.30	4.22	2.57	40.96
	Inventory	0.00	0.47	0.60	0.00	1.07
	Subtotal	**47.30**	**24.04**	**6.90**	**2.97**	**81.22**
Business Interruption	Income	0.37	25.95	0.18	1.25	27.75
	Relocation	15.48	7.83	0.26	0.64	24.21
	Rental Income	8.02	5.75	0.03	0.11	13.91
	Wage	0.87	26.34	0.35	6.62	34.18
	Subtotal	**24.74**	**65.88**	**0.81**	**8.62**	**100.05**
All	**Total**	**72.03**	**89.92**	**7.72**	**11.60**	**181.26**

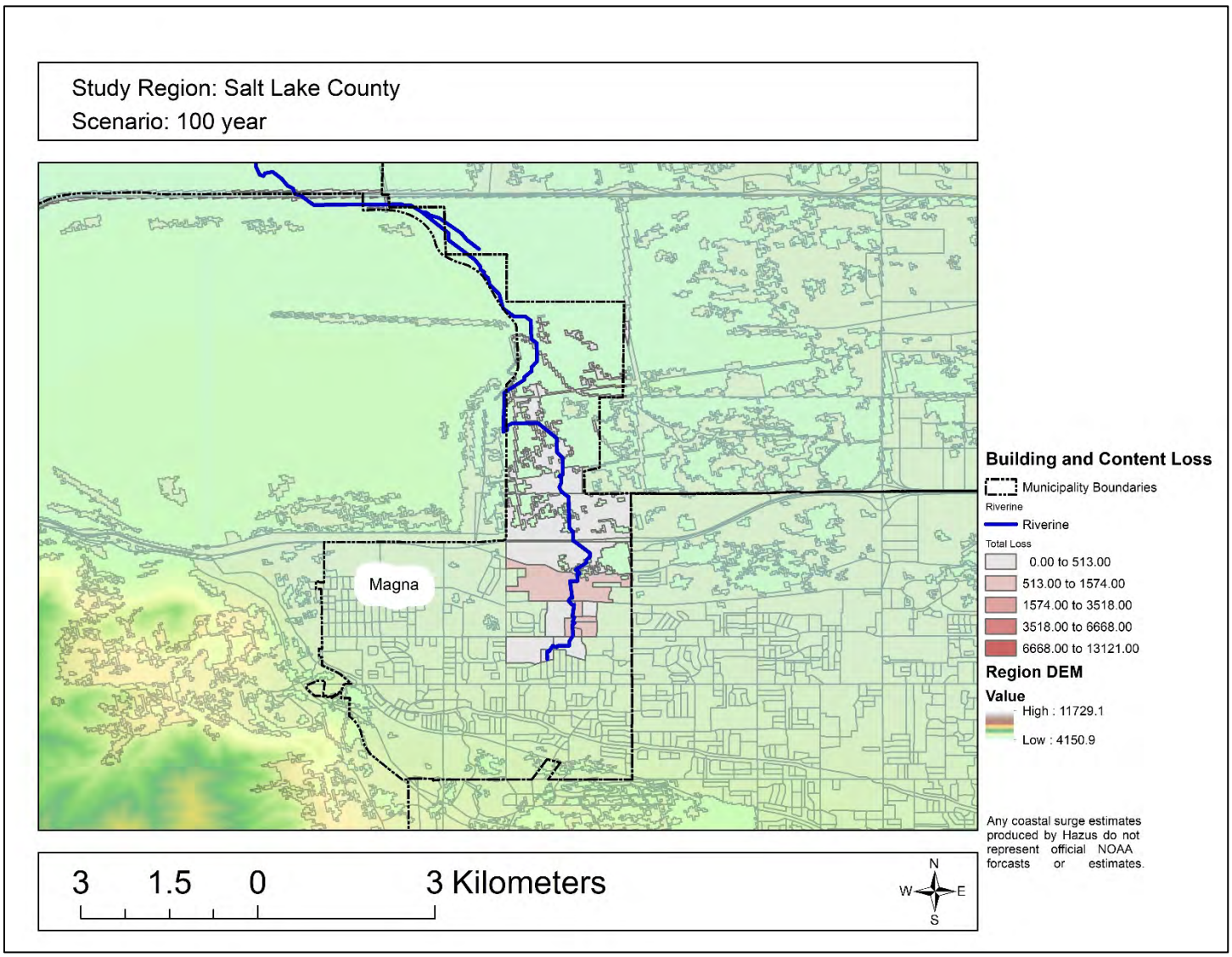
Table: Building-Related Economic Loss Estimates for 500-Year Flood Event (In Millions of Dollars)

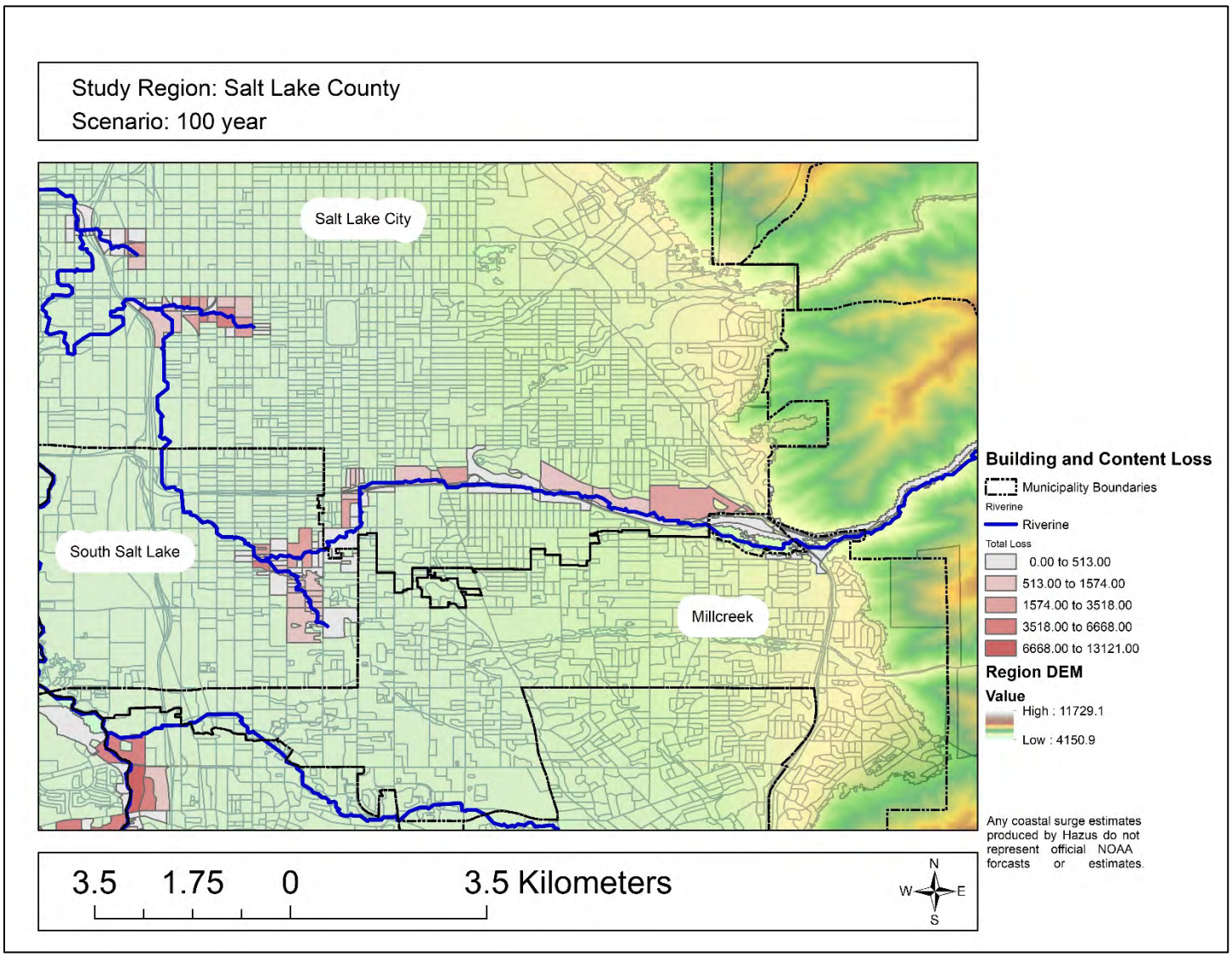
Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss	Building	81.61	19.31	4.78	1.03	106.73
	Content	46.16	55.23	10.09	6.69	118.16
	Inventory	0.00	1.34	1.51	0.02	2.88
	Subtotal	**127.76**	**75.88**	**16.38**	**7.74**	**227.77**
Business Interruption	Income	2.27	81.04	0.50	4.77	88.59
	Relocation	43.81	24.40	0.64	2.74	71.59
	Rental Income	25.05	17.23	0.08	0.53	42.89
	Wage	5.37	84.86	0.89	39.29	130.41
	Subtotal	76.50	207.54	2.12	47.32	333.47
All	**Total**	**204.26**	**283.42**	**18.50**	**55.06**	**561.23**

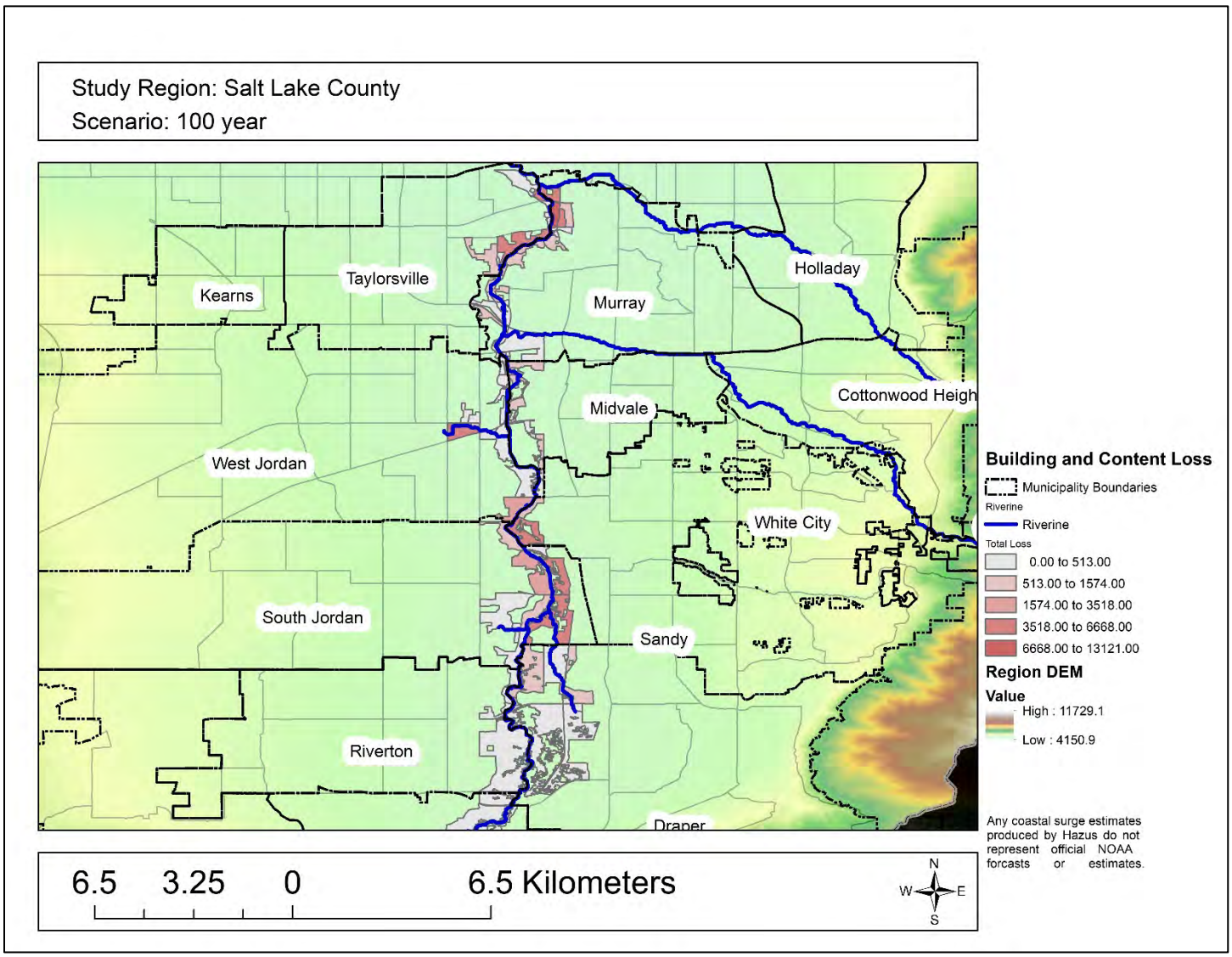
Map: Salt Lake County Area 1% Annual Chance Flood Risk (100-year)



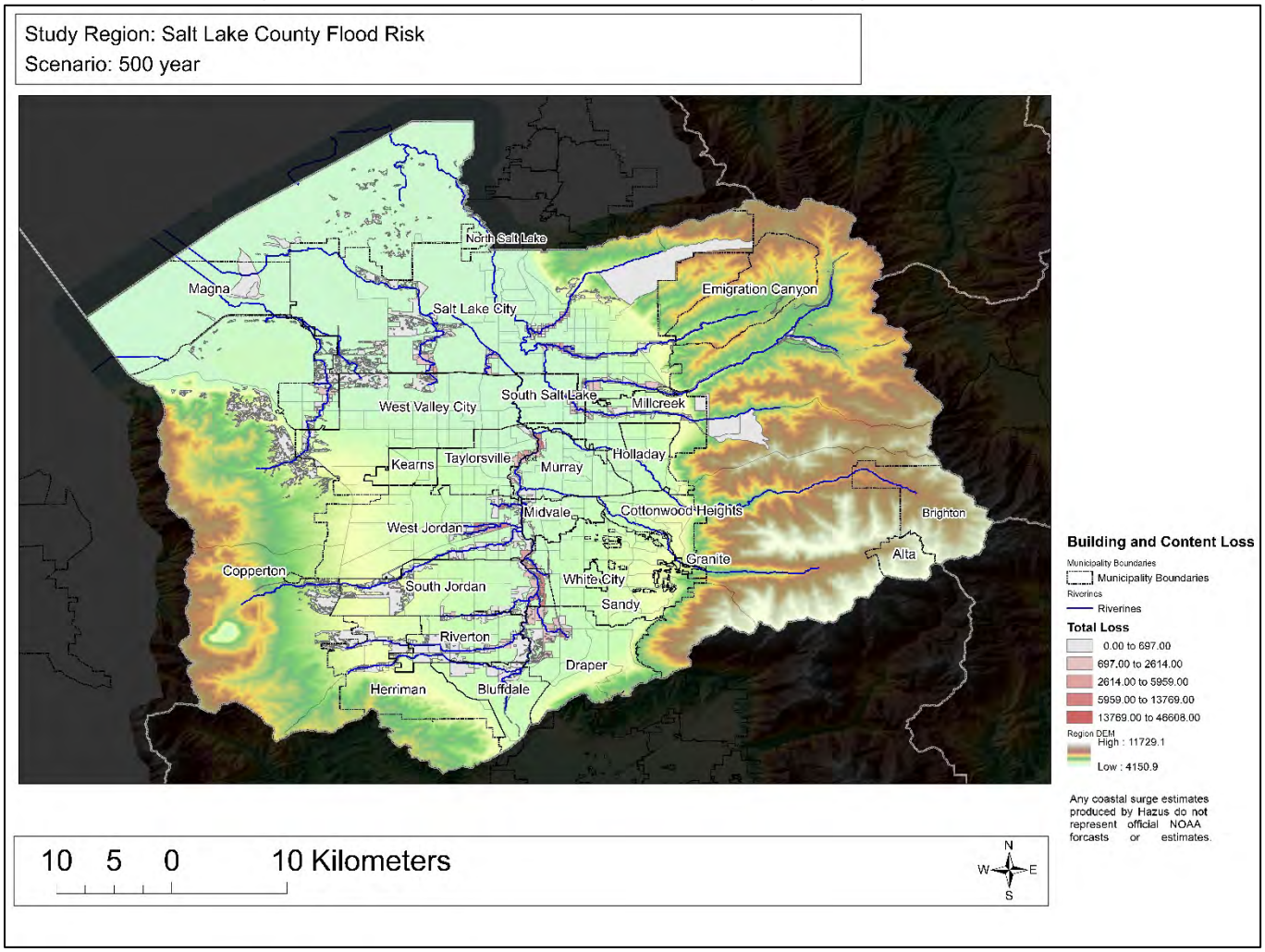

Study Region: Salt Lake County
Scenario: 100 year
Riverton
Draper
Bluffdale
Building and Content Loss
Municipality Boundaries
Riverine
Riverine
Total Loss
0.00 to 513.00
513.00 to 1574.00
1574.00 to 3518.00
3518.00 to 6668.00
6668.00 to 13121.00
Region DEM
Value
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
2.5 1.25 0 2.5 Kilometers
N
W
E
S

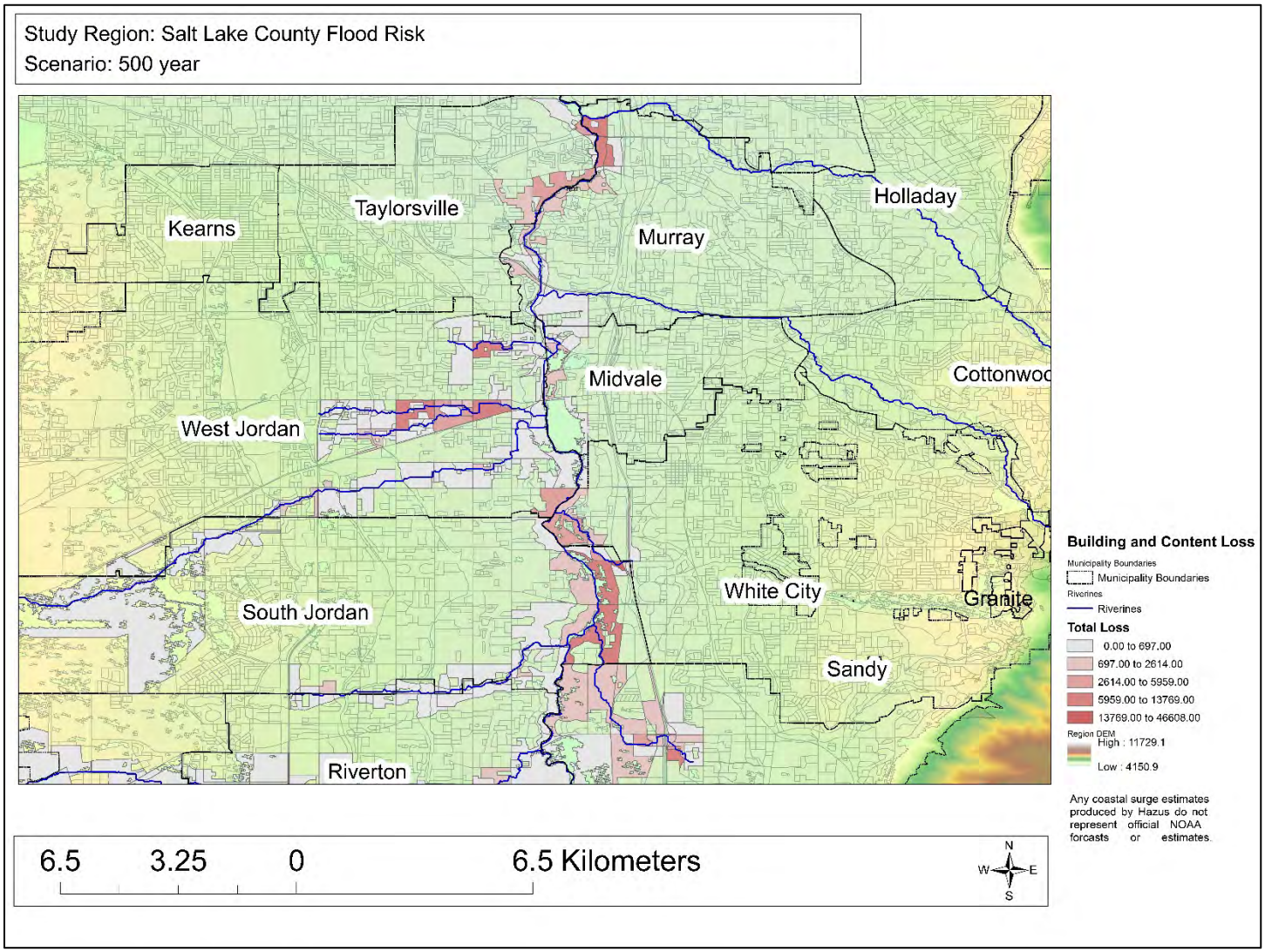

Study Region: Salt Lake County
Scenario: 100 year
Magna
Building and Content Loss
Municipality Boundaries
Riverine
Riverine
Total Loss
0.00 to 513.00
513.00 to 1574.00
1574.00 to 3518.00
3518.00 to 6668.00
6668.00 to 13121.00
Region DEM
Value
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
3 1.5 0 3 Kilometers
N
W
E
S

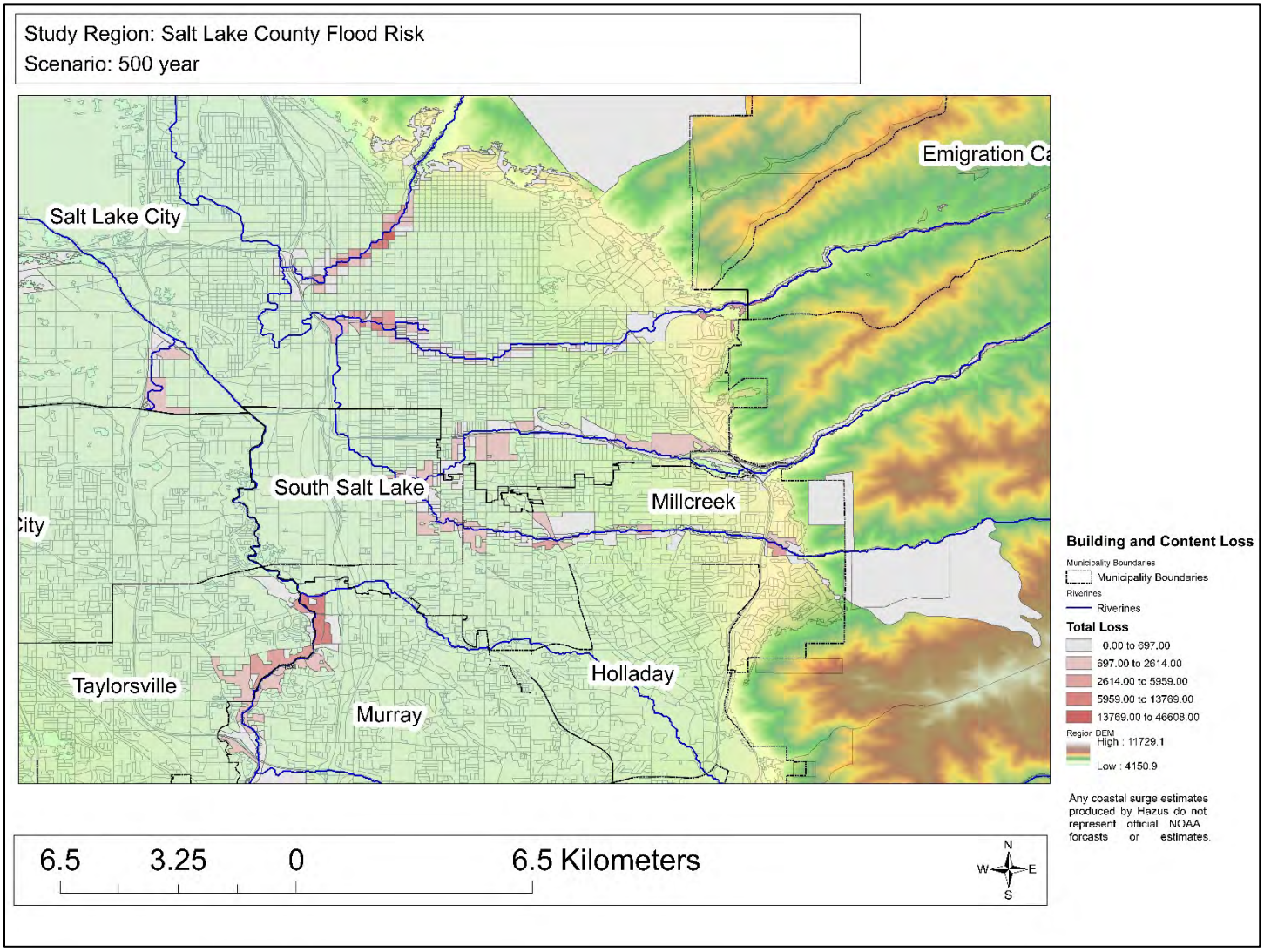

Study Region: Salt Lake County
Scenario: 100 year
Salt Lake City
South Salt Lake
Millcreek
Building and Content Loss
Municipality Boundaries
Riverine
Riverine
Total Loss
0.00 to 513.00
513.00 to 1574.00
1574.00 to 3518.00
3518.00 to 6668.00
6668.00 to 13121.00
Region DEM
Value
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
3.5 1.75 0 3.5 Kilometers
N
W
E
S

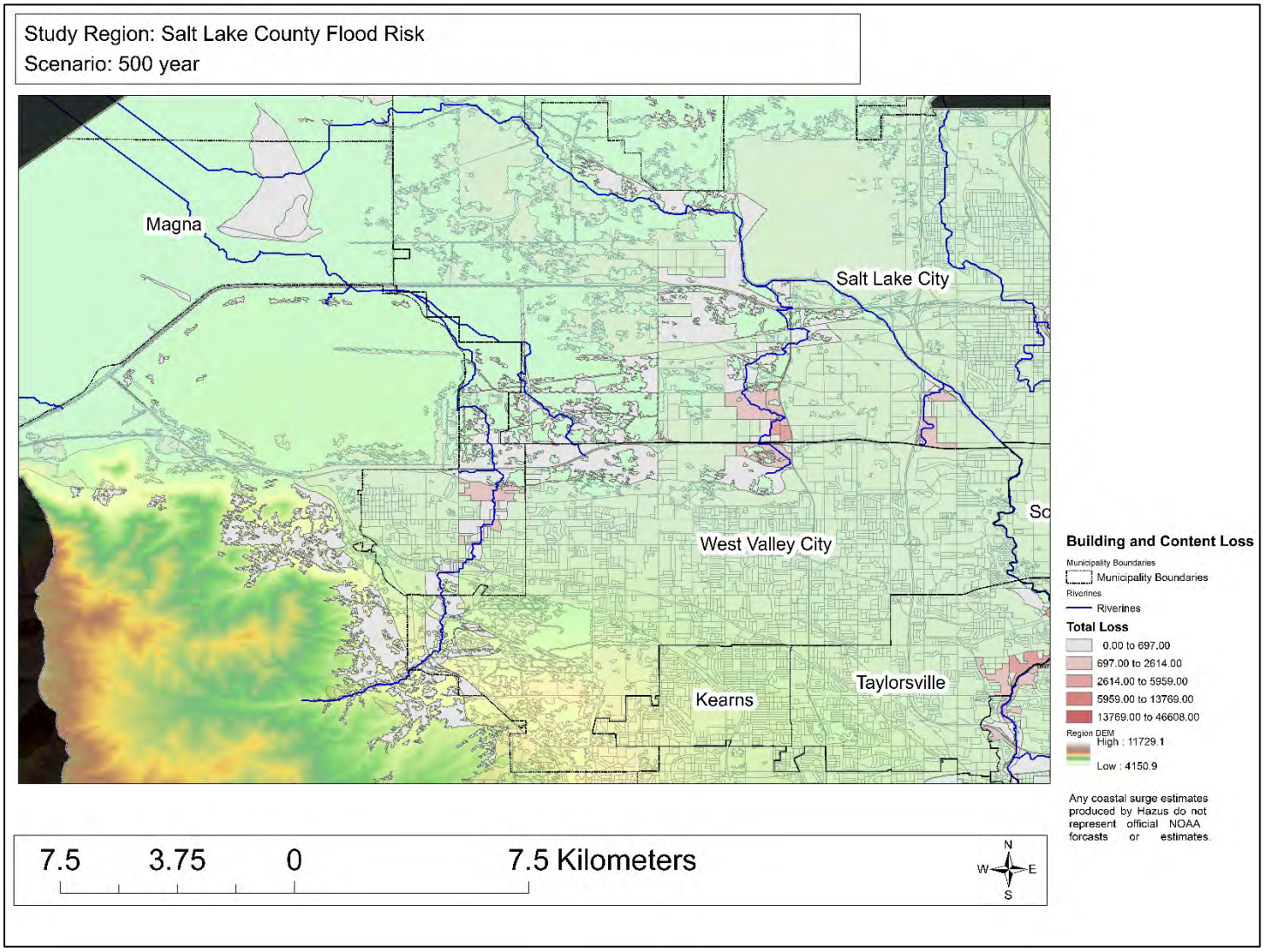

Study Region: Salt Lake County
Scenario: 100 year
Kearns
Taylorsville
Murray
Holladay
Midvale
Cottonwood Heigh
West Jordan
White City
South Jordan
Sandy
Riverton
Draper
Building and Content Loss
Municipality Boundaries
Riverine
Riverine
Total Loss
0.00 to 513.00
513.00 to 1574.00
1574.00 to 3518.00
3518.00 to 6668.00
6668.00 to 13121.00
Region DEM
Value
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
6.5 3.25 0 6.5 Kilometers
N
W
E
S

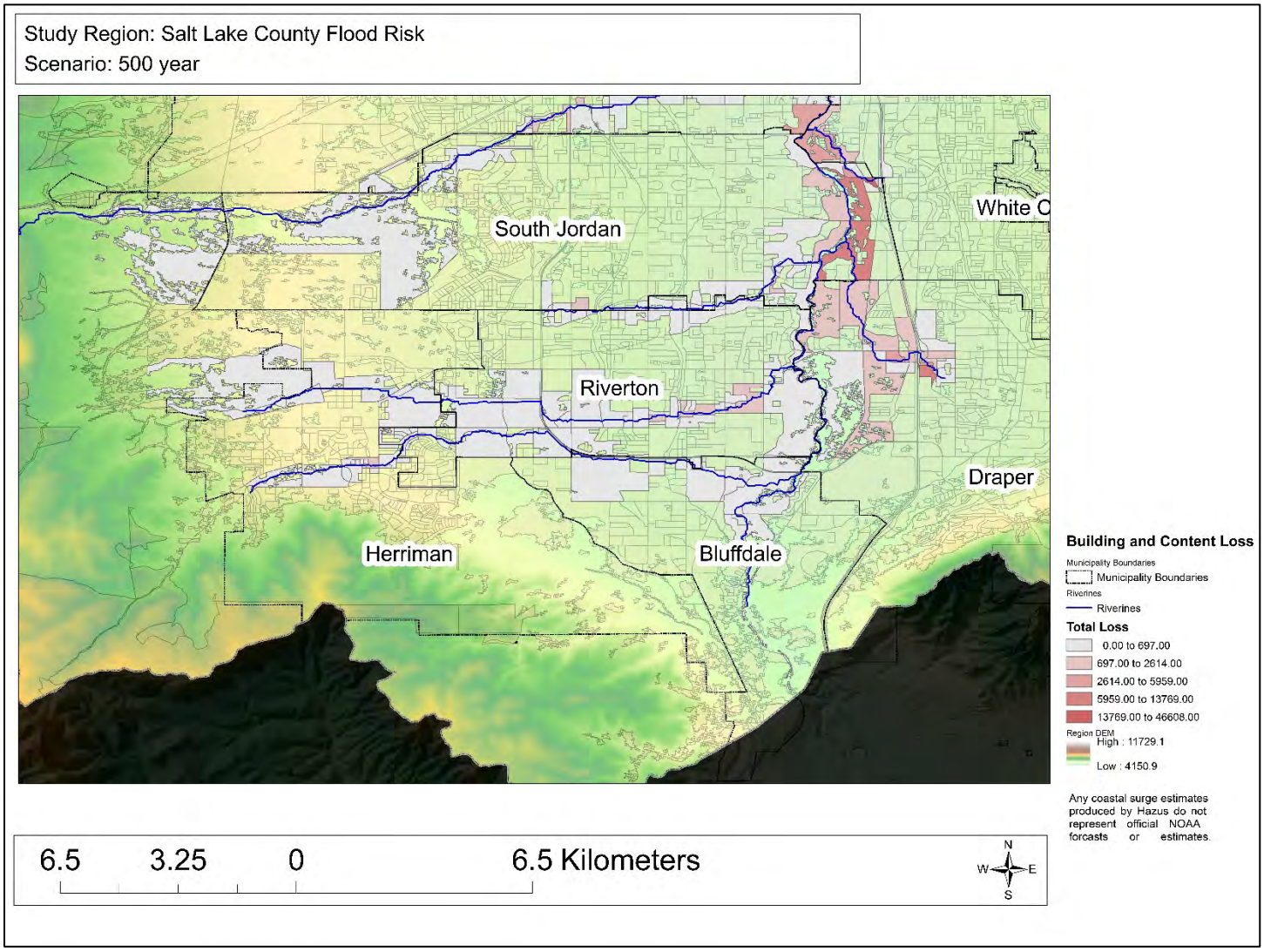
Map: Salt Lake County Area 0.2% Annual Chance Flood Risk (500-year)




Study Region: Salt Lake County Flood Risk
Scenario: 500 year
Kearns
Taylorsville
Murray
Holladay
Midvale
Cottonwoo
West Jordan
White City
Granite
South Jordan
Sandy
Riverton
Building and Content Loss
Municipality Boundaries
Municipality Boundaries
Riverines
Riverines
Total Loss
0.00 to 697.00
697.00 to 2614.00
2614.00 to 5959.00
5959.00 to 13769.00
13769.00 to 46608.00
Region DEM
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
6.5
3.25
0
6.5 Kilometers
N
W
E
S


Study Region: Salt Lake County Flood Risk
Scenario: 500 year
Salt Lake City
Emigration Ca
South Salt Lake
Millcreek
Holladay
Taylorsville
Murray
6.5
3.25
0
6.5 Kilometers
N
W
E
S
Building and Content Loss
Municipality Boundaries
Municipality Boundaries
Riverines
Riverines
Total Loss
0.00 to 697.00
697.00 to 2614.00
2614.00 to 5959.00
5959.00 to 13769.00
13769.00 to 46608.00
Region DEM
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.


Study Region: Salt Lake County Flood Risk
Scenario: 500 year
Magna
Salt Lake City
West Valley City
Taylorsville
Kearns
Building and Content Loss
Municipality Boundaries
Municipality Boundaries
Riverines
Riverines
Total Loss
0.00 to 697.00
697.00 to 2614.00
2614.00 to 5959.00
5959.00 to 13769.00
13769.00 to 46608.00
Region DEM
High : 11729.1
Low : 4150.9
Any coastal surge estimates produced by Hazus do not represent official NOAA forcasts or estimates.
7.5 3.75 0 7.5 Kilometers
N
W
E
S



Agriculture Loss

Agricultural losses are listed in the table below. 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.

Table: Agricultural Losses, April 15th Scenario

Crop	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

Vehicle Loss

The table below 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.

Table: Vehicle Losses

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

Debris Removal

The table below 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.

Table: Debris Generation and Removal

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

Essential Facility Damage

Hazus estimates that there are 8 emergency operations centers, 60 fire stations, 25 hospitals, 30 police stations, and 389 schools within the area of the flood scenarios for Salt Lake County. No essential facility is estimated to receive substantial or moderate damage from a 100-year event. For a 500-year event, 3 schools are estimated to receive at least moderate damage during the scenario, which will result in loss of use of the facility.

Social Impact

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. Displacement includes households evacuated from within or very near to the inundated area. For a 100-year flood event, the model estimates 1,437 households (4,310 people) will be displaced due to the flood. Of these, 325 people (out of a total population of 1,029,655) will seek temporary shelter in public shelters. For a 500-year flood event, the model estimates 3,643 households (10,930 people) will be displaced due to the flood. Of these, 498 people will seek temporary shelter.

NFIP Participation

Salt Lake County and all cities, except for newly incorporated city, Brighton, and the metro townships, participates in the National Flood Insurance Program (NFIP). NFIP Zone A in the table below refers to a 100-year flood event, as previously mentioned.

Six residential properties have experienced repetitive loss in the County. Average amount of loss was $36,455.00.Total amount paid was $546,819.00. Residential repetitive loss properties reside in Unincorporated Salt Lake County.

Table: Salt Lake County 2018 NFIP Statistics by County

Total Premium	A-Zone	No. Policies	Total Coverage	Total Claims Since 1978	Total Paid Since 1978
$747,827	500	1,022	$244,166,300	354	$1,265,725

Source: 2019 Utah State Hazard Mitigation Plan

Landslide and Slope Failure

Slope failure is any type of ground disturbance on a surface with any slope and not on flat ground. Landslides, also referred to as slope failures, are classified according to the type of movement and material involved. Movement types include falls, topples, slides, lateral spreads and flows. Materials include rocks, debris (coarse-grained soil), and earth (fine-grained soil). The most common landslides in Utah include rock falls, rock topples, debris slides, debris flows, earth slides, and earth flows (UNHH 2008).

Similarly, a landslide is a mass of earth or rock which moves downslope by flowing, spreading, sliding, toppling or falling. Landslides are one of the most commonly occurring natural hazards in Utah. They are most common in areas having moderate to steep slopes, weak slope materials, and relatively wet climates. In these areas, most landslides are associated with precipitation events sustained above-average precipitation, individual intense rainstorms, or snowmelt events. Erosion, removal of vegetation by wildfires, and earthquake induced ground shaking increase the likelihood of landslides. Human activities such as grading of slopes or increasing soil moisture through landscape irrigation can also trigger landslides (UNHH 2008).

Rock falls and topples are downslope movements of loosened blocks or boulders from a bedrock area. These generally occur along steep canyons with cliffs, deeply incised stream channels in bedrock, and steep bedrock road cuts. The greatest damage from rock falls has been to roads, railroads, and aboveground pipelines (UNHH 2008).

Debris slides and flows occur in steep mountainous areas and involve the relatively rapid, viscous flow of coarse-grained soil, rock, vegetation and other surface materials. Debris flows contain more water than slides and are potentially more dangerous because they can form quickly, move at high speeds, and travel long distances. Debris flows generally remain in stream channels but can flow out from canyon mouths for a considerable distance. They can damage buildings, bridges, roads, railroads, and pipelines (UNHH 2008).

Earth slides and flows are composed of fine-grained material, but earth flows contain more water than earth slides. Earth slides and flows vary in size, including some of the largest past earth slides in Utah. Like other landslides, they can damage anything in their path (UNHH 2008).

Slumps are common along road embankments and river terraces. They slip or slide along a curved plane away from the upper part of a slope, leaving a scarp. They generally do not move far from the source area.

Landslide distribution is dependent on geology, topography, and climate. They are most numerous in the Middle Rocky Mountain's physiographic province and in the High Plateaus section of the Colorado Plateau province. As previously mentioned, weak rock types, steep slope gradients and relatively abundant precipitation are primary contributors to land sliding. Vegetative cover, slope aspect, and ground shaking from earthquakes can also influence slope stability (UNHH 2008). Nearly all landslides in Utah are reactivations of pre-existing landslides. Risk can be reduced by avoiding and/or stabilizing landslides (UNHH 2008).

Landslide and Slope Failure

Potential Impact		High	**Probability**		High
		Medium		X	Medium
	X	Low			Low
		Minimal			Unlikely
Location	Generally in canyon mouths and foothills and areas of recent wildfire activity.				
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/Rock falls: Hours to Months. Debris flows: Instantaneous.				
Secondary Hazards	Flooding (natural dams), traffic accidents.				
Analysis Used	Information and maps provided by UGS, UDEM, AGRC.				

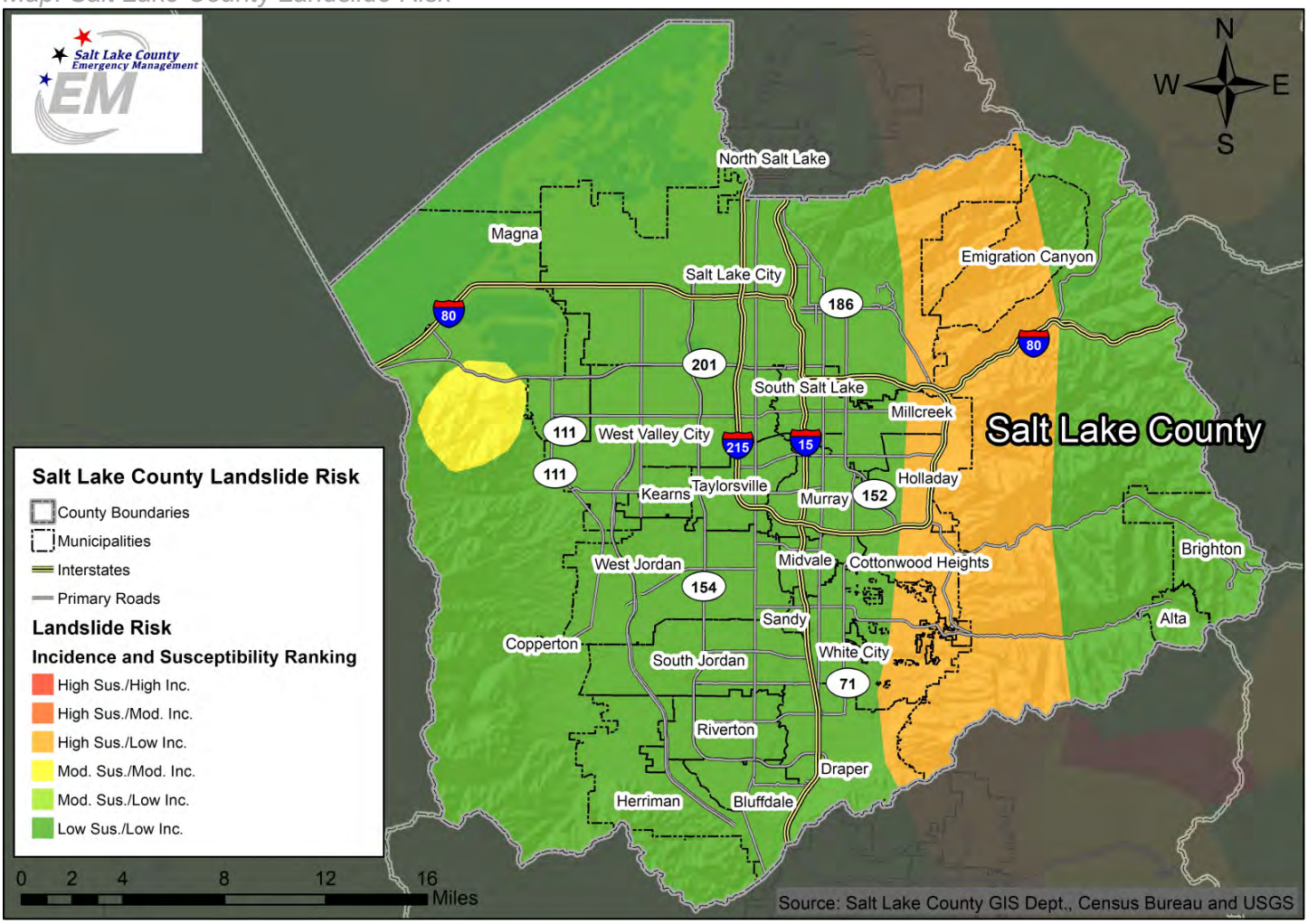
Range of Magnitude

The Rio Tinto Landslide was the single largest natural disaster in Salt Lake County's history. The recent landslide in North Salt Lake City falls into the "major" category. Due to the nature of Salt Lake County's topography and development moving into the steeper areas, the magnitude of damage is likely to continue to increase. Many landslide or slope failure events may be minor and cause little to no damage, but it is also possible that future landslides can range in costs from hundreds of thousands of dollars to hundreds of millions of dollars.

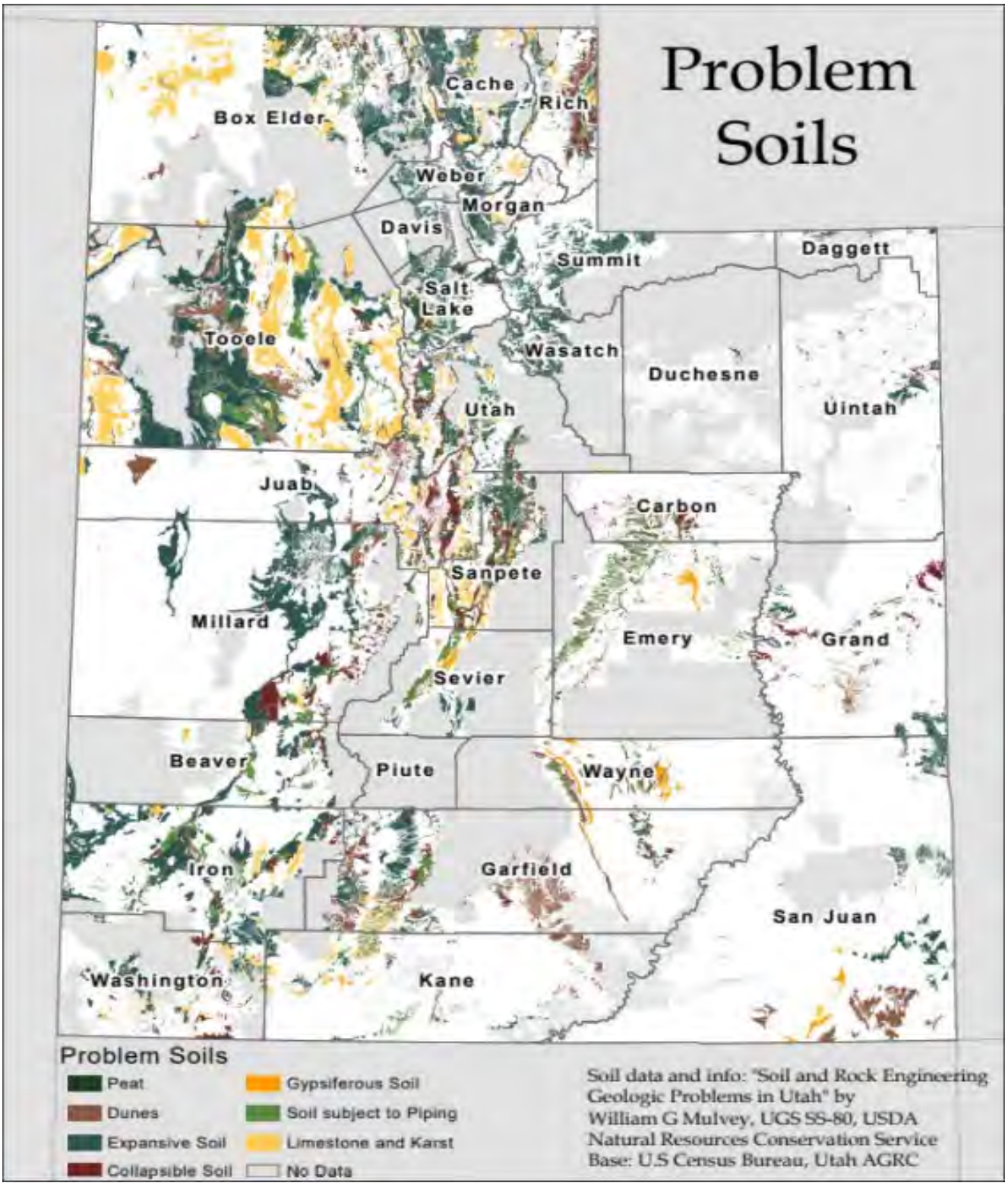
Location

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 Little Valley Red Rock landslide in Draper and the shallow disrupted landslides in and near Steep Mountain in Draper. As urbanization spreads into geologically unstable areas of the county, the risk to life and property increases.

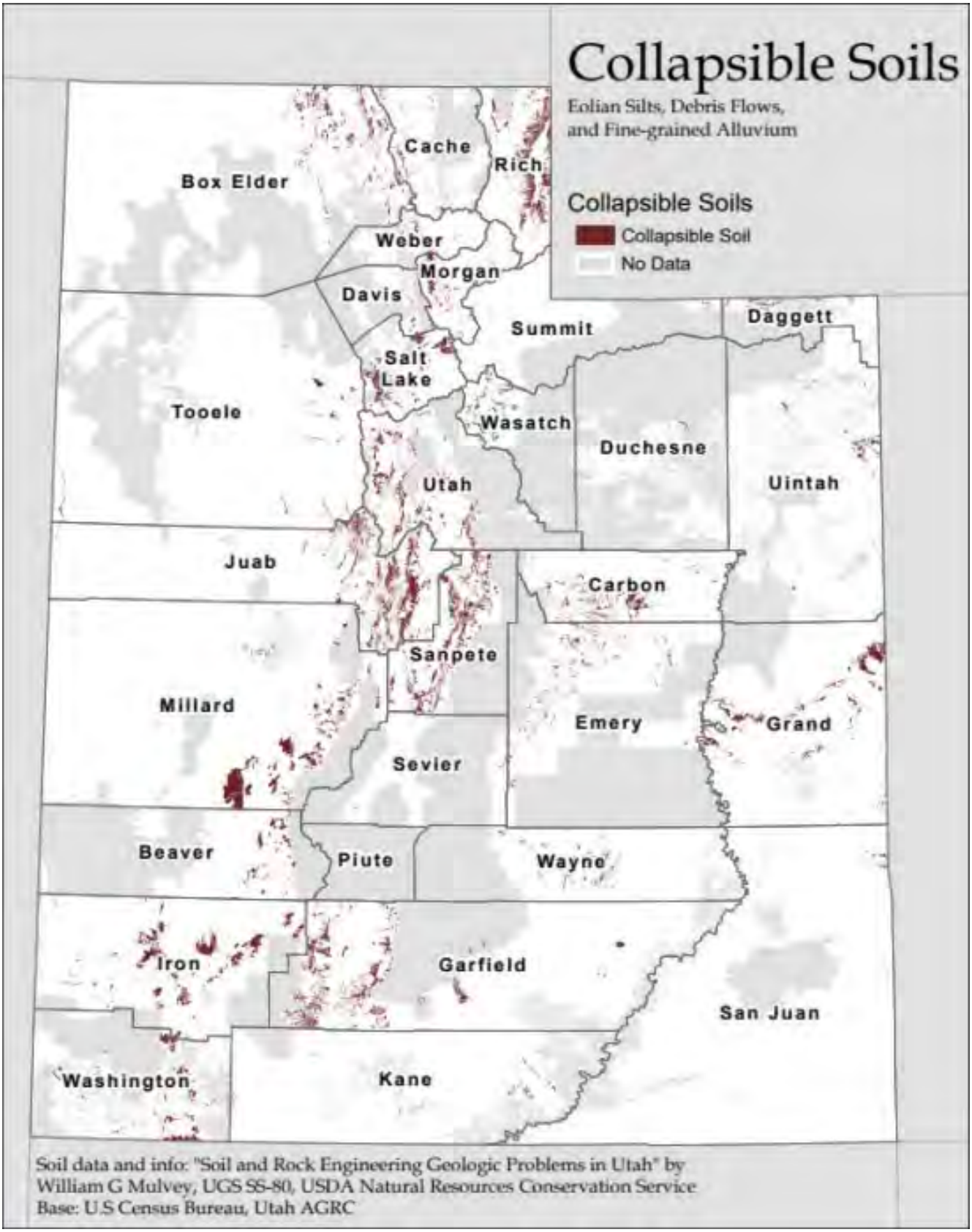
Map: Salt Lake County Landslide Risk



According to the 2019 Utah State Hazard Mitigation Plan, 56% of all slope failures in Salt Lake County occurred on hillsides where slopes range between 31 and 60%. In addition, there are approximately 1.63 square miles of the County ranked as being "High Hazard," in terms of landslide susceptibility; 320 sq miles are categorized as "Moderate," 25 sq miles as "Low," and 373.9 sq miles as "Extremely Low."



Source: 2019 Utah State Hazard Mitigation Plan



Source: 2019 Utah State Hazard Mitigation Plan

Historical Events and Probability of Future Occurrence

City Creek Canyon Landslides

A cluster of historical landslides is visible from the hairpin turn in Bonneville Boulevard in lower City Creek Canyon in Salt Lake City. The UGS and the Salt Lake City surveyor have monitored movement of the largest and most damaging of these landslides since June 1998. Since June 1998, the toe of the landslide has moved about 24 feet, and the main scarp has offset the ground surface about the same amount. Like most recurrently active landslides in northern Utah, movement typically occurs between March and June as ground-water levels rise following the snowmelt. Four houses at the top of the slide are threatened, and efforts to protect one house have cost in excess of $300,000. In 2006 the landslide reactivated again, moving about 2 feet, despite drier-than-normal conditions in Salt Lake City (2019 Utah State Hazard Mitigation Plan).

Courtesy UGS

Springhill Landslide

UGS has been monitoring conditions at the Springhill landslide in North Salt Lake, Davis County since 1998. In the late 1990s residents began noticing cracking and other distress related to relatively minor movement of the landslide. By 1998 a house at address 160 Springhill Drive that straddled the northern boundary of the landslide was severely damaged and condemned and several houses along Valley View Drive (formerly 350 East) and Springhill Circle also sustained damage. The City of North Salt Lake worked with DEM and FEMA to obtain PDM and HMGP grants to purchase the properties affected by this landslide. By 2013 the houses in the affected area of the landslide were demolished and North Salt Lake had turned the area into open space (2019 Utah State Hazard Mitigation Plan).

Courtesy UGS

Bingham Canyon Landslides

Two landslides occurred in 2013 at Rio Tinto's Bingham Canyon Mine. The first occurred on April 10, 2013 at 9:30 PM and moved around 65-70 million cubic meters of dirt and rock down the side of the mining pit. Officials at the mine anticipated the slide and took precautions. It is historically the largest landslide in the United States not connected to volcanism. On September 11, 2013 100 workers were evacuated when a second, smaller landslide occurred. No injuries occurred during either landslide (2019 Utah State Hazard Mitigation Plan).

It is highly likely that landslides and slope failures will continue to occur periodically within Salt Lake County. 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).

Secondary Hazards

Landslides can often enter water courses, increasing turbidity and polluting water supplies. Landslides can also alter river courses, disrupt large amounts of soil, contaminate the air, and cause deforestation. All of these environmental changes can lead to an increased risk of vector borne diseases or bacteria, potentially impacting human health long after the disaster has occurred. Other potential impacts to infrastructure include broken and failed railways, roadways, bridges, and even utility lines, which could lead to loss of power or the delay of delivery of vital services to certain parts of the county.

Vulnerability Assessment

The tables 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. The tables also estimates the total area, population, and buildings vulnerable to landslides for individual cities, although not every identifiable area is specifically listed. This data is carried over from previous plans due to time constraints and minimal concern about change in hazard risk.

Table: Infrastructure Vulnerable to Landslides, Salt Lake County

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

Daytime population in the County within high or moderate landslide susceptibility areas is approximately 23,573 people. The total night-time population within high or moderate landslide susceptibility areas is approximately 24,443 people.

Table: Vulnerability Assessment for Landslides, Incorporated Salt Lake County

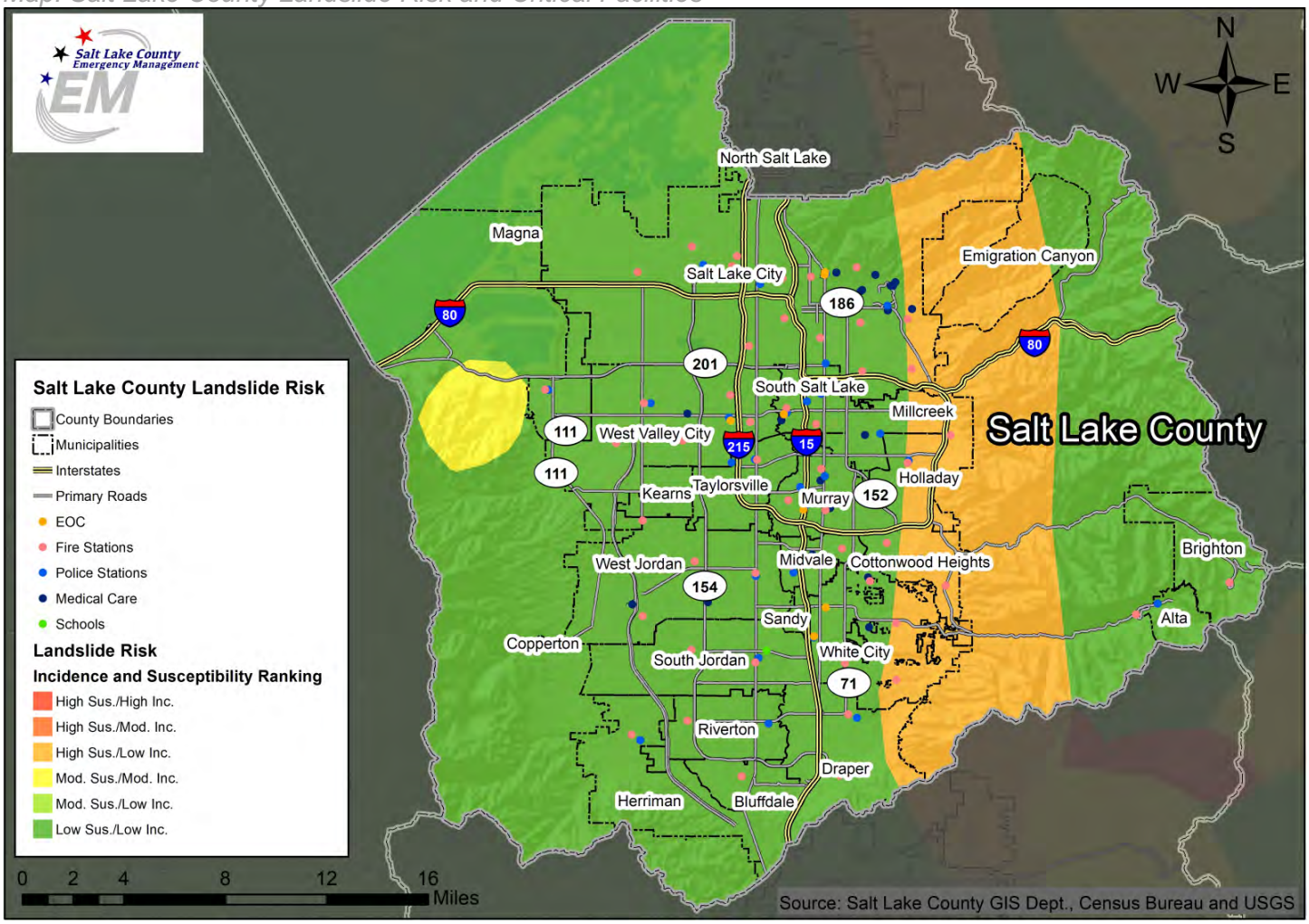
Incorporated Areas	Acres Affected	Population Affected	Structures in Areas of Moderate or Greater Hazard	
			Residential (Replacement Value)	Commercial (Annual Sales)
Alta	2,477	986	322 $65,881,200	0
Bluffdale	1,457	3,626	1,061 $217,080,600	1 $110,705
Copperton	14,390	510	215 $43,989,000	1 $9,785
Cottonwood 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
Emigration Canyon	11,281	3,562	1,378 $281,938,800	25 $12,583,730
Kearns	10	109	31 $6,342,600	1 $85,797
Herriman	2,508	4,139	1,242 $254,113,200	0
Holladay	397	1,721	506 $103,527,600	23 $3,371,052
Magna	40	254	157 $32,122,200	0
Midvale	11	53	18 $3,682,800	0
Millcreek	4	54	20 $4,092,000	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

Note: At the time the plan was updated, Brighton, was not considered an incorporated community. Information related Brighton is captured under Big Cottonwood Canyon.

Table: Vulnerability Assessment for Landslides, Unincorporated 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
East Millcreek	18	162	57 $11,662,200	1 $27,753
Granite	17,372	8,817	2,724 $557,330,400	6 $2,300,292
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

Map: Salt Lake County Landslide Risk and Critical Facilities



Public Health Epidemic/Pandemic

An epidemic is a localized outbreak that spreads rapidly and affects a large number of people or animals in a community. A pandemic is an epidemic that occurs worldwide or over a very large area and affects a large number of people or animals.

For example, an influenza pandemic occurs when a new, virulent strain of the Influenza A virus emerges and there is little or no immunity in human populations, allowing the virus to circulate globally. The virus would be easily transmitted and has the ability to make many people very sick in a relatively short period of time. Its effects on humans could be mild, moderate, or very severe, even leading to death (SLVHD Family Emergency Preparedness Guide). Influenza is caused by a virus that is spread from person-to-person primarily through respiratory droplets generated from coughing or sneezing. Transmission is most efficient among crowded populations in enclosed spaces. The virus may persist for several hours, particularly in cold, indoor, and low humidity environments. It spreads rapidly because it has a short incubation period (period between infection and onset of symptoms) of 1-3 days and because persons are infectious (able to transmit the virus to others) during early illness or even before the onset of symptoms (SLVHD 2010).

Based on their characteristics and capacity to spread, the following human diseases could also contribute to a serious epidemic and should be noted:

- Methicillin-resistant staphylococcus
- West Nile virus
- H1N1 influenza
- Severe acute respiratory syndrome
- Measles
- Hepatitis
- Tuberculosis
- E. coli
- Lye disease
- Hantavirus
- Leptospirosis

Public Health Epidemic/Pandemic Profile

Potential Impact		High	**Probability**		High
	X	Medium		X	Medium
		Low			Low
		Minimal			Unlikely
Location	May occur throughout the county. It is difficult to identify exactly when and where the next event will take place.				
Seasonal Conditions	Primarily fall and winter, with potential impacts year round.				
Conditions	Variable time frame and variable severity. Once novel virus is introduced to the area, person-to-person transmission may spread virus rapidly.				
Duration	Four to six weeks to several months, possibly up to a year				
Secondary Hazards	Social and economic consequences, possible surge on healthcare resources.				
Analysis Used	Salt Lake Valley Health Department, Center for Disease Control, UDEM, local input, and review of historic events and scientific records.				

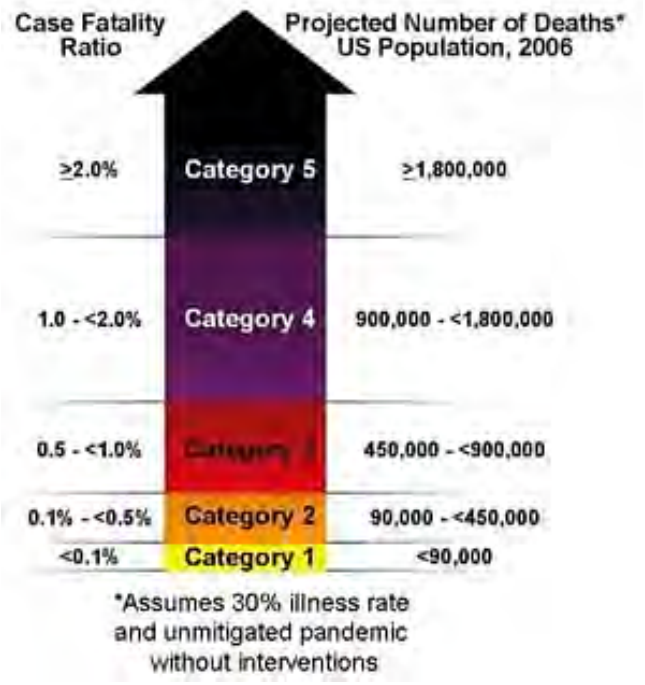
Range of Magnitude

The Pandemic Severity Index is a tool to assess the severity of pandemic illness and appropriate mitigation measures to implement.

	Pandemic Severity Index		
Interventions by Setting	**1**	**2 and 3**	**4 and 5**
Home			
Voluntary isolation of ill at home (adults and children); combine with use of antiviral treatment as available and indicated	Recommend	Recommend	Recommend
Voluntary quarantine of household members in homes with ill persons (adults and children); consider combining with antiviral prophylaxis if effective, feasible, and quantities sufficient	Generally not recommended	Consider	Recommend
School			
Child social distancing –dismissal of students from schools and school-based activities, and closure of child care programs	Generally not recommended	Consider: ≤ 4 weeks	Recommend: ≤ 12 weeks
–reduce out-of-school contacts and community mixing	Generally not recommended	Consider: ≤ 4 weeks	Recommend: ≤ 12 weeks
Workplace/Community Adult social distancing			
–decrease number of social contacts (e.g., encourage teleconferences, alternatives to face-to-face meetings)	Generally not recommended	Consider	Recommend
–increase distance between persons (e.g., reduce density in public transit, workplace)	Generally not recommended	Consider	Recommend
–modify, postpone, or cancel selected public gatherings to promote social distance (e.g., stadium events, theater performances)	Generally not recommended	Consider	Recommend
–modify workplace schedules and practices (e.g., telework, staggered shifts)	Generally not recommended	Consider	Recommend

Location

There is often no defined geographic boundary for public health epidemics. Pandemics can spread throughout the county, region, state, and beyond.



Pandemics are different from other types of hazards. They may have a much wider geographic impact, last several months, the evidence tends to be less visible, casualties are predominantly human rather than material or structural, state and federal aid resources may be limited, and the economic impacts may be more widespread.

A widespread outbreak of influenza could require temporary changes in many areas of society, such as schools, work, transportation, and other public services. Although the most effective tool for mitigating a pandemic is a well-matched vaccine, it is likely no perfectly matched vaccine will be available for a new virus for several months. There may also be insufficient quantities of antiviral medications (CDC Pre-Pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation). Therefore, mitigation measures can be designed to limit the impact on the community by slowing transmission, limiting opportunities for exposure, and delaying the outbreak peak to lessen the impact on the health care system (SLVHD 2010). Social distancing measures could also be implemented where public gatherings such as sporting events, church meetings, schools, and others would be closed to prevent further spread of the disease (SLVHD FEPG).

Historical Events and Probability of Future Occurrence

In 2018, at least 295 cases of hepatitis A were recorded in Utah (and two deaths), with the majority being reported primarily among the homeless of Salt Lake County. A small percentage of the outbreak occurred in nearby Utah County as well. Health officials set up hotlines and vaccinations were encouraged.

The Great Pandemic of 1918-1919 was the first reported pandemic in the Salt Lake County. The first cases in Utah undoubtedly appeared in the military camp at Fort Douglas. Like many states with a large rural population, Utah did not provide a report to the Public Health Service in the early weeks of the pandemic. This may have been because they were overwhelmed by the spread of the disease or it may have been because the state did not have enough public health officials available to make the weekly reports the Public Health Service demanded.

Although the odds of an eventual pandemic are high, the exact timing and frequency of occurrences are difficult to predict, making the risk low for any given year. In the 20th century, there were three influenza pandemics; in the 21st century, there has been one to date.

Secondary Hazards

Although public health emergencies usually will not directly impact physical infrastructure, the most likely secondary hazards would be social and economic in nature. If there was a surge on healthcare resources, shortages could cause civil disturbance events or mass evacuations, which would have additional far-reaching impacts.

Vulnerability Assessment

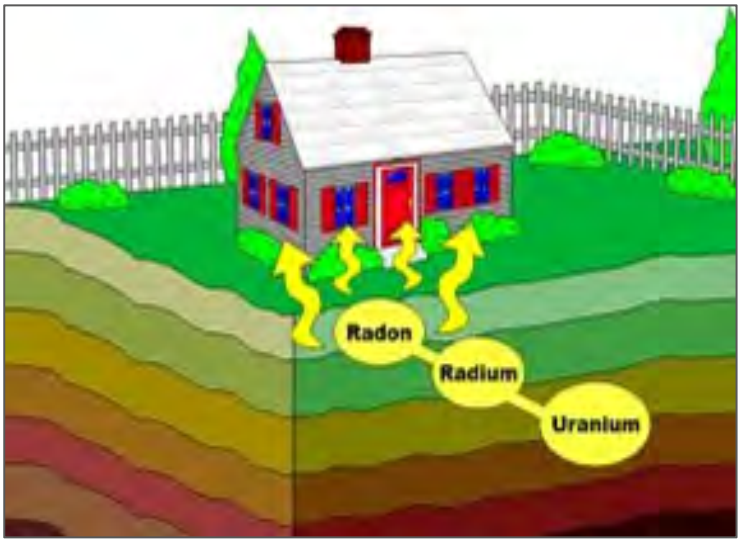
Individuals, families, employers, and communities will all experience difficulties dealing with community mitigation measures. Many problems will come from having children dismissed from schools and childcare programs. There are 546,000 children less than 18 years old currently in school in Utah, accounting for 21.8% of the population. An additional 205,000 residents (8.2%) are enrolled in college. Dismissing students from school would directly disrupt the schedule of 30% of the population. Secondary disruptions would occur for parents who would need to balance working with tending their children. Tertiary disruptions would occur for employers with absent employees that must stay home to care for children and could potentially result in workplaces closing or reducing operations and limiting the availability of essential services. Additionally 156,000 (17.9%) of Utah residents live alone; 30.1% are 65 years of age and older. Persons who live alone may be unable to follow isolation requirements if they need to acquire medications or shop for other essentials (SLVHD 2010).

Table: Community Mitigation Plan, Appendix H to the Salt Lake Valley Health Department Pandemic Influenza Preparedness and Response Plan

Characteristics	Pandemic Severity Index				
	Category 1	Category 2	Category 3	Category 4	Category 5
Case Fatality Ratio (Percentage)	<0.1	0.1-<0.5	0.5-<1.0	1.0-<2.0	>=2.0
Excess Death Rate (per 100,000)	<30	30-<150	150-<300	300-<600	>=600
Illness Rate (percentage of the population)	20-40	20-40	20-40	20-40	20-40
Potential Number of Deaths (based on 2008 population estimate of 1,041,578)	<312	312-<1,562	1,562-<3,125	3,125-<6,249	>=6,249
20th Century UT experience	Seasonal Influenza (illness rate 5-20%)	1957, 1968 Pandemic	None	None	1918 Pandemic

Radon

Radon is a radioactive gas released from the nuclear decay process of uranium and radium, which are trace elements of many soils. The radiation emitted is alpha, beta and gamma. It is odorless, colorless, and tasteless. As radon moves up through the ground it can enter a home through cracks and gaps in walls and floors, cavities inside walls, gaps around service pipes and water supply connections. Though relatively harmless at low levels, radon is classified by the EPA as a known human carcinogen and is considered the leading cause of non-smoking lung cancer in the United States. Small radioactive particles are inhaled and become lodged in the lungs damaging DNA. Because radon is tasteless, odorless, and invisible, it presents unique challenges in minimizing our daily exposure to this naturally occurring radiation (UNHH 2008).



Radon can be detected through an inexpensive test and can be mitigated through proper ventilation of excessive radon and installation of systems to prevent radon from entering the home.

The danger of high exposure to radon in mines was known back in the 1500s, yet the presence of radon in indoor air was not documented until 1950. Finally in 1970, research was initiated to address sources of indoor radon, determinants of concentration, health effects and approaches to mitigation. In 1984, a widely publicized incident in Salt Lake County escalated the problem of indoor radon and investigation intensified, with the EPA taking a strong lead to educate states via its State Indoor Radon Grant (SIRG).

EPA's grant has been partially funding the Utah Division of Radiation Control's (DRC) Indoor Radon Program that enables the Division to respond to a continuous stream of public telephone and email inquiries, provide education to homeowners and professionals, conduct "target area" indoor radon assistance and surveys and offer individualized assistance to homeowners and public agencies concerning all aspects of the indoor radon hazard problem.

"The Division's primary goal is to assure that radiation exposure to individuals is kept to the lowest practical level," said Lundberg. "A vital mechanism in reducing radiation exposure and potentially saving lives is our Indoor Radon Program."

Radiation risk to the American public from radon gas is undisputed. According to William Field (2011), radon is the leading environmental cause of cancer mortality in the United States and the seventh leading cause of cancer mortality overall. The Harvard School of Public Health in the Center for Risk Analysis has ranked radon as the highest of ten risks of death in homes in the United States, ahead of falls and home fires.

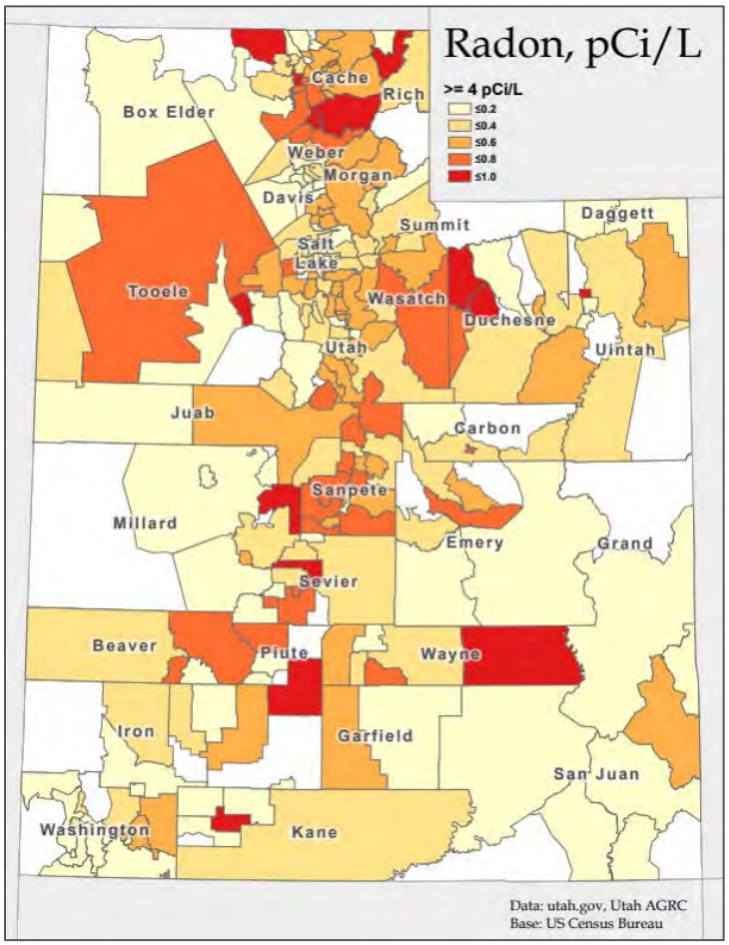
"Radon awareness in Utah has grown steadily the past decade," said Keyser. "Already this year, we have seen the number of radon tests conducted in Utah triple from the previous year."

Radon Hazard Profile

Potential Impact		High	**Probability**	X	High
		Medium			Medium
	X	Low			Low
		Minimal			Unlikely
Location	Region wide				
Seasonal Conditions	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.				

Range of Magnitude

Radiation is measured in curies. A curie is a rate of disintegration of 1 gram of radium. Radon is measured in picocuries per liter, shown as pCi/L. The 2019 Utah State Hazard Mitigation Plan maps the counties within the state according to Radon, pCi/L, which shows the range of magnitude that can be found throughout the County.



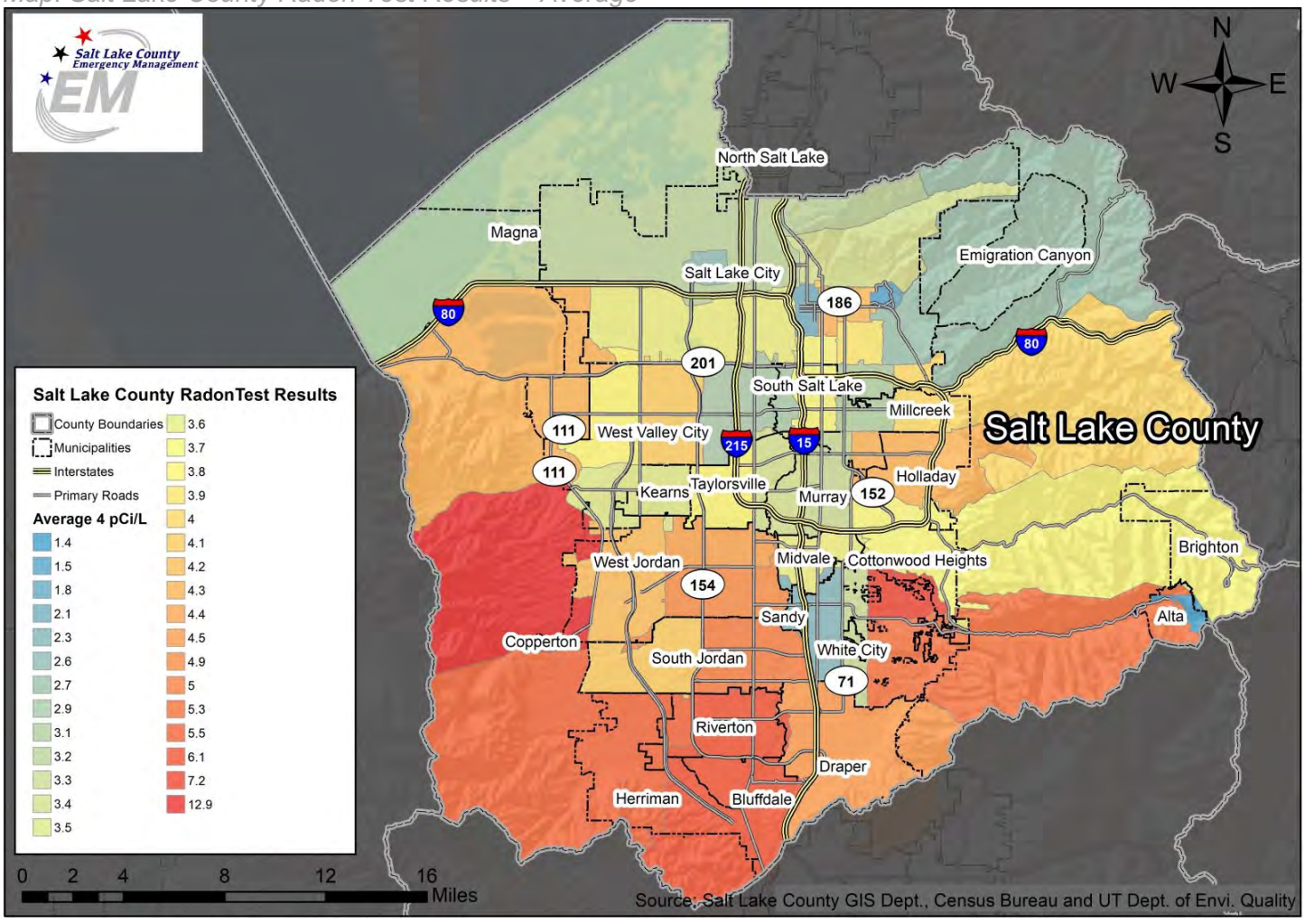
Source: 2019 Utah State Hazard Mitigation Plan

Location

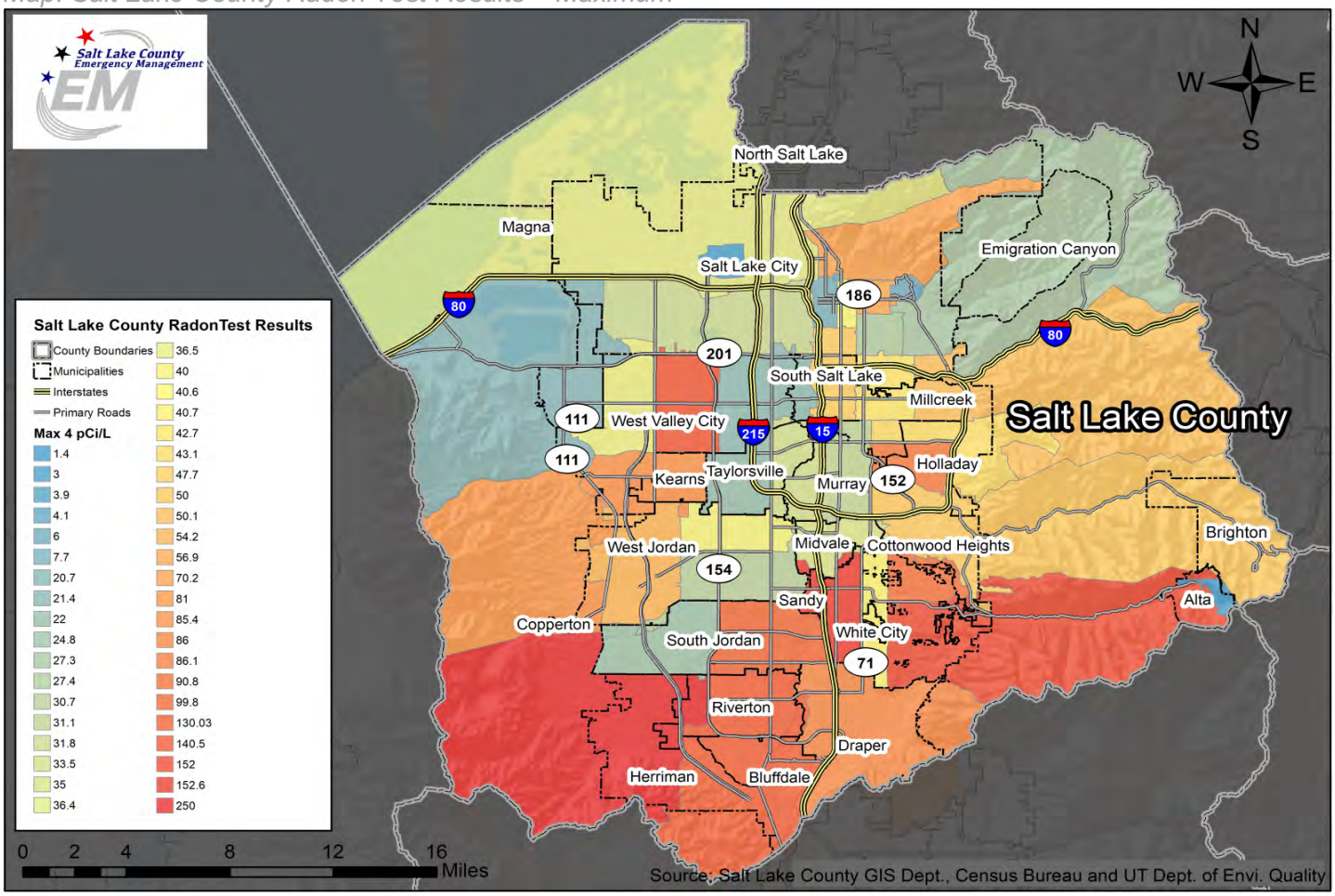
Radon gas can be found in most Utah homes. The gas comes from the small particles of uranium in rocks and soil, which decays into radium. In turn, the radium breaks down further into radon. As the radon moves up through the ground, it can enter a home through cracks and gaps in walls and floors if not properly vented.

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. Sites further from the mountains and foothills generally have lower concentrations of radon. Radon does not pose a threat to infrastructure. Through collections of tests performed by various households in the county, households containing higher levels of radon were indeed 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.

Map: Salt Lake County Radon Test Results – Average



Map: Salt Lake County Radon Test Results – Maximum



Historical Events and Probability of Future Occurrence

According to the US EPA, nearly 1 in 3 homes checked in seven states and on three Indian lands had screening levels over 4 pCi/L, the EPA's recommended action level for radon exposure.

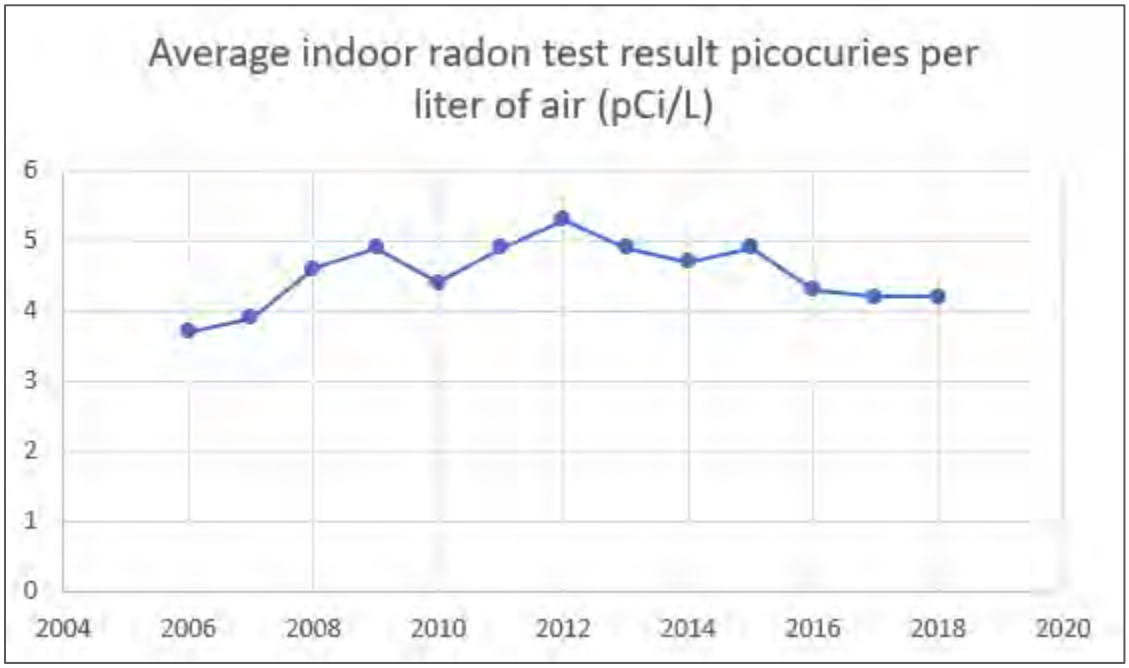
A family whose home has radon levels of 4 pCi/L is exposed to approximately 35 times as much radiation as the Nuclear Regulatory Commission would allow if that family was standing next to the fence of a radioactive waste site. (25 mrem limit, 800 mrem exposure)

An elementary school student that spends 8 hours per day and 180 days per year in a classroom with 4 pCi/L of radon will receive nearly 10 times as much radiation as the Nuclear Regulatory Commission allows at the edge of a nuclear power plant. (25 mrem limit, 200 mrem exposure)

The Utah Department of Public Health tracks the results for indoor radon levels within each county every year – the results of which can be seen below.

Table: Salt Lake County Results for Indoor Radon Levels

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
pCi/L	3.7	3.9	4.6	4.9	4.4	4.9	5.3	4.9	4.7	4.9	4.3	4.2	4.2



Source: https://epht.health.utah.gov/epht-view/query/result/radon/Radon/Average.html

The Salt Lake County Board of Realtors is currently maintaining a database of Radon readings in residential homes. County Ordinances require homes with unacceptable radon levels to undergo mitigation procedures prior to sale. This should eventually make all homes safe, however the County will continue to experience radon exposure for the foreseeable future.

Secondary Hazards

The secondary hazards from radon are unknown.

Vulnerability Assessment

Radon does not impact infrastructure, but all humans and households who are exposed within the County would be at risk. These figures can be seen in the Salt Lake County Demographics portion of this Plan. As previously stated, radon decays into radioactive particles that can be trapped in the lungs when inhaled. These particles release small bursts of energy that damage lung tissue and may lead to lung cancer. Most U.S. EPA lifetime safety standards for carcinogens are established based on a 1 in 100,000 risk of death. Most scientists agree that the risk of death for radon at 4 pCi/L is approximately 1 in 100. At the 4 pCi/L EPA action guideline level, radon carries approximately 1000 times the risk of death as any other EPA carcinogen. It is important to note that the action level is not a safe level, as there are no “safe” levels of radon gas. Radon is the second leading cause of lung cancer in the United States. Only smoking causes more lung-cancer deaths, and smoking combined with radon is a particularly serious health risk. Chances of getting lung cancer are higher from the combination of smoking and radon than from either source alone. Not everyone who is exposed to radon develops the disease, but the chances increase with increasing levels of radon and length of exposure. The amount of time between exposure and onset of the disease is usually many years.

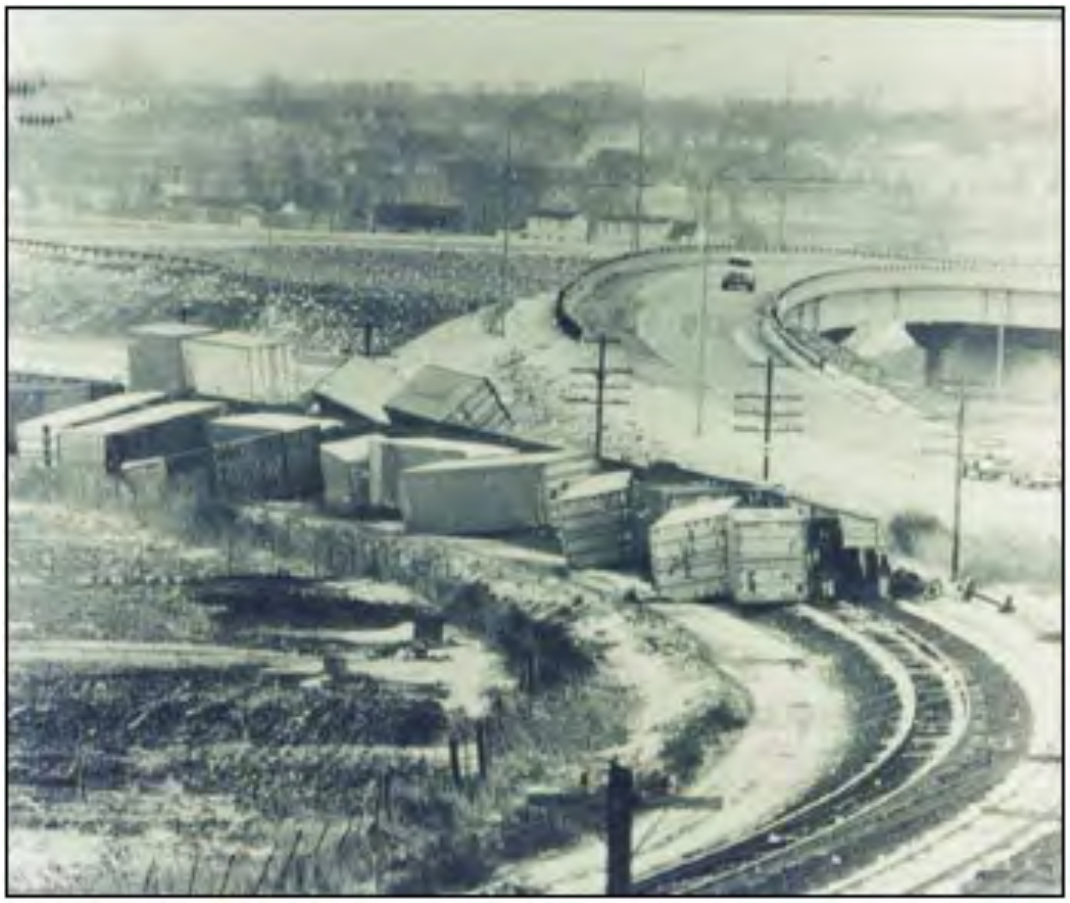
Severe Weather

High/Strong/Thunderstorm Winds:

High winds can occur with or without the presence of a storm and are unpredictable in regards to time and place. Salt Lake County has experienced high winds in the past and can expect future events.

Straight-line winds produced by thunderstorms are any winds not associated with the rotation of a tornado. Straight-line winds are responsible for most thunderstorm wind damage, and speeds can exceed 125 mph. Other damaging winds originating from thunderstorms include downbursts and microbursts. Utah has also experienced down slope wind events, which occur when wind generated as a deep layer of air is forced over a barrier. Winds accelerate down mountain slopes and generate high winds in a wave region formed at the base of the terrain. A down slope windstorm in December 2011 generated numerous reports of 60-80 mph winds, and maximum gusts of 80-100 mph in the Bountiful/Centerville area, resulting in loss of power and significant damage in the region (NWS 2012, Definitions for Severe Weather).

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, railroad cars and downed small airplanes.



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

Heavy Rain:

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. In 2017, near Salt Lake City International Airport 1.97 inches of rainfall was recorded; this was the wettest day on record for the month of March, and the 6th wettest day since records began in 1874.

Lightning:

Lightning is a discharge of atmospheric electricity from a thunderstorm. It can travel at speed up to 140,000 mph and reach temperatures approaching 54,000 degrees. Lightning is often perceived as a minor hazard; in reality, lightning causes damage to many structures and kills, or severely injures, numerous people in the United States. It is estimated that there are 16 million lightning storms worldwide every year.

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. At times hail in Salt Lake County exceeds 1 inch in diameter.

Figure: Salt Lake Valley, September 3rd, 1983 - Thunderstorms produce 0.5" – 1.5" hail

Source: Utah's Weather and Climate, Photo: National Weather Service

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).

Extreme Heat:

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.

Extreme heat is “summertime weather that is substantially hotter and/or more human than average for a location at that time of year” (EPA 2006). Extreme heat not only causes discomfort, but personal health can be affected through heat cramps, heat exhaustion or heat stroke. This can particularly affect vulnerable populations such as the very young, elderly, poor and homeless. Extreme heat places a substantial burden on power grids through widespread use of evaporative coolers and air conditioning. This strain can lead to brownouts or blackouts leaving many without power.

Severe Weather Hazard Profile

Potential Impact		High	**Probability**	X	High
	X	Medium			Medium
		Low			Low
		Minimal			Unlikely
Location	Can occur in areas throughout the entire county.				
Seasonal Pattern	Year round.				
Conditions	Vary based on latitude, elevation, aspect and landforms.				
Duration	Severe weather hazards generally last hours; some conditions can persist for days.				
Secondary Hazards	Wildfire, flooding.				
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historic events and scientific records.				

Range of Magnitude

High/Strong/Thunderstorm Wind:

According to NOAA data, the highest Strong Wind event recorded in the County occurred on January 8, 2005, with gusts up to 99 kts.

Heavy Rain:

On August 8, 2006, about 1.3 inches of rain fell within one hour from Murray to East Millcreek. On several occasions, around 2 inches of rain have fallen at multiple locations within the County. On January 8, 2005, in

one of the costliest natural disasters in Utah history to that also impacted Salt Lake County occurred. A stalled storm system just off the southern California coast was able to tap abundant tropical moisture from the central Equatorial Pacific Ocean and dump copious amounts of rain and wet snow on many portions of Utah. Rain and snow fell on an already deep snowpack, producing a water equivalent total of over 10 inches and unleashing a chain of natural hazards that destroyed 30 homes, took multiple lives, and inflicted property damages estimated around $300 million throughout the State.

Lightning:

Lightning routinely occurs and causes no significant damage, but has inflicted up to $300,000 in property damage in Salt Lake County in the past. Damage of this magnitude should be considered rare and unlikely, however.

Hail:

Hail up to 1.75 inches in diameter has been observed multiple times within Salt Lake County, although most severe storms are unlikely to produce hail of this magnitude, if any at all.

Fog:

Fog is a natural phenomenon that routinely occurs to some degree within the County, with no damages or extremely hazardous conditions occurring. If fog becomes dense enough, however, visibility around travel routes can become extremely limited and result in massive damages from transportation related accidents. Although rare, up to $500,000 in damages have been recorded from accidents directly attributable to dense fog.

Extreme Heat:

The highest temperature ever recorded in Salt Lake City was 107ºF on July 13, 2002, although the average July high for the County is around 91ºF.

Location

The entire region of Salt Lake County can be affected by most severe weather event, however, mountains and valleys are prone to the highest and lowest temperatures and their effects. Communities with dense development and with limited park space or forest preserve areas are at greater risk during extreme heat events. Wind events are most damaging to areas that are heavily wooded and areas with exposed property, major infrastructure, and above-ground utility lines.

Historical Events and Probability of Future Occurrence

High/Strong/Thunderstorm Wind:

According to NOAA data, there have been 205 High, 5 Strong, and 67 Thunderstorm Wind event days from 1996 to 2018 (23 years). These have resulted in approximately 15 deaths, 274 injuries, and $9,752,300 in property damage. This averages to approximately 1 death, 12 injuries, and $424,013 in property damage per year, which is highly likely to continue to into the near future. The median property damage amount for all high, strong, and thunderstorm wind events is $0, indicating that the data is skewed upwards by a smaller number of higher costing events. For example, three events that took place on August 1, 2006, May 2, 2001, and March 20, 2000, totaled approximately $4,500,000 by themselves. If these outliers are removed from the data, an average of $228,361 in property damages emerges, on average for each year, although the fact remains that the majority of events cause little to no property damage.

Very strong winds developed across much of Utah on April 16, 2018, ahead of a cold front, with wind damage reported in parts of the Wasatch Front. Maximum recorded wind gusts included 73 mph at SR-201 at I-80, 65 mph at Baccus, 63 mph at Flight Park South, and numerous other reported gusts in the 50-62 mph range. The gusts blew down multiple trees and one fell on a house in Murray. Trampolines became airborne and landed in yards, over fences, and on the roof of a home in one case. Total damages were recorded as $50,000 and more than 7,500 power outages were reported.

On August 1, 2006, severe thunderstorm winds up to 75 mph impacted the southern part of Salt Lake County in conjunction with Utah County Storms. Trees up to 12 inches in diameter snapped in East Millcreek, and large trees were uprooted in Sugarhouse area. Numerous power poles were also downed in the southern portion of County. According to a regional insurance claim estimate, the total reported damage was approximately $2,000,000.

On May 2, 2001, strong canyon winds developed along the Wasatch Front, lasting until the early morning of the 4th. The storm caused an estimated 3 million dollars in property damage between Davis and Salt Lake Counties, and several hundred thousand dollars damage to trees. The worst damage was reported in East Sandy and Cottonwood Heights. A semi-truck was overturned on I-15 in Centerville on the 3rd, and a large tree smashed into a house in Farmington. Thankfully, no injuries were reported.

Heavy Rain:

Although rain obviously occurs frequently as part of natural weather processes, rains heavy enough to be classified specifically as "heavy rain" events within the NOAA records have occurred 8 times from 1996 to 2018 – approximately 1 event every 3 year, a rate likely to continue. Total property damage from these 8 events are $1,567,000, although half (4) caused no reported damage at all.

On March 23, 2017, heavy rain fell across the Salt Lake Valley. At the Sunnyvale Apartments on 3940 South 764 West, two families had to evacuate their apartments due to flooding. Relatively close by at the Salt Lake City International Airport, 1.97 inches of rainfall was recorded; this was the wettest day on record for the month of March, and the 6th wettest day since records began in 1874.

As previously stated, on August 8, 2006, about 1.3 inches of rain fell within one hour from Murray to East Millcreek. On several occasions, around 2 inches of rain have fallen at multiple locations within the County. On January 8, 2005, in one of the costliest natural disasters in Utah history to that also impacted Salt Lake County occurred. A stalled storm system just off the southern California coast was able to tap abundant tropical moisture from the central Equatorial Pacific Ocean and dump copious amounts of rain and wet snow on many portions of Utah. Rain and snow fell on an already deep snowpack, producing a water equivalent total of over 10 inches and unleashing a chain of natural hazards that destroyed 30 homes, took multiple lives, and inflicted property damages estimated around $300 million throughout the State.

Lightning:

Lightning routinely occurs and causes no significant damage, but 11 events have been recorded from 1996 to 2018 that caused significant damage, injury, or death. During this time span, 4 deaths, 10 injuries, and $351,200 in property damage recorded. It is certain that lightning events will continue to occur routinely throughout the year within the County.

On May 24, 2000, an 11-year-old girl was killed and six other children were injured when lightning struck them as they were getting out of Midvalley Elementary School in Midvale. The children were walking across the playground, heading for their bus when the lightning struck. The victim was still alive as she was transferred to the hospital, but died later from her injuries. One other child was hospitalized, but recovered. The other five

children suffered minor injuries. Shortly afterwards, also in Midvale, a 36-year-old man was injured by lightning as he ran out to his car to roll up his windows.

On August 13, 1997, lightning struck a chimney and sparked a fire in the Aix La Chapelle Condominiums in Holladay. Several units received heavy fire damage, totaling $300,000 in damage.

Hail:

From 1996 to 2018, 39 hail events are recorded in the NOAA data, an average of approximately 2 significant events per year. Although minor hail events will certainly continue regularly as part of natural weather processes, the 48 events recorded by the NOAA are comprised of hail that is a minimum of .75 inches in diameter; .95 inches is the average diameter of the hail reported in these events. Only three of these events have significant damage recorded, totaling $27,000; all other events caused little to no significant damage.

Fog:

As previously mentioned, fog is a natural phenomenon that will routinely occur to some degree within the County, with no damages or extremely hazardous conditions occurring. If fog becomes dense enough, however, visibility around travel routes can become extremely limited and result in massive damages from transportation related accidents. There have been 4 dense fog incidents recorded by NOAA from 1996 to 2018, totaling $1,200,000 in resulting damages.

On January 8, 2003, dense fog formed along the Great Salt Lake during the morning commute, causing a 59 car pileup between the Salt Lake International Airport and Saltair. Amazingly, there were no fatalities, but 14 people were injured and taken to local hospitals. Approximately $500,000 in damages were recorded.

On February 3, 2002, dense fog caused an 11-vehicle pileup on Interstate 80 between Tooele and Grantsville. There were 3 fatalities and several injuries in an accident that involved 8 semi-tractor trailers, 2 passenger cars and a pickup truck. A semi slammed into the rear of another semi that had pulled off the freeway in the dense fog. That initial collision was followed by a chain of vehicles and the remaining semis slamming into each other. The pileup caused 4 of the semis to catch fire. The accident closed I-80 in both directions. Approximately $500,000 in damages were recorded.

Extreme Heat:

As previously stated, the highest temperature ever recorded in Salt Lake City was 107ºF on July 13, 2002, although the average July high for the County is around 91ºF. No extreme heat events or any corresponding death or injury have been recorded by NOAA within Salt Lake County, specifically, although it is certain that at least mild events have occurred with moderate regularity, and will continue into the future.

Secondary Hazards

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, and downed power lines and associated power outages. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Excessive heat events can cause failure of motorized systems such as ventilation systems used to control temperatures inside buildings. Fires can occur as a result of lightning strikes.

Power Outages

According to the Commonwealth Edison (ComEd), "Weather-related events cause 70 percent of all power outages." Power outages usually last anywhere from a few minutes to a few hours. In some extreme cases, power outages have lasted a few days or even a few weeks. Severe weather induced power failures can come from the following sources:

- Storms: Thunderstorms increase the chance of lightning striking a vital part of the power grid. In addition, simple things like rain or freezing rain may damage insulators and other components vital for maintaining a functioning circuit. Snowstorms with wet snow have the same effect. Insulators keep the flow of electricity moving and not shorting out on buildings and other structures so large amounts of moisture entering the insulators cause a fuse to blow.
- Wind: High and moderate winds lead to power outages by blowing objects into power lines and other components, causing them to break. Momentary outages may occur if an object, such as a tree limb, is blown on to a power line and then falls off. Areas near oceans and other large bodies of saltwater may also experience power outages if the wind creates enough salt spray to reach nearby system components vulnerable to damage from sea water. Both high winds (more than 55 mph) and moderate winds (35 to 55 mph) may be sufficient to cause power outages.

Vulnerability Assessment

The following populations are most vulnerable to a severe weather event, face isolation and exposure during severe storms, or could suffer more secondary effects of the hazard.

The majority of injuries and deaths associated with lighting strikes occur when people are outdoors; however, almost one-third of lightning related injuries occur indoors. Males are five times more likely than females to be struck by lightning, and people between the ages of 15 and 34 account for 41 percent of all lightning strike victims (CDC, 2013).

Young children, the elderly, those who are sick, overweight or have alcohol problems, and men in general (because they sweat more and become more quickly dehydrated) are more susceptible to extreme heat. The chronically ill and elderly are often taking prescription medications that interfere with the body's ability to dissipate heat. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Some behaviors also put people at greater risk: drinking alcohol; taking part in strenuous outdoor physical activities in hot weather; and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration. In past studies, extreme heat most strongly affected adults age 50 or older. Additionally, many more males than females were killed by heat than females, due to the higher rate of dehydration men experience.

The following table provides a breakdown of vulnerable populations for which data was available.

Table: Salt Lake County Vulnerable Populations to Severe Weather

Population Under 5	Population Under 18	Population Over 65	Male Population	Foreign Born	Speak English less than "Very Well"	Population with Disability	No Health Insurance	Population in Poverty
87,892	310,473	110,372	517,881	137,383	72,335	102,204	132,936	114,135

Source: 2017 American Community Survey

Severe Winter Weather

Extreme Cold:

Temperatures in Utah can reach the extreme ends of the thermometer. Winter months often experience temperatures below zero degrees Fahrenheit, however, prolonged periods of extremely cold weather are infrequent. An exception was January 2013, the coldest month on record for Salt Lake City since 1949. 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 also enhance the effects of extreme cold.

Winter Storms/ Ice Storms/ Winter Weather/ Blizzards:

Ice or sleet, even in the smallest quantities, can result in hazardous driving conditions and can be a significant cause of property damage. Sleet can be easily identified as frozen raindrops. Sleet does not stick to trees and wires. The most damaging winter storms are often ice storms. Ice storms are the result of cold rain that freezes on contact with objects having a temperature below freezing. Ice storms occur when moisture-laden gulf air converges with the northern jet stream causing strong winds and heavy precipitation. This precipitation takes the form of freezing rain coating power lines, communication lines, and trees with heavy ice. The winds will then cause the overburdened limbs and cables to snap; leaving large sectors of the population without power, heat, or communication. Falling trees and limbs can also cause building damage during an ice storm. A blizzard is categorized as a snowstorm with winds of 35 miles per hour or greater and/or visibility of less than one-quarter mile for three or more hours. The strong winds during a blizzard blow about falling and already existing snow, creating poor visibility and impassable roadways. Blizzards have the potential to result in property damage. Blizzard conditions not only cause power outages and loss of communication, but also make transportation difficult. The blowing of snow can reduce visibility to less than one-quarter mile, and the resulting disorientation makes even travel by foot dangerous if not deadly.

Heavy Snow/ Lake Effect Snow:

Significant snowstorms are characterized by the rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility.

East Bench, Salt Lake Valley, October 18, 1984;
22 inches of snow falls in 24 hours.

Source: Utah's Weather and Climate

Severe Winter Weather Profile

Potential Impact		High	**Probability**	X	High
	X	Medium			Medium
		Low			Low
		Minimal			Unlikely
Location	Can occur in areas throughout the entire county.				
Seasonal Pattern	Winter months				
Conditions	Vary based on latitude, elevation, aspect and landforms.				
Duration	Severe weather hazards generally last hours; some conditions can persist for days.				
Secondary Hazards	Secondary hazards can include potential for flooding, transportation failure, infrastructure damage and failure, including power outages.				
Analysis Used	National Climate Data Center, National Weather Service, Utah Avalanche Center, UDEM, local input, and review of historic events and scientific records.				

Range of Magnitude

Extreme Cold:

The coldest temperature recorded in Salt Lake was -22ºF on January 25, 1949; the average January low for the County is 23ºF.

Winter Storms/ Ice Storms/ Winter Weather/ Blizzards:

Although many of these events occur and cause little to no significant impact, there have been several occasions in the State's history that demonstrate the magnitude that is possible with these hazard events. There have been numerous other occasions where significant ice buildup has occurred, or 2 to 3 feet of snow has fallen along with gusts over 70 mph. In the Blizzard of 1997, up to four feet of snow fell in some places, numerous avalanches were triggered, and gusts of up to 77 mph were experienced, resulting in 50 injuries, several deaths, and approximately $40 million in damages throughout the State.

Heavy Snow/ Lake Effect Snow:

As previously described, heavy snow events routinely occur within the County, but cause no death, injury, or significant damage the majority of the time. There have been several occasions, however, where over 3 feet of snow has fallen, hundreds of thousands in damages have been incurred, or numerous deaths/injuries have been reported.

Location

The entire region of Salt Lake County can be affected by most severe weather event, however, mountains and valleys are prone to the highest and lowest temperatures and their effects. Communities with dense development and with limited park space or forest preserve areas are at greater risk during extreme heat events. Wind events are most damaging to areas that are heavily wooded and areas with exposed property, major infrastructure, and above-ground utility lines.

Historical Events and Probability of Future Occurrence

Extreme Cold:

The coldest temperature recorded in Salt Lake was -22ºF on January 25, 1949; the average January low for the County is 23ºF. Three cold/wind chill events have been recorded by NOAA within Salt Lake County from 1996 to 2018. No death, injury, or property damage has been recorded by NOAA as a result of any cold/wind chill event.

Winter Storms/ Ice Storms/ Winter Weather/ Blizzards:

According to NOAA data from 1996 to 2018, there have been 200 days with a blizzard, ice storm, winter weather, or winter storm event, totaling 13 deaths, 267 injuries, and $47,096,000 in damages. However, 3 of the deaths, 50 of the injuries, and $40,000,000 of the damages all occurred in one event on January 11, 1997. If this outlier is removed from the data, there is an average of approximately .43 deaths, 9.43 injuries, and $308,522 in property damages per year, although these averages are likely still skewed upwards by a smaller number of higher impact events.

On March 7, 2002, a ferocious cold front moved across Northern Utah with lightning, small hail and heavy snow. Very heavy snow along with strong winds made driving treacherous several hours after frontal passage. Around 200 accidents occurred in the Salt Lake Valley on the 8th, with 2 weather-related traffic fatalities and about 50 injuries. Approximately $140,000 in damages were recorded. Some of the snow totals in the mountains included 31 inches at Alta, 26 inches at Snowbird, 25 inches at Solitude, 15 inches at Trial Lake, and 12 inches at Sundance. Snowfall in the valleys and benches included 8 inches in Holladay and Olympus Cove, 7 inches in Sandy and Laketown, 6 inches in Centerville and Brigham City, and 5 inches at the Salt Lake City International Airport.

As previously mentioned, in the Blizzard of 1997, up to four feet of snow fell in some places, numerous avalanches were triggered, and gusts of up to 77 mph were experienced, resulting in 50 injuries, several deaths, and approximately $40 million in damages throughout the State. There have been numerous other occasions where significant ice buildup has occurred, or 2 to 3 feet of snow has fallen along with gusts over 70 mph.

Heavy/ Lake Effect Snow:

According to NOAA data from 1996 to 2018, there have been 222 days with a reported heavy or lake effect snow event. There were 6 deaths, 161 injuries, and $3,272,950 in property damage from these hazards during this time. This averages to approximately 1 death every four years, as well as 7 injuries and $142,302 in property damage per year. Most events cause no death, injury, or significant property damage, however, and these averages are influenced by a smaller number of high impact events.

On February 18, 2018, the Salt Lake and Tooele Valleys saw widespread heavy snowfall. Storm total snowfall reports included 25 inches in Sandy, 23 inches in Cottonwood Heights, 17.5 inches in Tooele, 15 inches in Olympus Cove, and 14 inches in Taylorsville. For the calendar day of February 19, Tooele recorded 13 inches of snow, which broke the calendar day record of 8 inches, set in 1945.

On December 5, 1996, a storm system combined with a moist westerly flow to spread heavy snow to much of the state. The valleys received from 6-11 inches while the mountains from 1-2 feet. The highest total for the mountains was at the Park City ski resort where 23 inches accumulated. The wet snow helped to trigger 6 avalanches during and shortly after the storm. A 37-year old man snowmobiling near Bountiful Peak was killed when he was overcome by one of these slides. There were also about 100 traffic accidents with 20 known injuries during this storm.

Secondary Hazards

The most significant secondary hazards associated with severe winter weather are structural damage from snow loads, wind damage, impacts on life safety, disruption of traffic, economic impact, loss of ability to evacuate, taxing first responder capabilities, service disruption (power, water, etc.), and communication disruption. Freezing temperatures and extreme cold may cause insulators to fail and conductors to break. Extreme cold has the added effect of making people turn up their heaters, which causes circuit overload and the resulting power outage. People turning on their lights and heaters in anticipation of the power being restored may extend an outage. It creates a high power demand on fusing that may not be able to handle the stress of the load.

Vulnerability Assessment

Similarly to severe weather vulnerability, all residents in the planning area are vulnerable to severe winter weather, but the elderly, low income, homeless, or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads or without adequate shelter may be especially vulnerable. Power outages can be life threatening to those dependent on electricity for life support. Power outages can also cause life-threatening situations if residents use alternative means to heat their homes without the use of proper ventilation. populations face isolation and exposure during severe winter weather events and could suffer more secondary effects of the hazard. The following chart provides a breakdown of vulnerable populations for which data was available.

Table: Salt Lake County Vulnerable Populations to Severe Winter Weather

Population Under 5	Population Under 18	Population Over 65	Foreign Born	Speak English less than "Very Well"	Population with Disability	No Health Insurance	Population in Poverty
87,892	310,473	110,372	137,383	72,335	102,204	132,936	114,135

Source: 2017 American Community Survey

Tornado

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that is caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms. The following are common ingredients for tornado formation:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft)
- Increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet.)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity.

Tornadoes can form from individual cells within severe thunderstorm squall lines or from an isolated super-cell thunderstorm. Weak tornadoes can sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour, stretch more than two miles across, and stay on the ground for dozens of miles.

Types of tornadoes include landspouts, multiple vortex tornadoes, and waterspouts. Other tornado-like phenomena that exist in nature include dust devils, fire whirls, and steam devils; downbursts are frequently confused with tornadoes, though their action is dissimilar.

Tornado Hazard Profile

Potential Impact		High	**Probability**		Highly Likely
		Medium		X	Likely
	X	Low			Possible
		Negligible (<10%)			Unlikely
Location	A tornado event is possible anywhere within the county.				
Seasonal Pattern	The majority of tornado and funnel cloud activity within the county has occurred during the late spring to early fall period of the year.				
Conditions	Tornadoes can often form from individual cells within severe thunderstorm squall lines.				
Duration	Tornadoes can last from a few seconds to an hour, although most last less than 10 minutes.				
Secondary Hazards	Potential secondary hazards include hazardous material releases, structural fires, and infrastructure failure if key facilities are damaged.				
Analysis Used	National Climate Data Center, local input, and review of historic events and scientific records.				

Range of Magnitude

Tornadoes were originally categorized using the Fujita Scale (F-Scale) or Pearson Fujita Scale, introduced in 1971, based on a relationship between the Beaufort Wind Scales (B-Scales) (measure of wind intensity) and the Mach number scale (measure of relative speed). The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. The F-Scale categorizes each tornado by intensity and area. The scale is divided into six categories, F0 (Gale) to F5 (Incredible). The table below explains each of the F-Scale categories.

Table: Fujita Damage Scale

Scale	Wind Speed (mph)	Typical Damage
F0	<73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena occur.

The primary limitations of the F-Scale rating system are a lack of damage indicators, no account of construction quality and variability, and no definitive correlation between damage and wind speed. These limitations have led to the inconsistent rating of tornadoes and, in some cases, an overestimate of tornado wind speeds. These limitations led to the development of the Enhanced Fujita Scale (EF-Scale) by the Texas Tech University Wind Science and Engineering Center and a national forum of meteorologists and wind engineers (NOAA 2008). The EF-Scale takes into account more variables than the original F-Scale did when assigning a wind speed rating to a tornado. The EF-Scale became operational on February 1, 2007.

Because the EF-Scale was revised from the original F-Scale to better reflect examinations of tornado damage, it considers how most structures are designed (NOAA 2008). Tornado ratings are assigned based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DI) and Degree of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, with six categories from EF0 to EF5, representing increasing degrees of damage. *Table: Enhanced Fujita Damage Scale* lists six categories of the EF-Scale.

The EF-Scale offers a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to the 28 indicators listed in *Table: Enhanced Fujita Scale Damage Indicators*. These estimates vary with height and exposure. Standard measurements are taken by weather stations in open exposures. *Table: The EF-Scale Ratings* describes the EF-scale ratings.

Table: Enhanced Fujita Scale Ratings

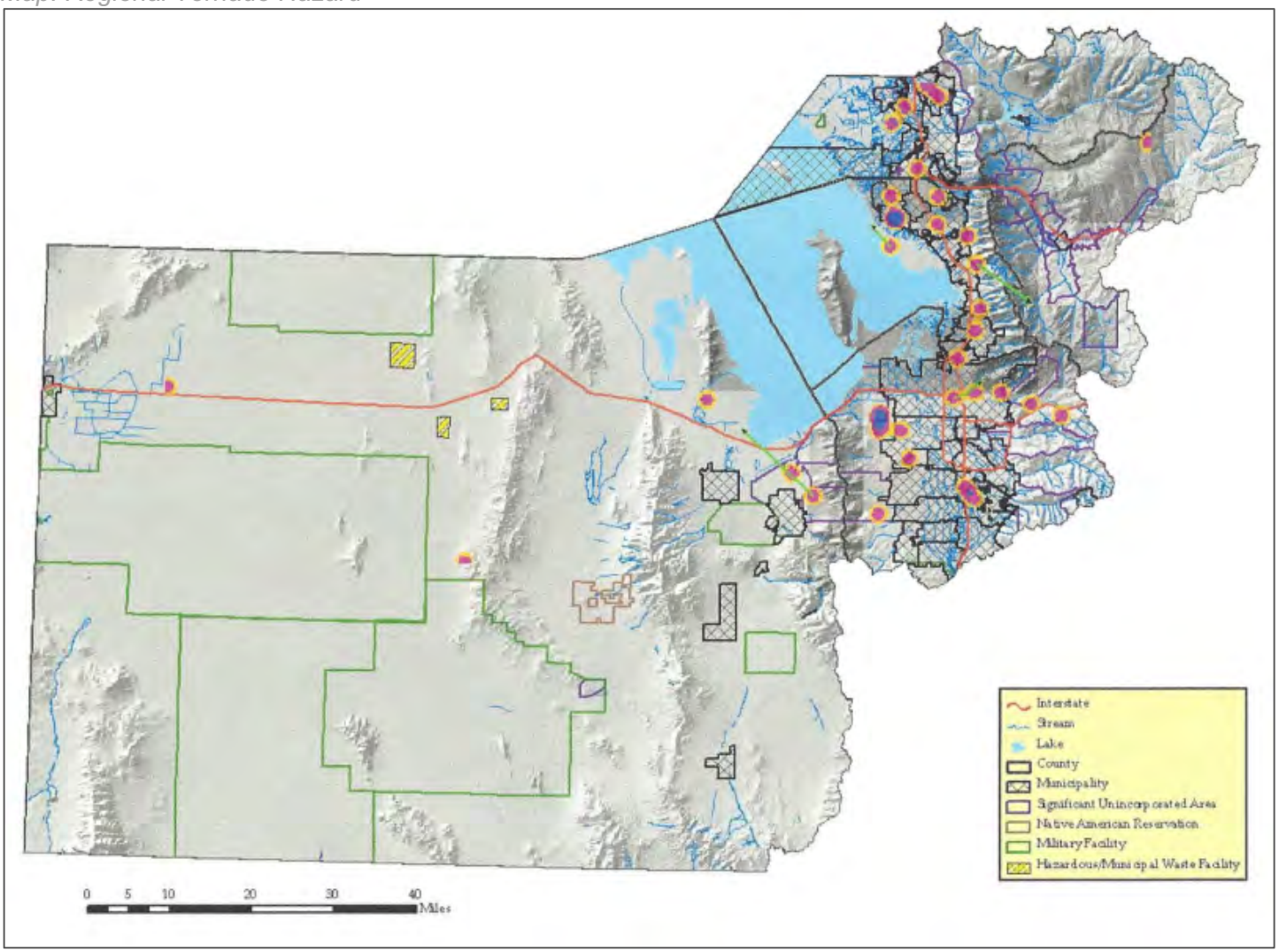
EF-Scale Number	Intensity Phrase	Wind Speed (mph)	Type of Damage Done
EF0	Light tornado	65–85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	Moderate tornado	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	Significant tornado	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	Severe tornado	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	Devastating tornado	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	Incredible tornado	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); high-rise buildings have significant structural deformation; incredible phenomena occur.

Location

Some tornadoes can have wind speeds greater than 250 mph with a damage zone 50 miles long and greater than a mile wide. Currently, the most intense tornado in Utah's history has been an F3 on August 11, 1993, in the Uinta Mountains. No recorded tornado has been greater than an F2 within Salt Lake County specifically, however. Although they are less common in the Intermountain Region, an average of 3 tornadoes per year occurs in Utah. Examples are the Salt Lake City tornado August 11, 1999 and the Manti tornado in 2002. Most tornadoes in Utah typically have winds less than 110 mph (F2 or smaller), and no wider than 60 feet and are on the ground no longer than a few minutes.

Tornado distribution for the region suggests many tornadoes are funnel clouds aloft coming into contact with the increasing elevation of the region's foothills and mountains, as can be seen in the map below. Several of the tornadoes to impact Salt Lake County have specifically struck the Magna Metro Township. A tornado event is possible anywhere within or immediately around the entire planning region, however.

Map: Regional Tornado Hazard

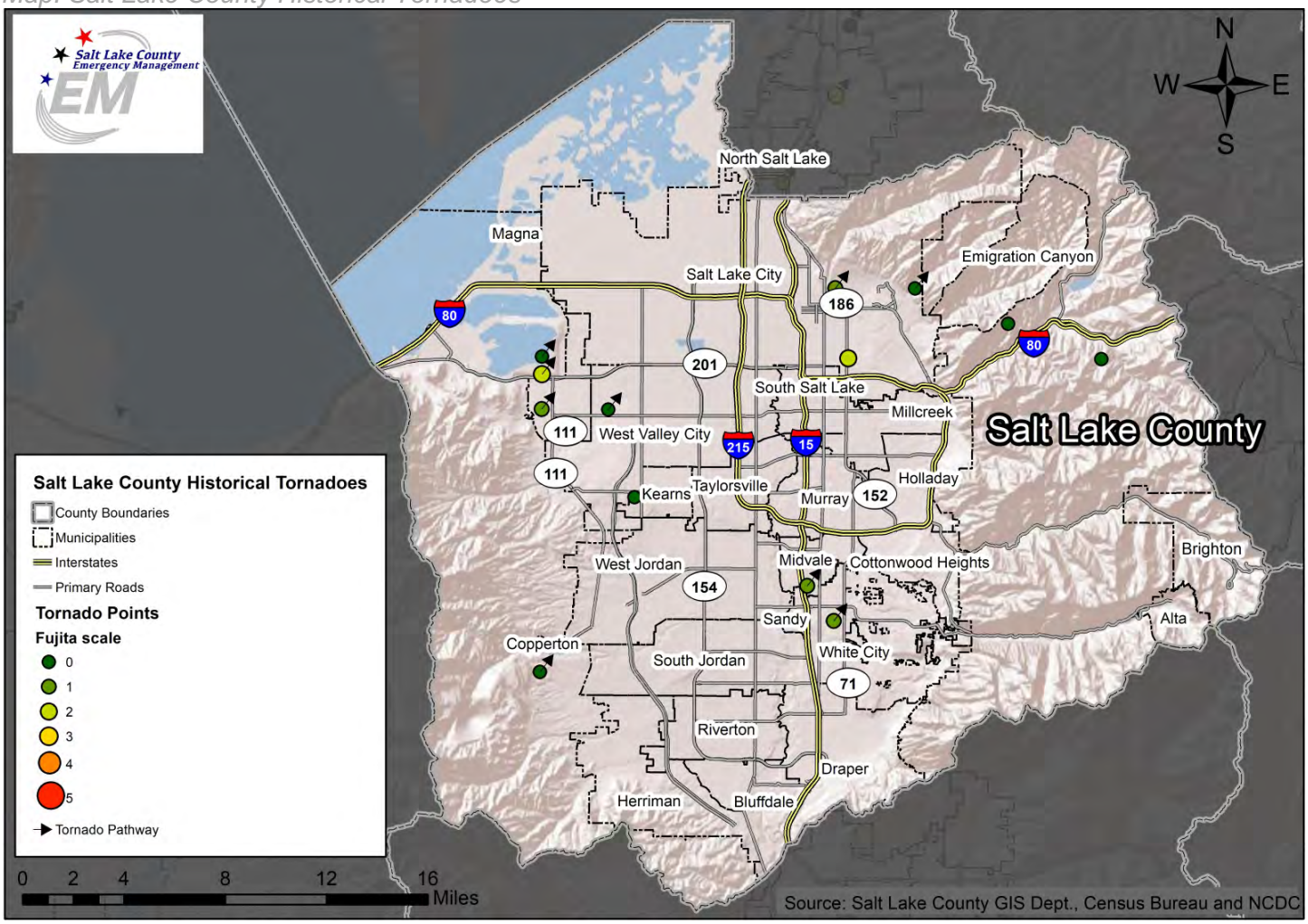


Source: NWS Storm Prediction Center

Historical Events and Probability of Future Occurrence

According to NOAA data from 1965 to 2018 (54 years), there have been 1 death, 80 injuries, and $170,165,000 in property damage within Salt Lake County from 18 tornado or funnel cloud events – an average of one event every three years. However, the most recent recorded event occurred in 2001. This would indicate that, although a tornado remains possible in any given year, the expected frequency of this hazard for the near future is likely to be less than one event every three years.

Map: Salt Lake County Historical Tornadoes



Historically, atmospheric conditions have not been favorable for tornado development in Utah due to a dry climate and mountainous terrain. Despite this fact, interactions of the relatively cool air of the Great Salt Lake and relatively warm air of urban areas could potentially create situations more favorable for tornado development. This phenomenon possibly contributed to the formation of the August 11, 1999, Salt Lake City tornado (Dunn and Vasiloff 2001). Around lunch time, a tornado touched down in the southwest portions of Salt Lake City. The tornado intensified to an F2 on the Fujita scale, and moved northeast through the metropolitan area of Salt Lake City. It caused widespread damage at the Delta Center, then ripped across an outdoor retailers convention tent, where the lone fatality occurred along with many of the injuries. After blowing out many windows in the Wyndam Hotel, the tornado continued its northeast track, knocking down scaffolding and shearing off a crane at the LDS Assembly Hall construction site. Next it skirted the Capitol Building, ripping out several large trees there and in historic Memory Grove. It then moved into the residential area known as The Avenues, damaging hundreds of

trees and ripping the roofs off of several homes, before finally lifting back into the clouds. All told, there was 1 fatality, 80 injured, and 300 buildings and homes sustained damage, with 34 homes deemed uninhabitable. At least 500 trees were totally destroyed, with 300 more damaged. Many vehicles were damaged or totaled as well. The $170 million in damages caused by this tornado make it the costliest disaster in Salt Lake County history. This event caused the only human losses to tornado events ever recorded in Salt Lake County.

Image: Salt Lake City Tornado,
August 11, 1999 - Orange fireball is a power sub-station exploding

Source: KTVX News 4

Secondary Hazards

Tornadoes have the potential to lead to widespread utility failure, thus exposing vulnerable populations to extreme temperatures. Tornado events may also be accompanied by strong thunderstorms, straight line winds, and hail, which can cause significant property damage on their own right.

Vulnerability Assessment

The following populations are most vulnerable to a severe weather event, face isolation and exposure during severe storms, or could suffer more secondary effects of the hazard. The elderly and functional needs populations are considered most vulnerable because they require extra time or outside assistance to seek shelter and are more likely to seek or need medical attention, which may not be available due to isolation during or after an event. The County population with a language barrier that possibly would be unable to follow warning messages would be vulnerable as well. Those living in mobile homes would be especially vulnerable to heavy winds and tornado activity. The following table provides a breakdown of vulnerable populations.

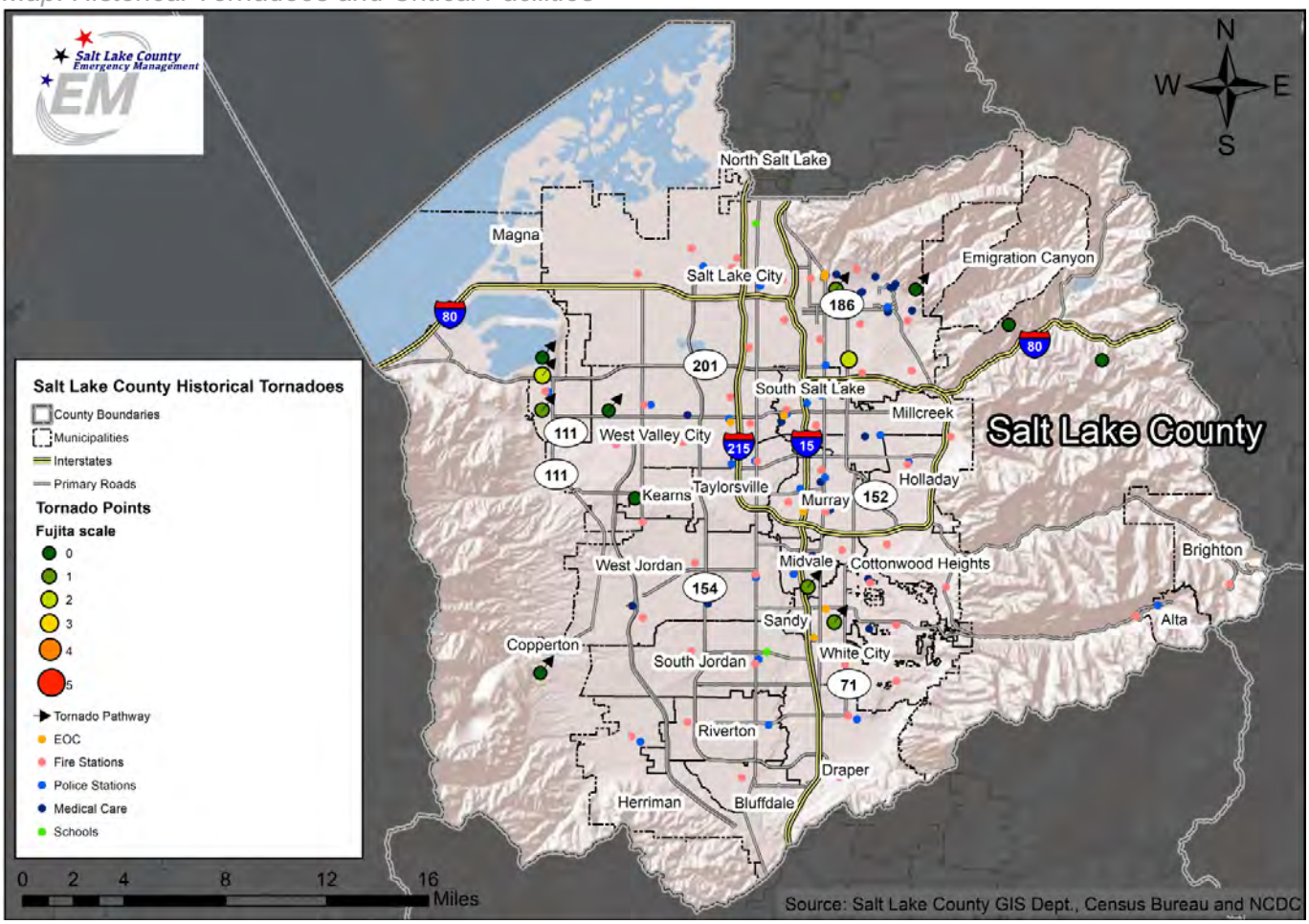
Table: Salt Lake County Vulnerable Populations to Tornado

Population Under 5	Population Over 65	Foreign Born	Speak English less than "Very Well"	Population with Disability	No Health Insurance	Population in Poverty	Population in Mobile Homes
87,892	110,372	137,383	72,335	102,204	132,936	114,135	7,199

Source: 2017 American Community Survey

The population in a car at the time of a tornado would also be vulnerable. According to the 2017 American Community Survey, the population in Salt Lake County transported to work by car, truck, or van is 482,321 people.

Map: Historical Tornadoes and Critical Facilities



Wildfire

Fire is a natural process in wildland areas. Wildfires are particularly concerning in the wildland-urban interface, however. The wildland-urban interface (WUI) is the line, area, or zone where structures or other human development meet or intermingle with undeveloped wildland or vegetative fuel. Examples include homes, storage sheds, recreational facilities, transmission lines, or other buildings. Significant human development has taken place in the WUI in Salt Lake County that has placed many people in fire-prone areas (UNHH 2008). Approximately 65% of Utah's wildfires are started by lightning, although 35% of fires are initiated by human activity.

The three conditions that affect fire behavior are topography, vegetation and weather.

Topography: Topography includes factors such as slope, aspect and elevation. Fires spread faster upslope because fuels are closer to flames. Aspect influences fuel moisture content. Fuels tend to be drier on south and west-facing slopes. Higher elevation is related to cooler temperatures and higher relative humidity, as well as changes in vegetative fuel types (UNHH 2008).

Vegetation: The type of vegetation around has a major effect on how quickly a fire will spread. For example, light grasses burn rapidly, whereas heavy, dense fuels like Douglas Fir burn slowly but with greater intensity. Different fuels burn at different rates of spread, intensity, and will resist control to different degrees (UNHH 2008).

Size, continuity and compactness also affect the fuel's rate of spread. Large fuels do not burn as readily as small fuels, and take more heat to ignite. Small fuels ignite easier and fire will spread more rapidly through them. Continuity describes how a fuel is arranged horizontally. Fuels that are broken up in patches burn unevenly and slower than uniform fuels. Compactness is how fuel is arranged vertically. Compact fuels burn slower than tall, deep fuels that have more oxygen available (UNHH 2008).

Weather: Weather (temperature, humidity, precipitation, and wind) affects the ease with which a fuel ignites, the intensity at which it burns, and how easy control may be. High temperatures heat fuels and reduce water content, which increases flammability. A decrease in relative humidity causes a proportionate decrease in fuel moisture, promoting easier ignition and more intense burning. Wind carries the heat from a fire into unburned fuels, drying them out and causing them to ignite easier. The wind may also blow burning embers into unburned areas ahead of the main fire that may start spot fires (UNHH 2008).

Wildfire removes vegetation that protects soil from excessive rainfall and resulting runoff. It also damages soil by making the soil hydrophobic, or water repellent. These conditions contribute to depletion of wildlife resources, soil erosion, water runoff, and in some cases severe slope failures and debris flows (UNHH 2008).

Providing adequate fire protection in the WUI can be difficult. Local suppression methods and resources may not be suited to wildfire suppression, and personnel can become easily overwhelmed when multiple structures are threatened simultaneously. Energy output from a wildfire may make protection of homes almost impossible and involves tremendous danger to firefighters and homeowners (UNHH 2008).

Wildfire Hazard Profile

Potential Impact		High	**Probability**	X	High
		Medium			Medium
	X	Low			Low
		Minimal			Unlikely
Location	Wildland-Urban Interface (WUI) zones near the foothills and in forested areas. Canyons, along Jordan River, undeveloped islands within urban areas (Dimple Dell)				
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, WWA, and UDEM.				

Range of Magnitude

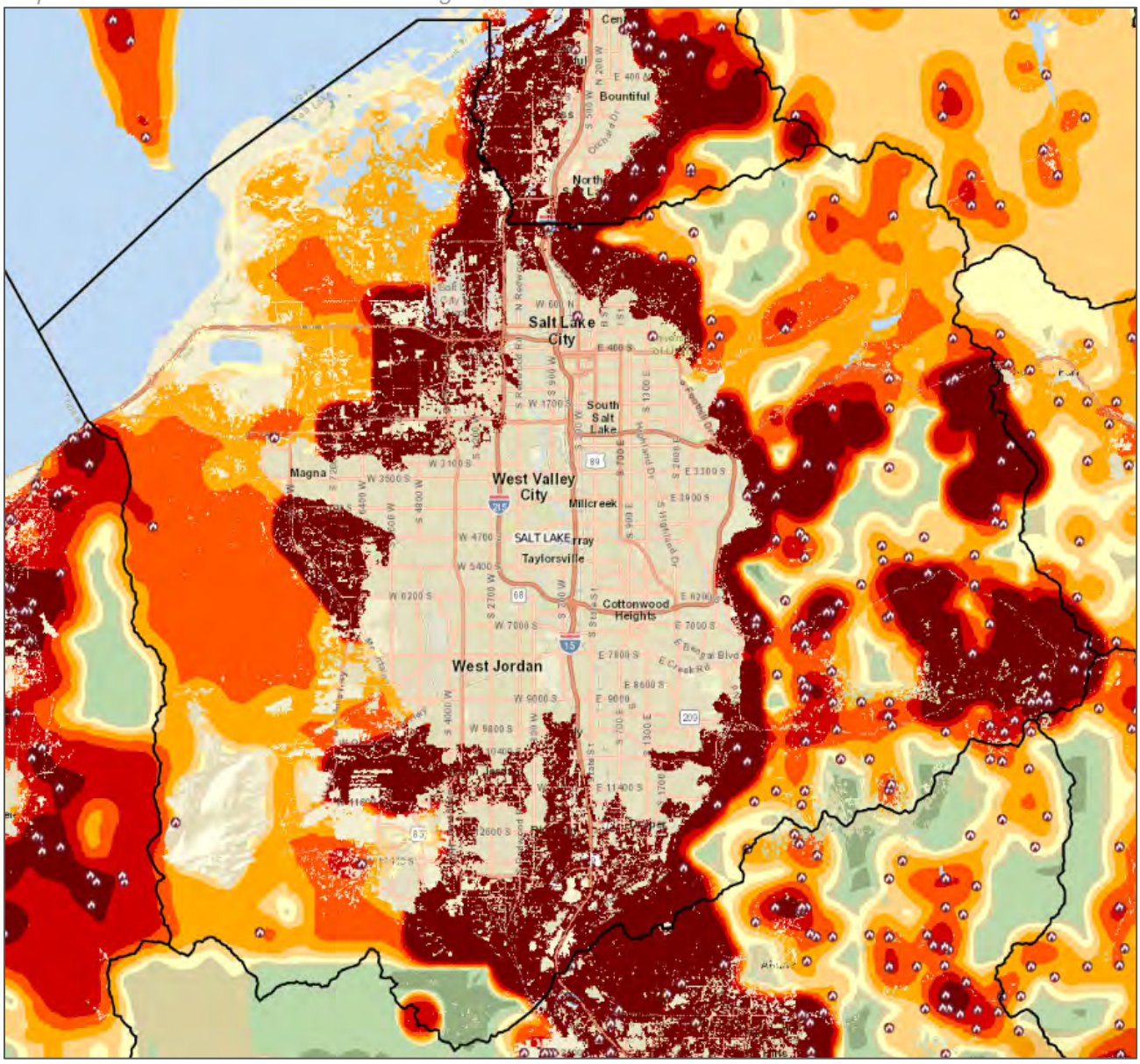
For information on the range of magnitude for wildfire in Salt Lake County, please see the Fire Threat Index information in the Vulnerability Assessment section of this hazard profile.

Location

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 and mountain shrub burn hot and fast, spreads easily and is found throughout the county. During prime burning conditions (hot, dry and windy) the pinion juniper class will burn.

As can be seen in the map below, historical wildfire ignition points have been marked, and areas most likely to be the source of ignition based on historical patterns are darkly shaded.

Map: Historical and Probable Wildfire Ignition Points



Source: West Wide Wildfire Risk Assessment

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 also 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.

Historical Events and Probability of Future Occurrence

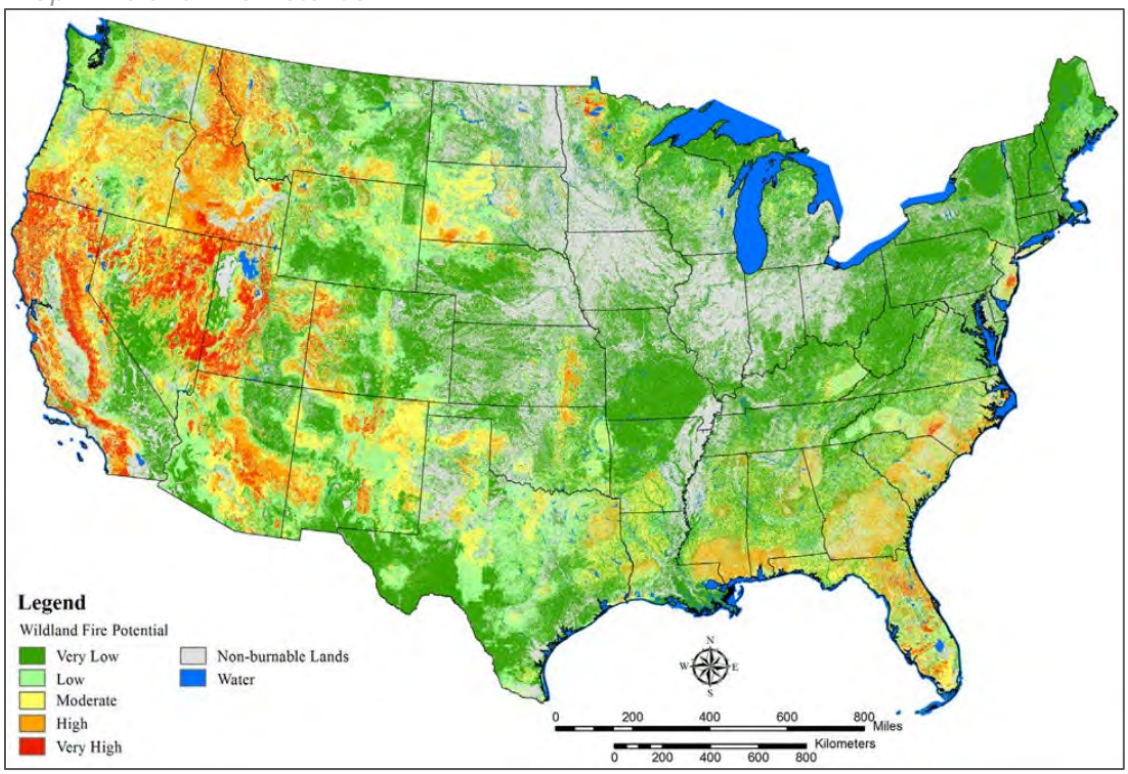
Several notable wildfires have occurred in Salt Lake County recently. These include a brush fire in the Avenues area of Salt Lake City on April 2015. Another fire occurred in Herriman City in 2016 destroying two homes and causing evacuations. In neighboring Tooele County the Dollar Ridge Fire burned destroyed 90 homes. These fires prompted major fire response, required evacuations of large numbers of citizens, and created the threat of debris flows in following years. The Dollar Ridge Fire received a Fire Management Assistance Declaration.

According to NOAA data, there have been 14 days with a wildfire event in Salt Lake County from 2010 to 2018.

There is near 100 percent chance of occurrence in next year, according to historical averages. As previously stated, there have been 14 recorded days from 2010 to 2018 with a wildfire event in Salt Lake County, according to NOAA data. This averages out to approximately 1.6 wildfire events every year. The USDA Forest Service portrays the majority of Salt Lake County as being a "Very High" or "High" rank for wildfire potential.

The map below shows the wildland fire potential for the broader region. The probable ignition points within the County are shown in the previous map, *Historical and Probable Wildfire Ignition Points.*

Map: Wildland Fire Potential



Source: Dillon, Menakis, and Fay, Wildland Fire Potential: A Tool for Assessing Wildfire Risk and Fuel Management Needs, 2015.

Secondary Hazards

The most obvious impacts of a wildfire would be property damage or complete loss, injury, or even death, but secondary impacts could include poor air quality due to smoke in nearby areas. Impacts to agricultural land could have impacts on the local and regional economy. As one might expect, the effect of wildfires on the environment is typically devastating. Many trees and other vegetation will be killed off, although many species of vegetation can flourish in the aftermath of a wildfire due to increased sunlight exposure to the ground. The initial impact to the environment from wildfires is severe, however, and stripping the land of vegetation can also lead to increased erosion or risk of slope failure, which could further threaten structures or impact water supplies and quality.

Vulnerability Assessment

Utah Summary

- 33% of burnable acres in the state are Moderate-to-High wildfire risk (classes 4 to 9).
- 45 million burnable acres across the state (82% of all lands)
- 457,090 are living at risk to wildfire within Wildland Development Areas
- 15.1 million acres of forest assets at risk to wildfire

An analysis based on the Utah Wildfire Risk Assessment Portal was performed to show the percentage of each county's threat to wildfire risk. The results show the threat based on a percentage of land that falls under certain threat categories ranging from VVL (Very Low) to VVH (Very High). There are 7 counties within Utah that have 25% or greater of its land being a high threat to wildfire, of which Salt Lake County has the highest percentage with 59.8%.

Table: Salt Lake County Wildfire Threat 2018

VVL%	VL%	L%	LM%	M%	HM%	H%	VH%	VVH%	High Totals
1.2%	8.9%	6.2%	9.5%	14.3%	18.0%	15.3%	11.2%	15.4%	59.8%

Source: 2019 Utah State Hazard Mitigation Plan

Table: Exposed Values in Salt Lake County for Wildfire

Residential Value	Non-Residential Value	Schools	Hospitals	Emergency Response Facilities	Total Building Value
$74,079,664,000	$24,604,780,000	335	16	110	$98,684,444,000

Source: 2019 Utah State Hazard Mitigation Plan

Table: Wildfire Vulnerability and Loss from LHMPs

People	Residential Units		Commercial Units	
	Units	Value	Units	Value
70,795	5424	$1,785,312,688	419	$1,809,855,542

Source: 2019 Utah State Hazard Mitigation Plan

It is recommended that growing counties follow FEMA's Firewise construction recommendations for all new development areas to minimize wildfire risk. The Firewise program encourages and assists neighborhoods to mitigate wildfire hazards. There are currently 28 Firewise communities in Utah.

Table: Firewise Communities in Salt Lake County

Community Name	Number of Residents	First Year
Emigration Canyon	850	2002
Hi-Country Estates Phase 1	88	2016
Mt. Air	100	2017

Source: 2019 Utah State Hazard Mitigation Plan

Wildfire is a natural part of Utah's ecosystems, but the development within and around wild lands over the last decade or two has posed challenges for wildfire and safety officials. In 2005, Utah initially identified almost 600 communities and their surrounding natural resources as "at risk" from wildland fire. The annually updated list consists of communities throughout Utah that have been determined by wildland fire officials to be at risk from wildland fire. The "Overall Score" represents the sum of multiple risk factors analyzed for each community. Examples of some risk factors are fire history, local vegetation, and firefighting capabilities. The Overall Score can range from 0 (No risk) to 12 (Extreme risk). This score allows Utah's fire prevention program officials to assess relative risk and create opportunities for communications with those communities on the list.

Table: Communities at Risk, FFSL 2019

Communities At Risk	Fire Occurrence	Fuels Hazards	Values Protected	Fire Protection Capability	Overall Score
Alta	1	1	2	2	6
Big Cottonwood	1	1	3	2	7
Bluffdale	2	3	2	1	8
Brighton	1	1	3	2	7
Copperton	2	2	2	1	7
Cottonwood Heights	1	2	3	1	7
Dimple Dell	2	3	3	1	9
Draper	2	2	3	1	8
Emigration Canyon	2	3	3	2	10
Herriman	2	3	2	1	8
High Country Estates	2	3	3	1	9
Holladay	1	2	1	1	5
Lambs Canyon	2	2	2	3	9
Little Cottonwood	1	1	2	2	6
Mount Aire	2	2	2	3	9
Olympus Cove	2	3	2	1	8
Salt Lake City	2	3	2	1	8
Sandy	2	3	2	1	8
Suncrest	1	2	2	1	6

Further wildfire vulnerability information was considered from the West Wide Wildfire Risk Assessment, or "WWA" produced by Sanborn on behalf of the Oregon Department of Forestry for 17 western states, including Utah. This assessment included partner states and agencies to quantify the magnitude of wildland fire risk to provide a baseline for quantifying mitigation activities and to monitor change over time. For a full description of the analysis methodology used, as well as more detailed versions of all the images and maps below, please see the full WWA Risk Assessment.

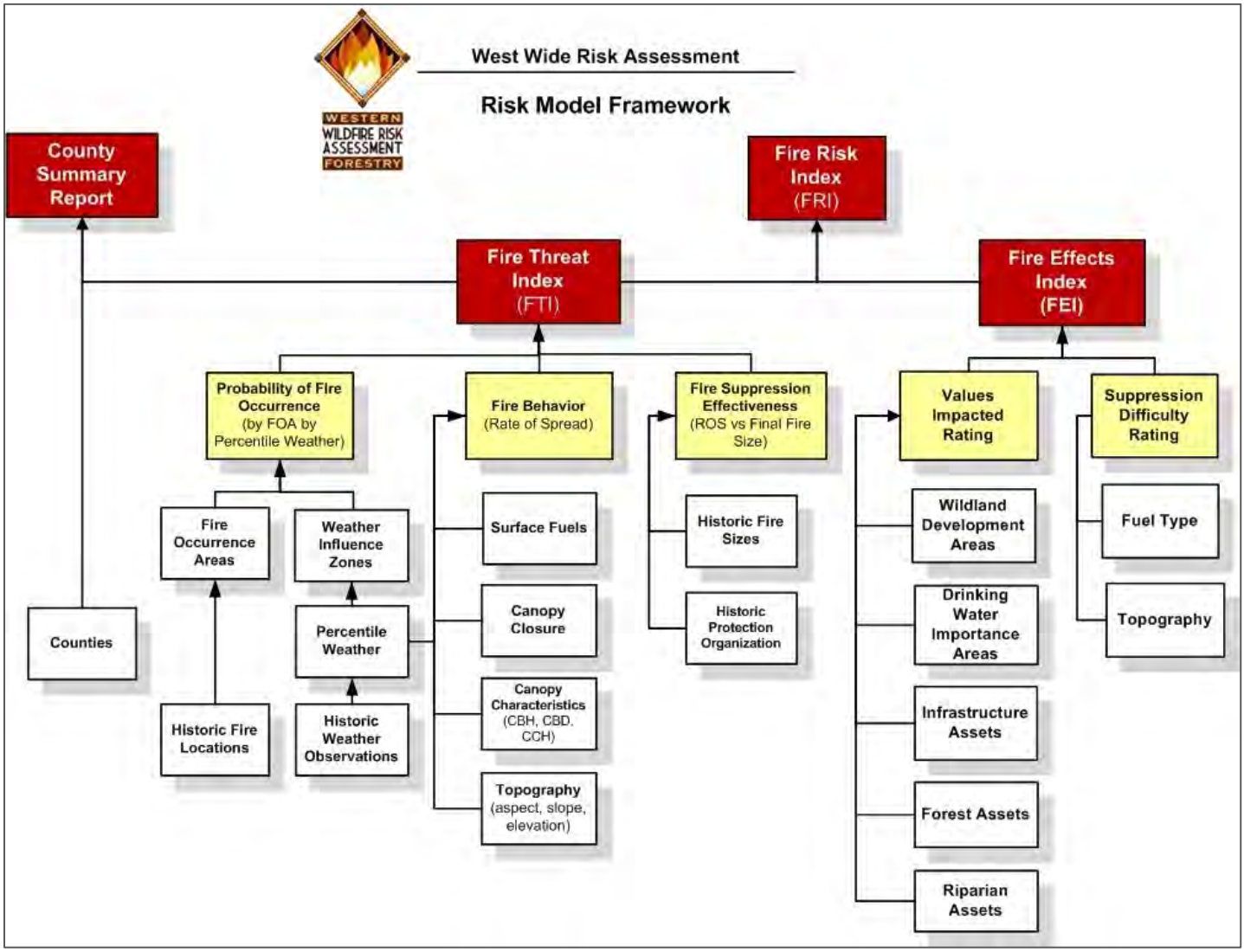
The WWA produced three primary outputs: The Fire Effects Index, the Fire Threat Index, and the Fire Risk Index.

The Fire Effects Index is based on a rating of suppression difficulty and values impacted, which identifies areas that have important values at risk to wildland fire and/or are costly to suppress.

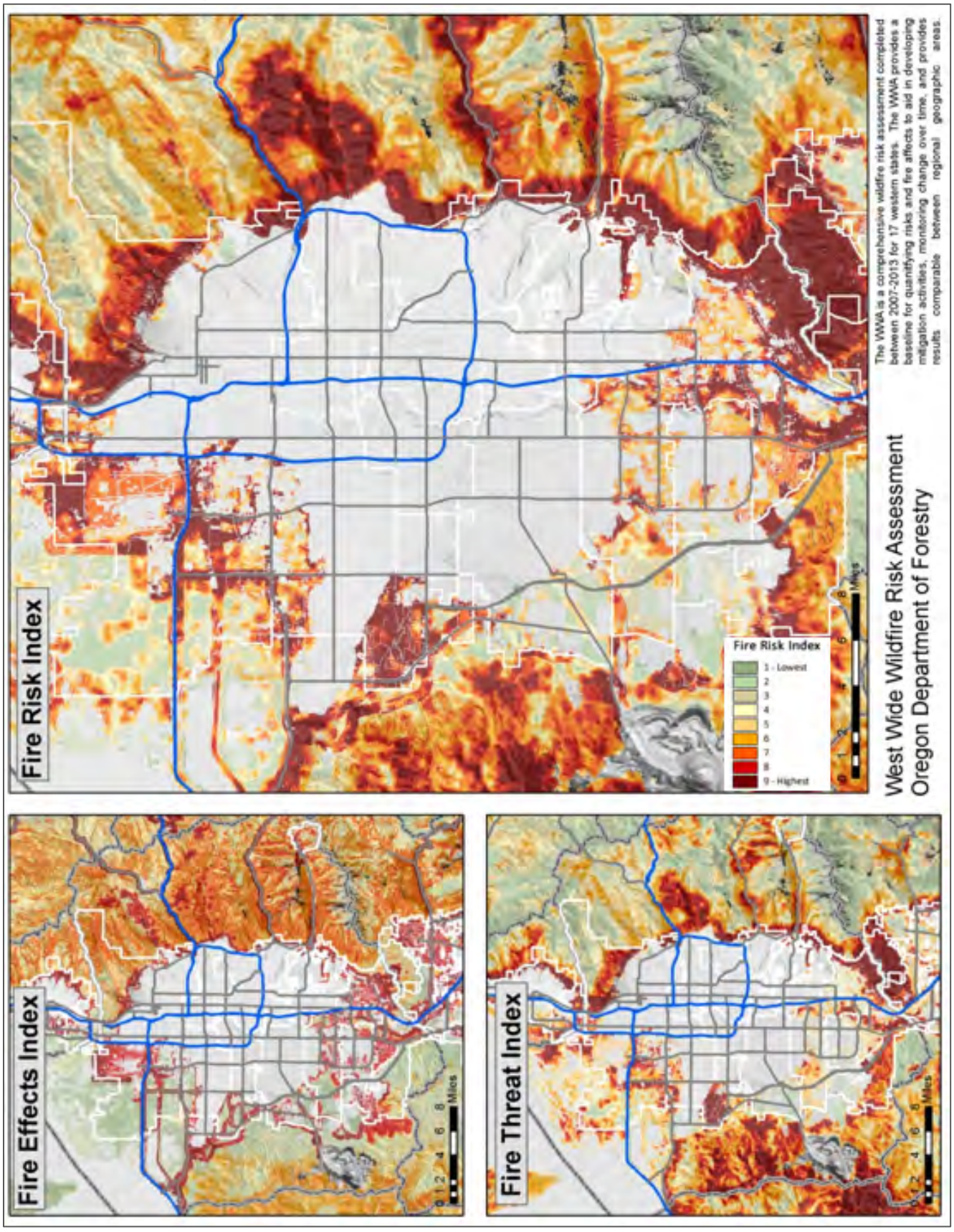
The Fire Threat Index (FTI) is a mathematical calculation to estimate the probability of an acre igniting and the expected final fire size.

The Fire Risk Index (FRI) is determined by the Fire Effects Index multiplied by the Fire Threat Index. This combines the probability of an acre burning with the expected effects if a fire occurs to reflects the possibility of suffering loss. This yields a measure of overall wildfire risk. The FRI can be used to identify areas where mitigation options may be of value, allow agencies to work together and better define priorities, develop a refined analysis of a complex landscape and fire situations using GIS, and increase communication with local residents to address community priorities and needs.

Table: WWA Wildfire Risk Assessment Process



Map: Salt Lake County, Fire Effects, Threat, and Risk Indices



Wildland Development Areas (WDA) indicates where people live in wildland areas that are threatened by fire from wildland fuels. WDA also reflects housing density depicting where people live in the wildland. The analysis process derives the number of house per square kilometer but is presented as “houses per acre” to aid in interpretation of the data.

Output values are grouped into nine classes based on their distribution across burnable acres. The breakpoints between classes use a consistent target cumulative percentile value. By design the categories were developed to display the highest rated 14.5% of the cells in categories 6-9 so the user will truly locate the differences within these highly rated cells. The class values represent a West Wide distribution of acres.

Table: Salt Lake County Acres Per Wildfire Risk Class

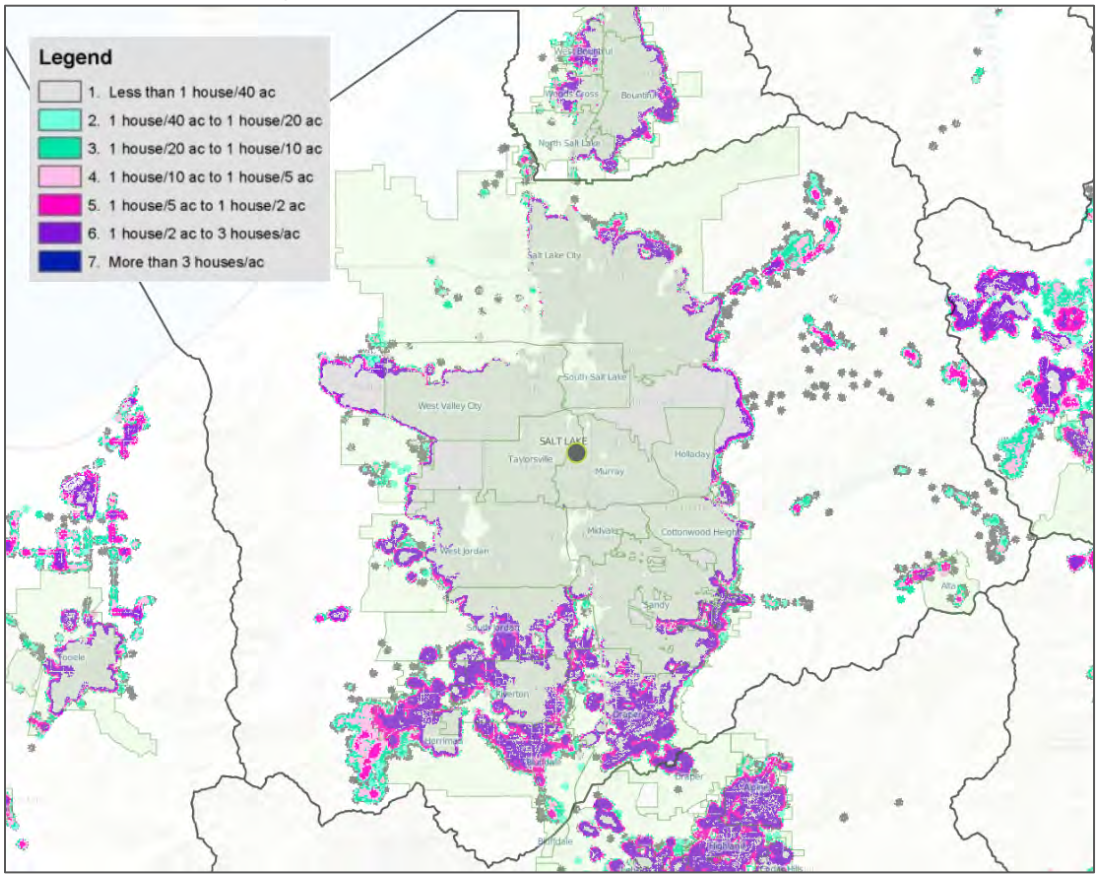
	1	2	3	4	5	6	7	8	9	Total	Ave.
FRI	11,796	32,623	14,453	26,843	37,571	43,154	41,988	35,263	63,719	307,385	6
FTI	22,208	40,671	13,257	23,243	38,992	49,997	36,924	30,857	51,235	307,385	6
FEI	33,172	58,237	11,032	10,588	38,838	30,976	51,829	42,984	29,730	307,385	5

Table: Salt Lake County, acres per risk class in each Wildland Development Area class

WDA Class	WDA 1	WDA 2	WDA 3	WDA 4	WDA 5	WDA 6	WDA 7	Total WDA	Avg. WDA
Acres	14,401	5,013	5,318	6,518	9,364	18,910	36	59,622	4

(307,385 total acres wildland, 209,120 non-wildland acres)

Map: Salt Lake County Wildland Development Areas

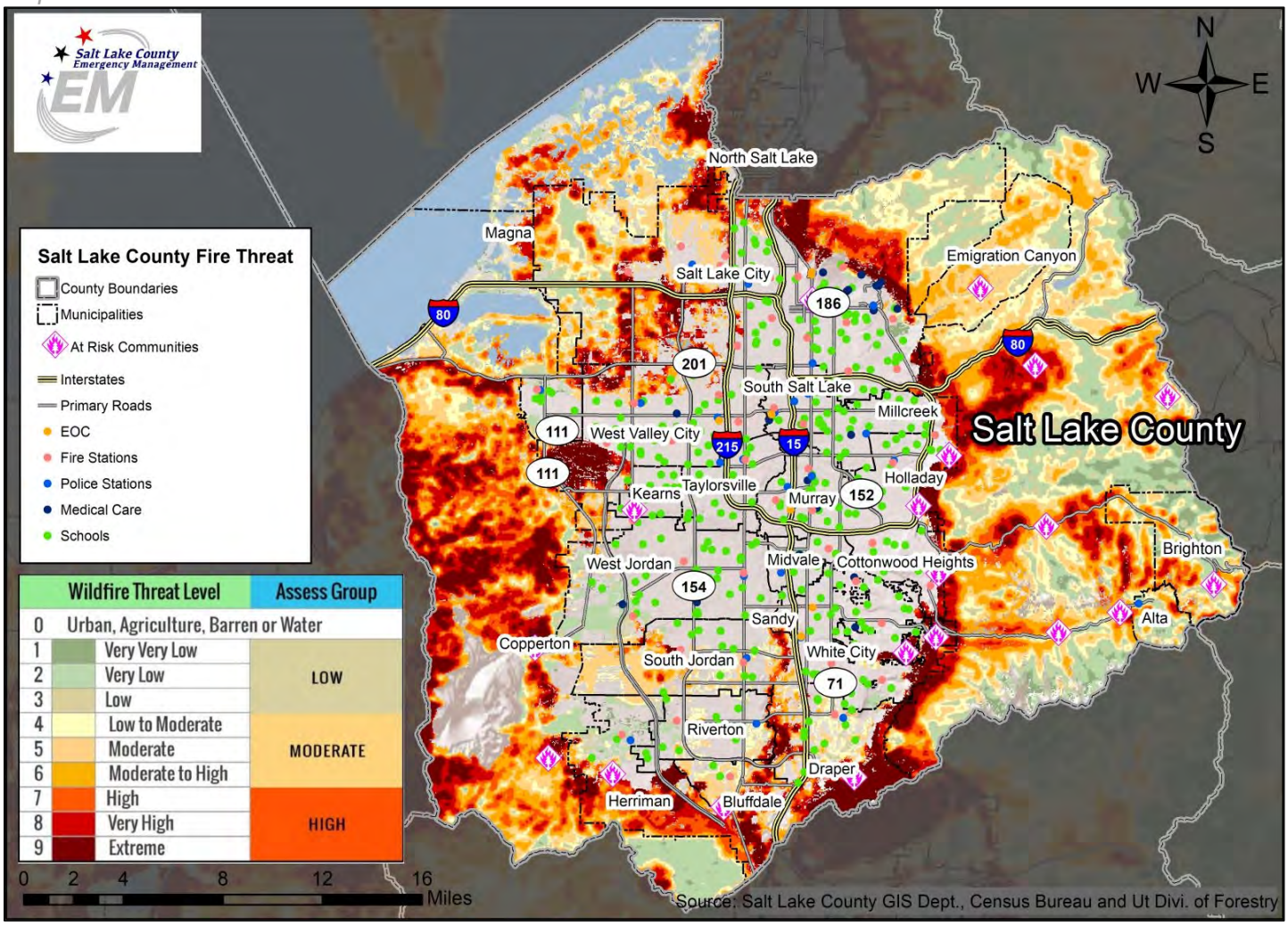


The table below estimates infrastructure vulnerable to wildland fire in Salt Lake County. Provided are the number of units or total length of infrastructure vulnerable and the estimated replacement costs as provided by HAZUS-MH lost estimation software.

Table: Infrastructure Vulnerable to Wildland Fire, Salt Lake County

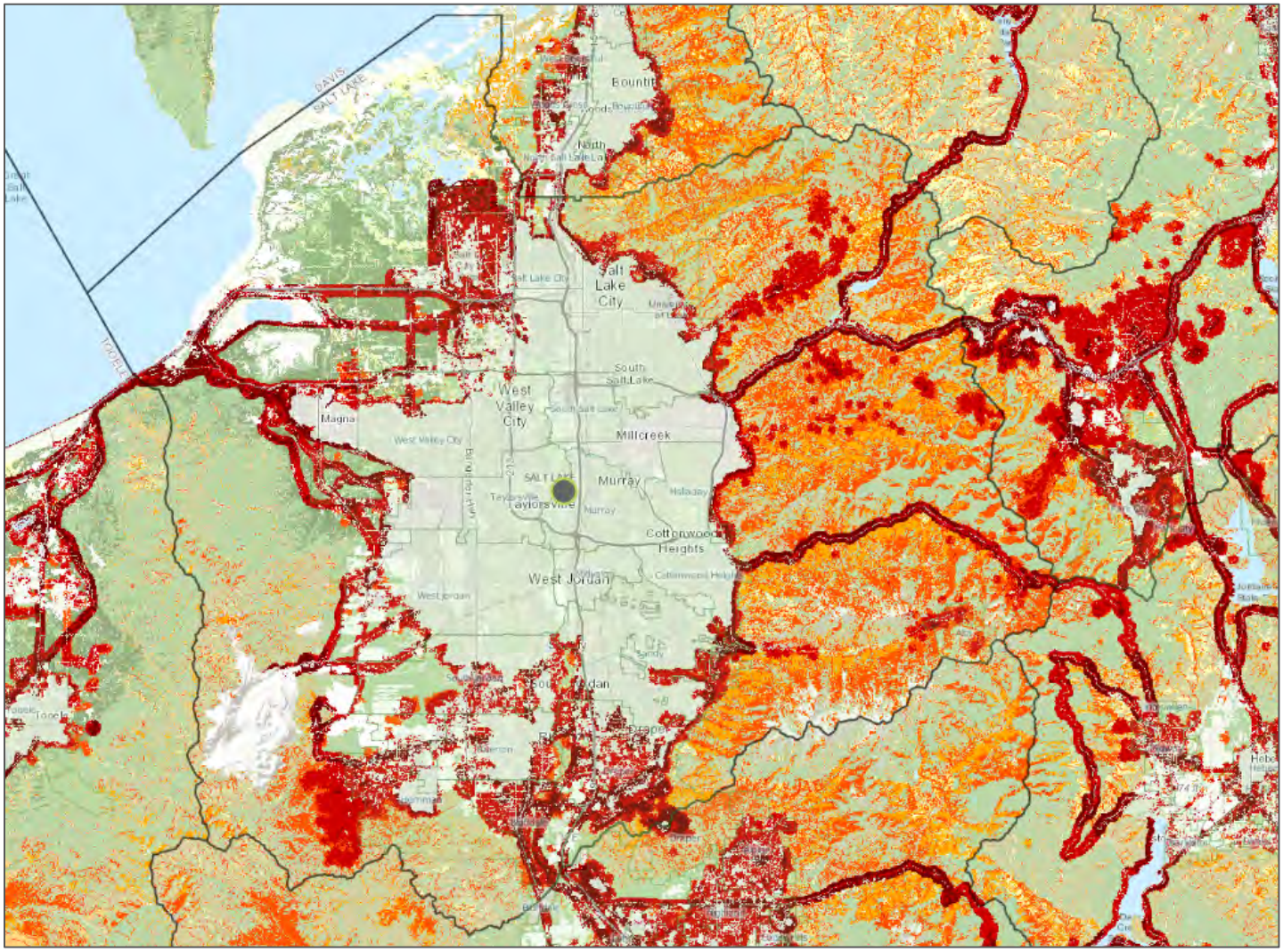
Item	Length (Miles) or Number of Units	Replacement Cost
Highways/Interstates	366.71 miles	$1,991,590,683
Highway Bridges	608 bridges	$1,298,659,176
Railway Segments	179.70 miles	$206,434,364
Railway Bridges	17 bridges	$2,275,560
Water Distribution Lines	N/A	N/A
Gas Lines	N/A	N/A
Sewer Lines	N/A	N/A
Total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

Map: Wildfire Threat and Critical Facilities



The Aggregate Value Impacts shown in the image below are defined by the Value Impacts Rating (VIR) from the WWA. The VIR is a collective value that represents adverse impacts by a wildfire based on the impacts to all of the five defined Values Impacted: Wildland Development Areas (WUI), Forest Assets, Riparian Assets, Drinking Water Importance Areas, and Infrastructure. The darker the color, the more negatively impacted the area is projected to be.

Map: Salt Lake County Wildfire Aggregate Value Impacts



Other Hazards of Interest

As previously mentioned, other hazards of interest were identified as having some potential to impact the planning area, but at a much lower risk level. These hazards included:

- Civil Disturbance
- Cyber Attack
- Hazardous Materials Incident (Transportation and Fixed Facility)
- Terrorism (Including Active Shooter Events)

Civil Disturbance

Definition

Civil disturbance or disorder is a wide-ranging phenomenon that encompasses any incident involving large groupings of individuals participating in activities that disrupt public order and put the safety of the public, businesses, or critical infrastructure at risk. This can include rioting, looting, and violent demonstrations.

Civil disorder can be a spontaneous impact of a triggering event such as the looting seen following disasters (Hurricane Katrina) or can be a specific hazard unrelated to any other hazard (WTO riots). It can arise from peaceful events, gatherings, or demonstrations or can be pre-planned and intentional. Ultimately, civil disturbances are rooted in highly complex social, economic, and political interactions.

The right of public assembly is protected by the First Amendment of the United States Constitution; accordingly, emergency managers must be careful to protect the rights of their citizenry. Disregard or perceived disregard for this right will be used by individuals participating in civil disorder to gain sympathy for their cause. Taking this into consideration, the most effective method to diminish politically motivated civil disorder is to stop it before it occurs. This involves significant planning by emergency managers and robust intelligence from law enforcement entities. Once a civil disorder has occurred, an assortment of riot quelling non-lethal weapons are available to responders. Finally, to protect the safety of the public, first responders, and other protesters, various options for lethal force can be used as a last resort.

Civil Disturbance During Disasters

Civil disorder during disasters often occurs in the time during or immediately after a disaster. This type of civil disorder primarily manifests itself in the form of looting. Other forms of types of civil disorder such as rioting are extremely rare following a disaster.

It is argued that the cause of civil disorder during disasters results from many types of motivating factors. One factor is the chaos resulting from a disaster alters the environment and the resulting social norms allowing for the rationalization of acts previously considered contemptible. This change in behavior coupled with a displaced or overtaxed police force allows civil disorder to grow during or after disasters. Another factor that may result in civil disorder during disasters is the lack of or the fear of the lack of basic human supplies. Disasters often disrupt a community ability to provide food, clothing, and potable water for its citizenry. Fearing for survival, a populace may begin to loot for these basic necessities. Lastly, it has been argued that the genesis of civil disorder during disasters stems from social inequalities. There is a strong correlation between lower socio-economic status and crime. There is evidence to suggest that during and immediately following disasters these conditions are exacerbated resulting in higher crime rates, specifically looting.

All this considered, differing opinions exists of the frequency of looting during disasters. Some argue that the occurrence of widespread looting is a misconception and that perceptions are influenced by misinterpreting behavior, misunderstandings over the ownership of property, exaggerating claims of looting, and sensational media coverage. In addition, it is widely observed that pro-social behaviors such as citizens volunteering to help and feed one another far outweigh anti-social behavior such as looting. Nonetheless, looting does exist in many disasters to some degree. Its origins are rooted in social issues but are probably influenced by a combination of the above factors.

Due to the resulting impacts of a disaster, the affected populace is already under duress; therefore, responders and emergency managers must take appropriate caution when responding to these events. Shifting search and rescue activities to trained strike teams may free up enough police to quell looting. Setting up disaster recovery operations as quickly and efficiently as possible will provide residents assistance in maintaining basic life needs. Finally, strong public information campaigns will help to inform citizenry and quell fears.

Politically Motivation Civil Disorder

Politically motivated civil disorder results when a large group of individuals disturb public order to affect political or social change. This can occur in a pre-planned fashion, in response to a significant social event, or spontaneously at large crowd gatherings. This type of civil disorder can manifest itself in rioting, looting, or unauthorized gatherings and the disrupting of the public order.

Politically motivated civil disorder can happen for a number of reasons. Some of these reasons are to affect change in socio-economic inequalities, to change existing laws, to take advantage of a lawless situation, or can be anarchist in nature. This type of civil disorder can occur but is not limited to the following scenarios: peaceful marches and parades, pre-planned summit and major political events, and large gatherings at concerts and sport arenas.

Often in politically motivated civil disorder, initial targets are symbolic acts of defiance against what the participants see as institutions upholding the societal norms they wish to change. This includes destructive behaviors towards police forces and their equipment, firefighters and their equipment, and other symbols of law and order. This destructive behavior often morphs to crimes of opportunity such as looting and theft. Finally, aggression toward the public and peacekeepers can take place.

In recent years, politically motivated civil disorder and those that participate in it have become increasingly organized. These individuals often attach their cause to otherwise innocuous or peaceful demonstrations to take advantage of a police force strained with other responsibilities. Anarchist groups such as the Black Bloc have incorporated guerilla tactics into their operations such as hiding their identity and using misdirection on police forces to have the greatest opportunity to inflict damage. Another tactic of these groups is to incite violence in the larger crowd. Exploiting already existing tensions on a variety of issues, such as hunger, poor employment opportunities, inadequate community services, poor housing, and labor issues can elevate tensions within a large group. When tensions are high, a seemingly minor incident, rumor, or act of injustice can ignite a crowd to riot and act violently.

Civil Disturbance Potential in Salt Lake County

According to the Southern Poverty Law Center, as of 2018, there were 9 hate groups being tracked in Utah, including 2 with significant presences in Salt Lake City. These two groups are the Kingston Group and Identity Evropa. Although civil disturbances could theoretically arise from any contentious situation or gathering of predisposed people, it is important for the County to remain aware of groups with the potential to spark these events.

Historical Events and Future Probability

Although not extremely likely in any particular year, it is certainly possible that civil disturbances and riots of significant magnitude could occur within the County. In one example that took place in February 2016, there was a civil disturbance that arose as a result of an altercation between police and a teenage male, which resulted in the shooting of the teen. A crowd soon gathered and began to throw rocks and yell obscenities at police forces, requiring the further arrest of four people who failed to obey commands to evacuate. In another example that took place in Salt Lake City in 2002, unruly Olympic celebrations saw a crowd attempt to force its way into a beer tent and evade security. The situation escalated and required 75 to 100 police in full riot gear to regain control of the area. At least 30 people were arrested.

Vulnerability Analysis for Civil Disorder/Riot Hazard

Although civil disorder poses a threat to the public on its own, the many hazard impacts associated with civil disorder also pose a threat to the safety of the public.

Impact to Salt Lake County Residents

There are many ways that civil disorder events can impact County residents. Individuals engaging in civil disruption will often attach themselves to unrelated protests as a means of getting their message out and as a diversion for police. Unfortunately, residents of the county who are peaceful protesters could potentially be trapped in the chaos that ensues. With these types of events, injuries and fatalities are a possibility.

Impact to Essential Facilities and Other Property

Essential facilities may be impacted if they are near or the target of the civil disorder/riot. Businesses are often the focus of civil disruption as individuals will target these establishments for looting and vandalism. Also, in scenarios where supplies are limited, these businesses are often looted for their goods. Any building/edifice where the riot or disorder is taking place may be vulnerable to damages.

Impact to Critical Infrastructure

This hazard typically does not damage infrastructure, but large groups can block traffic (either because there are so many people at the gathering or as a protesting tactic).

Impact to Operations

First responders are at particular risk of civil disruption. First responders are most likely the first group of individuals on the scene as civil disruption occurs. This puts them at direct risk of injury during a disruption. Additionally, responders are viewed as part of the authority the disruption is protesting against and therefore, they could become targets. The nature of civil disturbances is such that local emergency response services are often overwhelmed.

Impact to Environment

This hazard typically does not typically directly impact the environment, except in the unlikely event that hazardous materials were to be intentionally released.

Cyber Attack

A cyberattack is an effort by hackers to gain access to an electronic network or system. Cyberattacks happen all day, every day, around the world. Major targets typically include governments, banks, and businesses, but any online network can be attacked.

Advancements in technology have increased the productivity of our nation and made daily operations and markets reliant on cyber systems. As a result, the United States has become, and will increasingly continue to be, vulnerable to non-traditional attacks including cyberattacks on information and operations. Cyberspace is the nervous system for all critical infrastructures and is composed of hundreds of thousands of interconnected computers, servers, routers, switches, and fiber optic cables that allow our critical infrastructures to work. Studies performed by the Government Accounting Office and the Computer Security Institute found that the number of cyber security threats to both public and private sectors are on the rise. The aggressors range from nation-states to unorganized groups or individuals. According to the Salt Lake Tribune, around 2010, Utah government computer systems faced 25,000 to 30,000 attempted cyberattacks every day. At the time, Utah Public Safety Commissioner Keith Squires thought that was massive. "But [by only 2014] we have had spikes of over 300 million attacks [each day] against the state databases": a 10,000-fold increase.

The attacks on computer systems can come in the form of viruses, Trojans, worms, spoofs, or hoaxes from virtually anywhere in the world. Computer viruses, ranging from devastating to simply annoying, are sent out daily by organizations and individual hackers, and intermittently by people who fail to protect their computer software.

Previous Occurrences for Cyberattack Hazard

Cyberattacks occur regularly in Utah (and Salt Lake County) but are not typically reported in a central database. A cursory list of cyberattacks on the U.S. over the last few decades can be found at risidata.com. Examples include:

- In May, 2019, A denial of service attack, which involves overwhelming computer systems with information in a bid to take them down, successfully interrupted electrical systems in Salt Lake County, according to the Department of Energy.
- In November, 2015, a distributed denial of services attack targeted the Salt Lake City School District, disrupting websites and grading systems.

Future Probability for Cyberattack Hazard

This hazard will likely continue to occur with moderate frequency because significant occurrences of this hazard have rarely occurred (even though isolated or low impact events may occur with regularity). As society becomes increasingly dependent on technology, the threat and likelihood of cyber-attacks will only increase.

Location for Cyberattack Hazard

Cyberattacks occur virtually. They can originate from anywhere in the world and can target anywhere in the world.

Hazard Extent for Cyberattack

At minimum, cyberattacks can target a single individual's information or cause the physical manipulation of items connected to the network. In major cyberattacks, information can be stolen from millions of people.

Vulnerability to Cyberattack Hazard

All existing and future assets/infrastructure, are unlikely to receive direct damages. However, the systems and technologies that are integrated within these assets will undoubtedly be affected, especially as technology becomes more advanced and automated. Any resident of Salt Lake County that is connected to the internet is vulnerable to cyberattacks and identify theft. These incidents have long been a growing trend along with the increasing adoption of technology. Victims of this hazard are likely to experience substantial monetary loss or harassment. Any disruption to Internet service or critical infrastructure information systems could potentially threaten lives, property, the economy, and national security. Any essential facility connected to a network is at risk for a cyberattack. For example, individuals and businesses are reliant on information systems and the Internet for daily tasks; without access to these systems, there could be major financial losses. Furthermore, delivery systems including water, electricity, even things such as groceries rely on information systems to coordinate and complete the delivery. While sabotage to computer systems normally would not lead to harm to health and safety, it is possible. As technology becomes more integrated into society, the more access hackers will have to sensitive systems. Integration of systems (such as electrical grids, air traffic control centers, traffic lights, etc) can leave these systems vulnerable to attack. If these systems are compromised, it is possible that people may be injured or killed. Cyberattacks carried out on public infrastructure can directly impact the County's ability to operate essential facilities and provide services. Forms of sabotage to computer systems include the introduction of viruses, malware or spyware that can cripple a computer network or steal private and public information. Emergency services, such as 911 dispatch would have difficulties because most phone lines work via the Internet. Medical response and care is reliant on electricity, water and information systems and the Internet to access medical records. If the Internet was not available, many information systems would be useless and operations for many of the critical infrastructure sectors may stop altogether, causing major problems for both the public and private sector.

Hazardous Materials Incident (Transportation and Fixed Facility)

Definition

Hazardous Material (Hazmat) Incident – Fixed Site is defined as an uncontrolled release of a hazardous material originating from a building, structure or fixed equipment which is capable of posing a risk to life, health, safety, property or the environment.

Hazardous Material (Hazmat) Incident – Transportation is defined as an uncontrolled release of a hazardous material during transport which is capable of posing a risk to life, health, safety, property or the environment.

Historical Events and Future Occurrences

As can be seen in the table below, the United States Coast Guard National Response Center reported receiving an average of about 10 calls per year about fixed facility hazmat releases in Salt Lake County in recent years. Although many hazmat incidents occur at industrial facilities, this is not always the case. Many transportation related hazmat incidents also occur, with a majority occurring during the loading or unloading phases of the transportation. According to data from the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Office of Hazardous Material Safety (PHMSA), there have been 332 recorded instances of transportation related hazardous materials releases in Utah from 2009 to 2019. This averages to about 33 transportation hazmat incidents per year. Both of these averages can be reasonably expected to continue, going forward.

Table: Reported Fixed Site Hazmat Releases in Salt Lake County

Year	Number of Reports Received
2014	12
2015	16
2016	8
2017	5
2018	11
Source: U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil, Standard Query Report for Salt Lake County, Fixed Incident Commons, 2014 - 2018	

From 2014-2018 approximately 1,555 reported hazardous materials incidents in the State of Utah occurred, according to the U.S. DOT's Pipeline and Hazardous Materials Safety Administration. The following table shows the year (2014-2018), number of incidents, and the State's total damages.

Table: Reports of Hazardous Materials Incidents in the State of Utah

Year	Number of Incidents	Damage
2014	261	$532,102
2015	279	$1,153,997
2016	312	$407,253
2017	347	$434,613
2018	356	$1,221,687
Total	**1,555**	**$3,749,652**

Source: http://www.phmsa.dot.gov

Vulnerability & Potential Impact/Consequences

Area Impacted

Besides fixed facility locations, rail lines, major roadways, and shipping centers also are the sites of potential hazmat incident risk to the County. Although large-scale, off-site impacts are not common with hazmat transportation incidents, they are certainly possible within the County. Off-site impacts can include evacuation, closure of roadways and environmental contamination. In Salt Lake County, hazmat incidents have rarely, if ever, required an evacuation.

Economic Impact

The economic impact due to this hazard can be highly variable, especially when including the costs of environmental remediation. According to the U.S. EPA Hazmat Response Team, costs for responding to a hazmat incident can range from $1,000-$100,000. Costs to the public can include response efforts, commuter delays and damage to transportation infrastructure. Some property damage from this type of event may be expected, especially if the release results in a fire or explosion. Additional impact in the form of lost business revenue, can result if the incident causes a business to close.

Terrorism

Definition

For the purposes of this Plan, terrorism can be thought of an intentional, unlawful use of force, violence or subversion against persons or property to eliminate, harm, intimidate, or coerce a government, the civilian population, or any segment thereof, in furtherance of political, social, or religious objectives. For this Plan, this hazard definition will include active shooter situations, which may be either randomly or intentionally directed and could impact significant numbers of people.

Geographic Location for Terrorism Hazard

Terrorism typically targets a specific location – in many active shooter situations, the setting is often a commercial, governmental, educational, or religious institution. Other terrorist events may target major infrastructure, in accordance with the perpetrator's specific end goal However, terrorists can also target certain population groups, such as minorities. Residential areas are less likely to be directly targeted.

Hazard Extent for Terrorism

Terrorist events typically, but not always, aim to impact large numbers of people. Depending on a number of factors including terrorist intent, setting, victim response, and response time from law enforcement, the amount of damage incurred or casualties actually inflicted can vary widely. Additionally, those who are not directly impacted by the event may still be psychologically impacted through fear, concern for safety, and reduced activity. Therefore, the impact of a terrorist event in Salt Lake County could potentially have relatively minimal impact, or indirectly effect every resident of the County.

Historical Events

The most recognized forms of terrorism include assassination, bombings and extortion. These acts are often identified with particular groups or organizations. The Middle East and portions of Europe, South America and Asia have been greatly impacted for many years by acts of terrorism and sabotage. In more recent years, the United States has been victim to acts of terrorism.

According to the Global Terrorism Database, there have been 7 recorded cases of terrorism in Salt Lake City, resulting in 2 fatalities and 1 injury. These events can be seen in the image below.

DATE	COUNTRY	CITY	PERPETRATOR GROUP	FATALITIES	INJURED	TARGET TYPE
2010-06-05	United States	Salt Lake City	Animal Liberation Front (ALF)	0	0	Business
1995-06-10	United States	Salt Lake City	Animal Liberation Front (ALF) (suspected)	0	0	Business
1987-02-20	United States	Salt Lake City	Anti-Technology extremists	0	1	Business
1981-10-08	United States	Salt Lake City	Anti-Technology extremists	0	0	Educational Institution
1980-08-20	United States	Salt Lake City	White supremacists/nationalists	2	1	Private Citizens & Property
1975-09-05	United States	Salt Lake City	Weather Underground, Weathermen	0	0	Business
1970-05-13	United States	Salt Lake City	Left-Wing Militants	0	0	Military

Source: Global Terrorism Database

Probability for Terrorism Hazard

While this hazard has not happened frequently and is not highly probable in any particular year, the possibility of significant future terrorism incidents cannot be discounted. As a low probability, high consequence hazard, terrorism prevention and mitigation should remain a priority for all participating jurisdictions. Historically, these incidents have been isolated or low impact events and the hazard's overall impact to both the County and participating jurisdictions has been minor (relatively).

Vulnerability & Potential Impact/Consequences

Impact to Salt Lake County Residents

Due the tragic events of September 11, 2001, and the rise of active shooter events in recent years, no citizen of the United States is unaware of the enormous potential impacts of terrorist acts to life and property. The emotional impacts: fear, dread, anger, outrage, etc., serve to compound the enormous physical, economic, and social damage. The continuing terrorist threat itself has a profound impact on many aspects of everyday life.

Impact to Essential Facilities, Critical Infrastructure, and Other Property

As previously stated, terrorists may target essential facilities to disrupt normal life for Salt Lake County residents. Airports, places of worship, communication and transit facilities, waterways, and commercial, industrial, and governmental buildings are all at a higher risk of being targeted. Beyond firearms, past incidents in the nation have demonstrated that fires and bombs have also often been utilized to incite terror. These incidents created damage to the intended facility/location. As stated previously, high profile locations are likely to be targeted as opposed to residential areas. Terrorist acts carried out on public infrastructure can directly impact the County's ability to operate essential facilities and provide services.

Impact to Operations

Law enforcement officials would likely be required to respond swiftly and with a large deployment to deal with a terrorist incident. If such an attack targets a major building or infrastructure, many other first responders may be needed to fight fires or search for survivors trapped in debris. Many law enforcement officials may put themselves in harm's way and potentially suffer injury or death. In addition, medical personnel would be needed to respond to the potentially large number of victims in need of assistance. The full impact to operations would likely be significant but depend upon the specific location and intention of the terrorist attack.

Impact to Environment

This hazard does not typically impact the environment. Exceptions include setting of wildfires, intentional hazardous materials releases, or destroying a dam. All of these scenarios would likely result in significant damage to the environment as well as loss of property and human life.

In a broad based analysis, the following state assets have been identified as potentially vulnerable to terrorism:

- Water: such as lakes and reservoirs
- Dams (federal, state and privately owned)
- Canals, pipelines, and levees
- Highways, airports, public roads, and bridges
- Agriculture: farms
- Finance: commercial banks; credit unions
- Oil and Natural Gas; hazardous liquid pipelines, refineries and terminal facilities
- Electrical Power: private and local power plans; and
- Chemical “high risk” facilities

Table: Assessing Terrorism Vulnerability

Hazard	Application Mode	Hazard Duration	Extent of Effects: Static/Dynamic	Mitigating and Exacerbating Conditions
Conventional Bomb	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile	Instantaneous; additional secondary devices may be used lengthening the time duration of the hazard until the attack site is determined to be clear	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Energy decreases logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc can provide protection by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to target; lack of barriers/shielding poor construction; and ease of concealment of device.
Chemical Agent	Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/containers; or munitions	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists.	Contamination can be carried out of the initial target area by persons, vehicles, water, and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperatures can affect evaporation of aerosols. Ground temperatures affect evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazard. Precipitation can dilute and disperse agents, but disperse vapors can also enlarge target area. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects.

Biological Agent	Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits and moving sprayers.	Biological agents may pose viable threats for hours to years depending on the agent and the conditions in which it exists.	Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infection can also be spread via human or animal vectors.	Altitude of release agent used and the effectiveness with which it is deployed, contamination can above ground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents. Enclosed structures elongate the lifespan of biological agents due to the lack of ultraviolet radiation.
Radiological Agent	Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point of line sources such as munitions, covert deposits and moving sprayers.	Contaminants may remain hazardous for seconds to years depending on isotope used.	Initial effects will be localized to site of attack; depending on meteorological conditions, subsequent behavior or radioactive contaminants may be dynamic.	Duration of exposure, distance from source or radiation, and the amount of shielding between source and target determine exposure to radiation.
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air or at high altitude.	Light/heat flash and blast/shock wave lasts for seconds; nuclear radiation and fallout hazards can persist for years. Electromagnetic pulse from a high-altitude detonation lasts for seconds and affects only unprotected electronic systems.	Initial light, heat, and blast effects of a subsurface, ground or air burst are static and are determined by the device's characteristics and employment; fallout of radioactive contaminants may be dynamic depending on meteorological conditions.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat, and blast energy decreases logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.

Hazards and Future Development

Table: Salt Lake County Population Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	1,094,650	1,249,961	1,361,099	1,470,574	1,594,804	1,693,513	598,863	55%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

Table: Salt Lake County Household Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	379,320	454,929	521,352	579,472	635,143	689,490	310,170	82%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

Table: Salt Lake County Employment Projections

County	2015	2025	2035	2045	2055	2065	Absolute Change 2015 - 2065	Percent Change 2015 - 2065
Salt Lake County	844,316	1,053,362	1,182,092	1,293,225	1,385,240	1,454,567	610,251	72%

Source: Kem C. Gardner Policy Institute 2015-2065 State and County Projections

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.

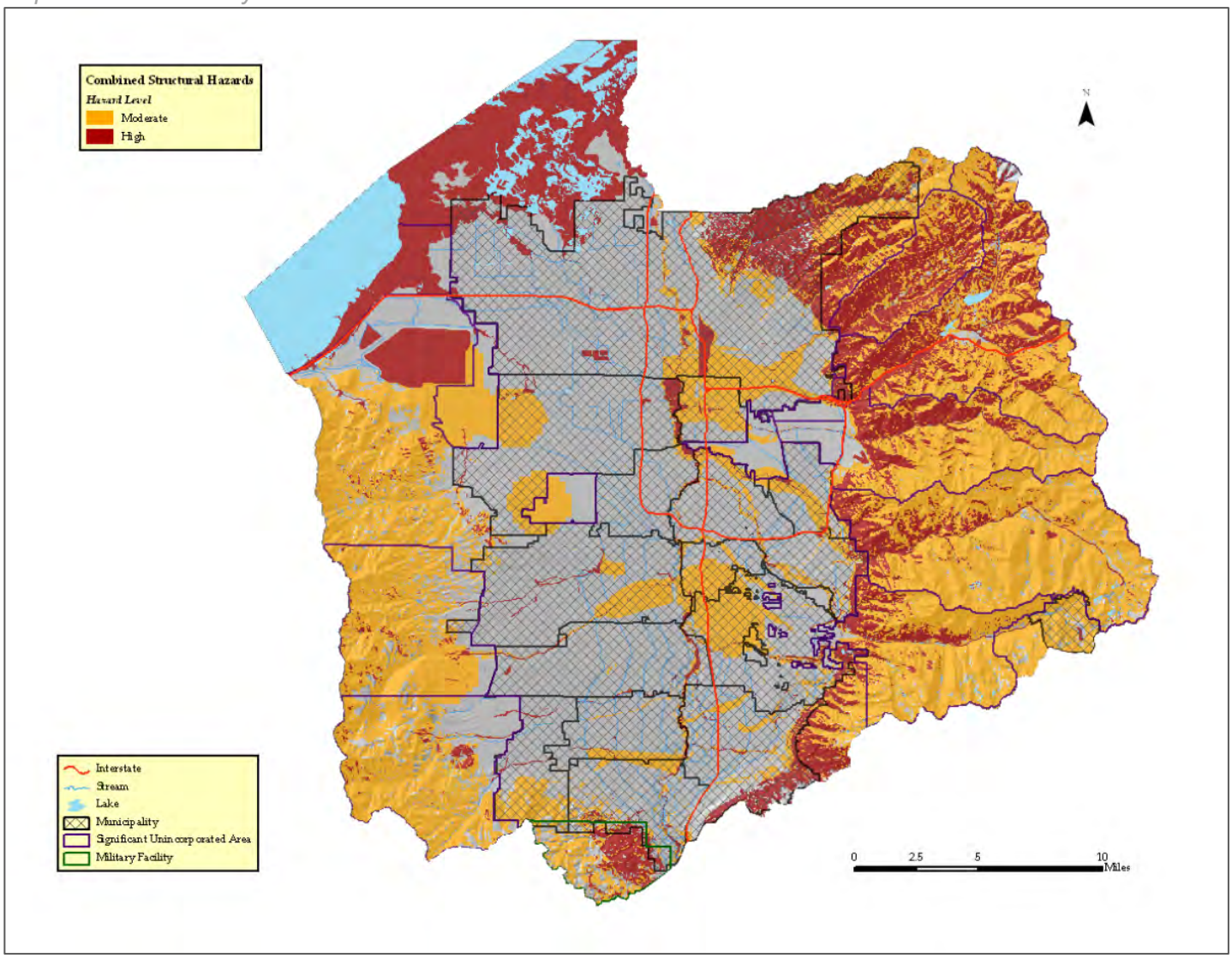
Wildfire risk is most severe in the foothills of the Wasatch Mountain Range. These areas, known as Wildland-Urban Interface (WUI) zones, are most vulnerable due to the amount and types of vegetation and new structures that act as fuel to a burning fire. This threat may be mitigated by encouraging communities 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.

The map below shows the combined risk of nine structural-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 structural-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: Salt Lake County Combined Structural Hazard Risk



Hazard Risk Ranking

A risk ranking for all the hazards was performed that assessed the probability of each hazard's occurrence, as well as its likely impact on people, property, and the economy. This process was a critical component in selecting mitigation actions for this plan update. The ranking is not intended to focus all actions on the single hazard with the highest rank, but to ensure that attention is given to all hazards that have a significant impact. At the same time, the ranking allows communities to identify hazards with little or no impact so that those hazards can be eliminated from consideration for actions. The results of the countywide ranking, presented in the sub-section, Ranking Results, are used in establishing mitigation action and priorities presented in the Mitigation Strategies and Alternatives section of this Plan.

Probability of Occurrence

The probability of occurrence of a hazard is indicated by a probability factor based on the likelihood of annual occurrence:

- High—Significant hazard event is likely to occur annually (Probability Factor = 3)
- Medium—Significant hazard event is likely to occur within 25 years (Probability Factor = 2)
- Low—Significant hazard event is likely to occur within 100 years (Probability Factor = 1)
- Unlikely—There is little to no probability of significant occurrence or the recurrence interval is greater than every 100 years (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the area. The table below summarizes the probability assessment for each hazard of concern for this plan.

Table: Probability of Hazards

Hazard Event	Probability (High, Medium, Low)	Probability Factor (Adjust Probability Factor to Change Scores)
Avalanche	High	3
Dam Failure	Low	1
Drought	Medium	2
Civil Disturbance	Medium	2
Cyber Attack	Medium	2
Earthquake	Medium	2
Flooding	High	3
Hazardous Materials Incident	High	3
Landslide and Slope Failure	Medium	2
Public Health Epidemic/ Pandemic	Medium	2
Radon	High	3
Severe Weather	High	3
Severe Winter Weather	High	3
Terrorism	Low	1
Tornado	Medium	2
Wildfire	High	3

Impact

Hazard impacts were assessed in five categories: impacts on people, impacts on property, impacts on the local economy, and the catastrophic potential of the hazard. Numerical impact factors were assigned as follows:

- **Population Exposed**—Values were assigned based on the percentage of the total **population exposed** to the hazard event. The degree of actual impact on individuals from any hazard event can vary widely, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs.
    - High—30% or more of the population is exposed to a hazard (Impact Factor = 3)
    - Medium—15% to 29% of the population is exposed to a hazard (Impact Factor = 2)
    - Low—14% or less of the population is exposed to the hazard (Impact Factor = 1)
    - No impact—None of the population is exposed to a hazard (Impact Factor = 0)
- **Catastrophic Factor**—The potential that an occurrence of this hazard could be catastrophic.
    - High—High potential that this hazard event could be catastrophic (Impact Factor = 3)
    - Medium—Medium potential that this hazard event could be catastrophic (Impact Factor = 2)
    - Low—Low potential that this hazard event could be catastrophic (Impact Factor = 1)
    - Unlikely—Virtually no potential that this hazard event could be catastrophic (Impact Factor = 0)
- **Property Damages**—Values were assigned based on the expected total ***property damages incurred*** from the hazard event. It is important to note that values represent estimates of the loss from a **major event** of each hazard based on historical data for each event or probabilistic models/studies.
    - High—More than $5,000,000 in property damages is expected from a single major hazard event, or damages are expected to occur to 15% or more of the property value within the jurisdiction (Impact Factor = 3)
    - Medium—More than $500,000, but less than $5,000,000 in property damages is expected from a single major hazard event, or expected damages are expected to more than 5%, but less than 15% of the property value within the jurisdiction (Impact Factor = 2)
    - Low—Less than $500,000 in property damages is expected from a single major hazard event, or less than 5% of the property value within the jurisdiction (Impact Factor = 1)
    - No impact—Little to no property damage is expected from a single major hazard event (Impact Factor = 0)
- **Property Exposed**—Values were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
    - High—25% or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
    - Medium—10% to 24% of the total assessed property value is exposed to a hazard (Impact Factor = 2)
    - Low—9% or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
    - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)

- **Economic Factor**—An estimation of the impact, expressed in terms of dollars, on the local economy is based on a loss of business revenue, worker wages and local tax revenues or on the impact on the local gross domestic product (GDP).
    - High—Where the total economic impact is likely to be greater than $10 million (Impact Factor = 3)
    - Medium—Total economic impact is likely to be greater than $100,000, but less than or equal to $10 million (Impact Factor = 2)
    - Low—Total economic impact is not likely to be greater than $100,000 (Impact Factor = 1)
    - No Impact—Virtually no significant economic impact (Impact Factor = 0)

Each category was assigned a weighting factor to reflect its significance, consistent with those typically used for measuring the benefits of hazard mitigation actions: a weighting factor of 3 for both population exposed to the hazard and its potential for catastrophe; a weighting factor of 2 for property damages probable due to a major hazard event; and a weighting factor of 1 for both property exposed to the hazard and its impact on the economy. The following tables summarize the impacts ratings for each hazard.

Table: Population Exposed to Hazard Event

Hazard Event	Population Exposed (High, Medium, Low)	Impact Factor (Adjust Impact Factor to Change Scores)	Multiplied by Weighting Factor (3)
Avalanche	Low	1	3
Dam Failure	Low	1	3
Drought	High	3	9
Civil Disturbance	Low	1	3
Cyber Attack	High	3	9
Earthquake	High	3	9
Flooding	Medium	2	6
Hazardous Materials Incident	Medium	2	6
Landslide and Slope Failure	Low	1	3
Public Health Epidemic/ Pandemic	High	3	9
Radon	High	3	9
Severe Weather	High	3	9
Severe Winter Weather	High	3	9
Terrorism	Medium	2	6
Tornado	Low	1	3
Wildfire	Low	1	3

Table: Potential for Hazard Event to be Catastrophic

Hazard Event	Potential for Catastrophe (High, Medium, Low)	Impact Factor (Adjust Impact Factor to Change Scores)	Multiplied by Weighting Factor (3)
Avalanche	Unlikely	0	0
Dam Failure	Medium	2	6
Drought	Low	1	3
Civil Disturbance	Unlikely	0	0
Cyber Attack	Medium	2	6
Earthquake	High	3	9
Flooding	Low	1	3
Hazardous Materials Incident	Low	1	3
Landslide and Slope Failure	Unlikely	0	0
Public Health Epidemic/ Pandemic	High	3	9
Radon	Unlikely	0	0
Severe Weather	Unlikely	0	0
Severe Winter Weather	Unlikely	0	0
Terrorism	High	3	9
Tornado	Unlikely	0	0
Wildfire	Low	1	3

Table: Property Damages from Major Hazard Event

Hazard Event	Property Damages from Major Event (High, Medium, Low)	Impact Factor (Adjust Impact Factor to Change Scores)	Multiplied by Weighting Factor (2)
Avalanche	Medium	2	4
Dam Failure	High	3	6
Drought	No Impact	0	0
Civil Disturbance	Medium	2	4
Cyber Attack	No Impact	0	0
Earthquake	High	3	6
Flooding	High	3	6
Hazardous Materials Incident	Low	1	2
Landslide and Slope Failure	Medium	2	4
Public Health Epidemic/ Pandemic	No Impact	0	0
Radon	No Impact	0	0
Severe Weather	Medium	2	4
Severe Winter Weather	Medium	2	4
Terrorism	High	3	6
Tornado	High	3	6
Wildfire	High	3	6

Table: Property Exposed to Hazard Event

Hazard Event	Property Exposed (High, Medium, Low)	Impact Factor (Adjust Impact Factor to Change Scores)	Multiplied by Weighting Factor (1)
Avalanche	Low	1	1
Dam Failure	Low	1	1
Drought	No Impact	0	0
Civil Disturbance	Low	1	1
Cyber Attack	No Impact	0	0
Earthquake	High	3	3
Flooding	Medium	2	2
Hazardous Materials Incident	Low	1	1
Landslide and Slope Failure	Low	1	1
Public Health Epidemic/ Pandemic	No Impact	0	0
Radon	No Impact	0	0
Severe Weather	High	3	3
Severe Winter Weather	High	3	3
Terrorism	Low	1	1
Tornado	Low	1	1
Wildfire	Low	1	1

Table: Impact on Economy from Hazard Event

Hazard Event	Impact on Economy (High, Medium, Low)	Impact Factor (Adjust Impact Factor to Change Scores)	Multiplied by Weighting Factor (1)
Avalanche	Medium	2	2
Dam Failure	Low	1	1
Drought	Low	1	1
Civil Disturbance	Medium	2	2
Cyber Attack	Medium	2	2
Earthquake	High	3	3
Flooding	Medium	2	2
Hazardous Materials Incident	Low	1	1
Landslide and Slope Failure	Medium	2	2
Public Health Epidemic/ Pandemic	High	3	3
Radon	No Impact	0	0
Severe Weather	Low	1	1
Severe Winter Weather	Medium	2	2
Terrorism	High	3	3
Tornado	Medium	2	2
Wildfire	Medium	2	2

Ranking Results

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors as shown in the table below.

Table: Hazard Risk Ranking Analysis

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Earthquake	2	30	60
Flooding	3	19	57
Severe Winter Weather	3	18	54
Severe Weather	3	17	51
Wildfire	3	15	45
Public Health Epidemic/ Pandemic	2	21	42
Hazardous Materials Incident	3	13	39
Cyber Attack	2	17	34
Avalanche	3	10	30
Radon	3	9	27
Drought	2	13	26
Terrorism	1	25	25
Tornado	2	12	24
Landslide and Slope Failure	2	10	20
Civil Disturbance	2	10	20
Dam Failure	1	17	17

Mitigation Strategies

The heart of the mitigation plan is the mitigation strategy, which serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. In this section, mitigation goals and objectives were reevaluated and updated; and mitigation actions/projects were updated/amended, identified, evaluated, and prioritized.

Mitigation Goals

The Mitigation Planning Team has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals, objectives, and mitigation actions were developed based on these tasks. The team held a series of meetings designed to develop mitigation strategies as described further throughout this section. Goals for this mitigation plan are statements that:

- Represent the desires of the entire community
- Include all members of the community both public and private
- Can be accomplished in the future whether near-term or long-term

Goals form the basis for objectives and actions that will be taken and are not dependent on feasibility of implementation. Objectives—which are different than goals—define strategies that will accomplish the goals and are specific and measurable. The following are the goals in a prioritized fashion:

Goal 1
Protect the lives, health, and safety of the citizens of Salt Lake County before, during, and after a disaster.

Goal 2
Protect and eliminate and/or reduce damages and disruptions to critical facilities, structures, and infrastructure during disasters.

Goal 3
Enhance and protect the communication and warning/notification systems in the County.

Goal 4
Promote education and awareness programs, campaigns, and efforts designed to encourage citizens, private and public entities to mitigate and become more resilient to disasters.

Goal 5
Ensure and promote ways to increase government and private sector continuity of services during and after a disaster.

Goal 6
Advocate, support, and promote the continued coordination and integration of disaster planning efforts throughout the County.

Goal 7
Advocate, support, and promote the use of laws and local regulations and ordinances aimed to mitigate hazards and to enhance resiliency.

Mitigation Action Plan

The action plan helps to prioritize mitigation initiatives according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The action plan also provides the framework for how the proposed projects and initiatives will be implemented and administered over the next 5 years. Countywide mitigation actions will be listed using this table in Volume 1: Mitigation Strategies and Alternatives, while actions for each participating jurisdiction will be listed in their respective annexes in Volume 2. Each mitigation project identified during the 2019 plan update for both the County or jurisdiction has been organized based on the following table below, which is meant to guide the updates and progress for each mitigation initiative by helping to implement a programmatic approach.

Table: Mitigation Action Form

Mitigation Action	[Mitigation Action Title]	
Year Initiated		
Applicable Jurisdiction		
Lead Agency/ Organization		
Supporting Agencies/ Organizations		
Applicable Goal(s)		
Potential Funding Source(s)		
Estimated Cost		
Cost Analysis (Low, Medium, High)		
Benefits (loss avoided)		
Benefit Analysis (Low, Medium, High)		
Projected Completion Date (Also list as Short, Long-term, or Ongoing)		
Priority and Level of Importance (Low, Medium, High)		
Hazards Mitigated		
Recommended Mitigation Action/Implementation Plan and Project Description		
Action/ Implementation Plan and Project Description:	[Additional narrative about the project and its implementation]	
Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019		
2020		
2021		
2022		
2023		

Mitigation Strategy/Action Timeline Parameters

While the preference is to provide definitive project completion dates, this is not possible for every mitigation strategy/action. Therefore, the parameters for the timeline (**Projected Completion Date**) are as follows:

- **Short Term**—To be completed in 1 to 5 years
- **Long Term**—To be completed in greater than 5 years
- **Ongoing**—Currently being implemented under existing programs, but without a definite completion date.

Mitigation Strategy/Action Benefit Parameters

Benefit ratings were defined as follows:

- **High**—Project will provide an immediate reduction of risk exposure for life and property.
- **Medium**—Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low**—Long-term benefits of the project are difficult to quantify in the short term

Mitigation Strategy/Action Estimated Cost Parameters

While the preference is to provide definitive costs (dollar figures) for each mitigation strategy/action, this is not possible for every mitigation strategy/action. Therefore, the estimated costs for the mitigation initiatives identified in this Plan were identified as high, medium, or low, using the following ranges:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Mitigation Strategy/Action Prioritization Process

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

The priorities are defined as follows:

- **High Priority**—A project that addressed numerous goals or hazards, has benefits that exceed cost, has funding secured or is an ongoing project, and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that addressed multiple goals and hazards, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM, or other grant programs. The project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will address few or no goals, mitigate the risk of one or few hazards, has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the timeline for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

For many of the strategies identified in this action plan, the partners may seek financial assistance under the HMGP or HMA programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the partners reserve the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

Mitigation Strategies and Alternatives

Plan participants assessed and included a comprehensive range of hazard mitigation strategies/actions, including strategies from FEMA documents, strategies from the 2015 Salt Lake County Hazard Mitigation Plan, and suggestions from participating communities and their respective stakeholders during a series of workshops that took place throughout the County throughout the Fall of 2019.

Each of the participating communities, including Salt Lake County, were invited to participate in a series of workshops in which goals, objectives, and strategies were discussed, identified, updated and prioritized. Each participant in this session was provided with a number of resources to help them identify relevant mitigation strategies. A final draft of the Plan was also presented to all stakeholders to allow them to provide final edits and approval of the strategies and their priority.

One of the benefits of using an online planning system was to ensure neighboring communities had full visibility of each other's mitigation initiatives. This was done to ensure synergies were identified, when applicable, and that mitigation actions in one community would not adversely impact another nearby community.

County-Wide Actions

The heart of the mitigation plan is the mitigation strategy, which serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. In this section, mitigation actions/projects were updated/amended, identified, evaluated, and prioritized. This section is organized as follows:

- New Mitigation Actions - New actions identified during this 2019 update process
- Existing Mitigation Actions - Actions that are still in progress. During the 2019 update, these mitigation actions and projects were modified and/or amended, as needed.
- Completed Mitigation Actions - An archive of all identified and completed projects.

New Mitigation Actions

The following are new mitigation actions created during the 2019 update.

- Develop an Enhanced Emergency Notification Communication System for the County
- Coordinate with Community Development and Community Planning to Integrate Programs
- Enhance Security at Critical Infrastructure Sites
- Enhance Interoperable Radio Communications Systems throughout the County
- Elevate and/or Mitigate Roadways in Low-Lying Areas Prone to Flooding
- Conduct Flood-Specific Impact Studies
- Work with Communities (Newly Incorporated and Metro Townships) not Currently in the NFIP to Adopt the Program
- Develop a County-Wide Program to Purchase Repetitive Loss Properties
- Develop and Implement a Water Conservation Plan
- Provide Information to Flood-Prone Areas about the Need for NFIP Coverage
- Develop and Implement Public Education Programs on Disaster Awareness
- Procure Generators and Transfer Switches for Schools, Public Facilities, and Critical Facilities
- Assess and Prioritize the Burying of Utilities
- Commodity Flow Allocation Study for Rail and Road Transportation
- Move Electrical Panels, Mechanical, Generators above BFE in Facilities in Flood-Prone Areas
- Enhancement and Expansion of Green Space
- EOC Enhancements
- Integrate WebEOC and Other Technological Enhancements
- CERT and Other Related Programs
- Establish Functional and Access Needs Registry Program
- Mutual Aid Agreement Development and/or Updates
- Countywide Green Infrastructure Plan
- Evaluate Capacity for all Local Governments to Provide Emergency Power to Critical Infrastructure
- Implement and/or Sustain Salt Lake County's Disaster Recovery Program
- Retrofit critical facilities and infrastructure to withstand avalanches
- Bring deficient High Hazard dams up to current industry standards
- Increase the size of culverts and bridges
- Remove debris and vegetation from floodway and drainage structures through a systematic maintenance program
- Improve flood resistance through enhancement of wing walls, flood barriers, foundations, etc. at likely flood impact points
- Construct debris basins, flood retention ponds, energy flow dissipaters in an effort to control the flow and release of flood waters

- Construct temporary debris traps and other flood mitigating structures in wildfire-burned areas
- Retrofit critical facilities and infrastructure to withstand earthquakes and other geologic hazards
- To retrofit businesses, residential structures, infrastructure, and public buildings (especially in historic districts) to withstand moderate earthquakes and other geologic hazards
- Using flexible piping when extending water, sewer, or natural gas service
- Installing shutoff valves and emergency connector hoses where water mains cross fault lines
- Encourage all new construction to meet enhanced standards for windloading, snow-loading and other weather-related hazards
- Plan for and maintain adequate road and debris clearing capabilities
- Install pump stations in strategic locations to mitigate flooding
- Collaborate with private canal companies to mitigate drainage, leakage, and capacity issues
- Conduct levee upgrades and certification
- Assess high-pressure pipelines to ensure they meet seismic standards

Mitigation Action	Develop an enhanced emergency notification communication system for the County
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM
Supporting Agencies/ Organizations	Local Emergency Management
Applicable Goal(s)	Goals: 1, 3
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All Hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Coordinate Conservation, Preservation, and Mitigation Actions with Community Development and Community Planning Divisions to Ensure Integration of Programs across all Communities
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD
Supporting Agencies/ Organizations	All participating jurisdictions
Applicable Goal(s)	Goals: 1, 4, 5, 6
Potential Funding Source(s)	General Funds
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Dam/Levee Failure, Drought, Earthquake, Flood, Hazardous Materials Incident (Transportation and Fixed Facility), Wildfire
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Enhance security at critical public safety and technology infrastructure sites. Develop and implement a CIKR Security/Hardening Program
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 3
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Examples of strategic locations that may benefit from security upgrades and hardening include, but are not limited to: Salt Lake County Government Center and Salt Lake County Public Works Yard; key local law enforcement centers and public gathering places; local municipal buildings and courts.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Enhance interoperable radio communications systems throughout the County
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	All jurisdictions within the County
Applicable Goal(s)	Goals: 2, 3, 5
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	High
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Additional efforts are needed to continue improving interoperable communications throughout the County; and to create redundant systems should the primary communication infrastructure fail. Additional efforts include, but are not limited to ensuring enhanced interoperability with key partners, such as public works and across the many participating jurisdictions, agencies, and partners. This is especially important for communities in remote/isolated locations.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Elevating and/or mitigate roadways in low-lying areas prone to overland flooding
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 2, 5
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Conduct Flood-Specific Impact Studies [Eastside Canal and Creek Study]
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 4, 6
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine), Severe Thunderstorm
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Although a number of studies have been completed in the past, a comprehensive Eastside Canal and Creek Study is needed to better understand risks, vulnerabilities, and opportunities for mitigation. The estimated cost is $500,000.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Work with communities (newly incorporated and metro townships) not currently in the NFIP to adopt the program
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD
Supporting Agencies/ Organizations	SLCo EM, Local Emergency Management
Applicable Goal(s)	Goals: 2, 4
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	All cities in the County, with the exception of newly incorporated Brighton and metro townships, currently participate in the NFIP.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Develop a county-wide program to purchase repetitive loss properties and to develop a program to monitor locations of buy-outs. Encourage local jurisdictions to institute a buy-out plan for flood-prone structures or those susceptible to landslide and other geological concerns.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD
Supporting Agencies/ Organizations	SLCo EM, Local Emergency Management
Applicable Goal(s)	Goals: 1, 2, 4, 6
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Riverine), Earthquake, Landslide
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Develop and implement a water conservation plan
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD
Supporting Agencies/ Organizations	SLCo EM, Local Emergency Management, Salt Lake County Emergency Services
Applicable Goal(s)	Goals: 2, 4, 5
Potential Funding Source(s)	General Funds
Estimated Cost	TBD
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	
Benefit Analysis (Low, Medium, High)	Low
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Drought, Extreme Heat Incident
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Provide information to property owners in flood-prone areas and the need for NFIP coverage
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Salt Lake County Public Works & Municipal Services, Local Emergency Management
Supporting Agencies/ Organizations	Salt Lake County Emergency Services: A division of Public Works & Municipal Services
Applicable Goal(s)	Goals: 4
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	
Benefit Analysis (Low, Medium, High)	Low
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Develop and Implement Public Education Programs on Disaster Awareness
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goal 4
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Low
Hazards Mitigated	All Hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Procure generators and transfer switches for schools, public facilities, and critical facilities. This includes generators/redundant backup power at traffic signals in key locations.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 2, 5
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	TBD
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Assess and prioritize the burying of utilities (i.e. especially in areas where new development is occurring)
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	Utility Companies
Applicable Goal(s)	Goals: 1, 2, 3, 5
Potential Funding Source(s)	Private Sector Funds, HMA Grants
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Dam Failure, Flood (Flash and Riverine), High Wind and Tornado, Landslide, Severe Thunderstorm, Severe Winter Storm, Wildfire
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Commodity flow allocation study for rail and road transportation
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	Dept. Regional Transportation, Housing & Economic Development
Applicable Goal(s)	Goals: 2, 5
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Low
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	Low
Hazards Mitigated	Hazardous Materials Incident
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Move electrical panels, mechanical, generators above base flood elevation (BFE) in facilities located in flood-prone areas
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	Salt Lake County Emergency Services
Applicable Goal(s)	Goals: 2, 5
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Enhancement and expansion of green space
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	
Mitigation Action and Project Maintenance	

Year	Status	Comments
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	EOC Enhancements
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County
Lead Agency/ Organization	SLCo EM
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Short Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	The Salt Lake County EOC requires significant enhancements to ensure situational awareness and improved coordination across the valley.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Integrate WebEOC and other technological enhancements and integration throughout the County
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	All jurisdictions throughout the County
Applicable Goal(s)	Goals: 1, 2, 3, 4, 5, 6
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Construct Snow Sheds for Avalanche Mitigation in Little Cottonwood Canyon
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Salt Lake Emergency Management
Supporting Agencies/ Organizations	Utah Department of Transportation
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	HMA, General Funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Avalanche
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Enhance and continue to promote the implementation of the CERT and other related programs
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	Local emergency management
Applicable Goal(s)	Goals: 1, 4, 5
Potential Funding Source(s)	General Funds
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Establish functional and access needs registry or similar program
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	Salt Lake County Dept. of Human Services
Applicable Goal(s)	Goals: 1, 4
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Mutual aid agreement development and/or updates
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	All participating jurisdictions within the County
Applicable Goal(s)	Goals: 5, 6, 7
Potential Funding Source(s)	General Funds
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Specifically, address the need to develop and maintain mutual aid agreements with public works departments within the county.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Develop and implement countywide green infrastructure plan
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD
Supporting Agencies/ Organizations	All participating jurisdictions within the County
Applicable Goal(s)	Goal: 2
Potential Funding Source(s)	General Funds, HMA
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Evaluate capability and capacity for all local governments to provide and sustain emergency power to critical infrastructure resources under their control
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM, Local Emergency Management
Supporting Agencies/ Organizations	All participating jurisdictions within the County
Applicable Goal(s)	Goals: 2, 3, 5, 6
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Continue implementing and improving Salt Lake County's Disaster Recovery Program by developing and updating key plans, strategies, and recovery protocols.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLCo EM
Supporting Agencies/ Organizations	All participating jurisdictions within the County, Salt Lake County Emergency Services (A Division of Public Works & Municipal Services)
Applicable Goal(s)	Goals: 1, 5
Potential Funding Source(s)	General Funds, HSGP Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	All hazards
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Examples include, but are not limited to the following: Many local jurisdictions indicated they do not have an updated Local Disaster Recovery Plan. An additional recognized gap is the need for local Debris Management Plans in the County that meet current regulations and position the County and local jurisdictions to successfully manage recovery efforts following a major disaster.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Retrofit critical facilities and infrastructure to withstand avalanches
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County PW & Municipal Services, MSD, Local Governments, Ski Resorts, Private Owners
Supporting Agencies/ Organizations	SLCo EM, Local Emergency Management
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, General Funds, Resort Revenue, Private Funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Avalanche
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Bring deficient High Hazard dams up to current industry standards
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County, Local Governments
Supporting Agencies/ Organizations	Utah Dam Safety
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	General Funds, National dam safety funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine), Dam Failure
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Examples include, but are not limited to: Mountain Dell Dam (Mountain Dell Dam is 5 miles east of Salt Lake City next to Interstate 80) -- efforts are currently underway by Salt Lake City to mitigate existing leaks. Seismic activity are a threat to all of the dams in the County, and necessary retrofitting may be necessary to decrease the risk of failure due to an earthquake.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Increase the size of culverts and bridges
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Remove debris and vegetation from floodway and drainage structures through a systematic maintenance program
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Specific examples identified with key partners include, but are not limited to: Dredging of the Jordan River and other waterways, as required.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Improve flood resistance through enhancement of wing walls, flood barriers, foundations, etc. at likely flood impact points.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Construct debris basins, flood retention ponds, energy flow dissipaters in an effort to control the flow and release of flood waters.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Specific examples include, but are not limited to: constructing a diversion at Millcreek to a drainage area.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Construct temporary debris traps and other flood mitigating structures in wildfire-burned areas.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	Utah DNR, NRCS, UDOT
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, capital improvement budgets, bonds, state and local funds, Utah DNR, NRCS
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine), Wildfire
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	
Mitigation Action and Project Maintenance	

Year	Status	Comments
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Retrofit critical facilities and infrastructure to withstand earthquakes and other geologic hazards.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Owners of Facilities
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	PDM, HMGP, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	To retrofit businesses, residential structures, infrastructure, and public buildings (especially in historic districts) to withstand moderate earthquakes and other geologic hazards
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Owners of Facilities, Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	PDM, HMGP, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Using flexible piping when extending water, sewer, or natural gas service
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Utility Companies, Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	PDM, HMGP, capital improvement budgets, bonds, state and local funds, utility companies
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Installing shutoff valves and emergency connector hoses where water mains cross fault lines.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Utility Companies, Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	PDM, HMGP, capital improvement budgets, bonds, state and local funds, Utility Companies
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Encourage all new construction to meet enhanced standards for windloading, snow-loading and other weather-related hazards.
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Facility Owners, Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	General Funds, HMA Grants
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Severe Weather
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Plan for and maintain adequate road and debris clearing capabilities
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 5
Potential Funding Source(s)	General Funds, HMA Grants, State Funds, UDOT
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Severe Weather
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Specific examples include, but are not limited to: expanding the capabilities of the County's snow removal fleet.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Install pump stations in strategic locations to mitigate flooding
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	Medium
Cost Analysis (Low, Medium, High)	Medium
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Collaborate with private canal companies to mitigate drainage, leakage, and capacity issues
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD, Canal Districts
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	For certain problem areas in the County, appropriate mitigation solutions may include but are not limited to: installing liner or piping, and/or installing culverts.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Conduct levee upgrades and certification
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	SLC Public Works & Municipal Services, Local Public Works/Engineering Depts., MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2
Potential Funding Source(s)	PDM, HMGP, FMA, NRCS, capital improvement budgets, bonds, state and local funds
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Med, High)	High
Hazards Mitigated	Flood (Flash and Riverine)
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	The levees along the Surplus Canal do not currently meet FEMA levee certification criteria defined in the Code of Federal Regulations (CFR) 65.10 using the current effective FEMA base flood magnitude of 4,500 cfs. Levee upgrades and improvements include, but are not limited to: • Storm drainpipes that penetrate the levees should be provided with closure devices per FEMA standards to prevent river water from flooding land behind levee enclosures. This action should be given a high priority to increase levee performance during a flood event and to facilitate certifying the levees. • In certain locations, channel dredging activities have destabilized the toe of the canal banks, which has also made the reaches of the canal banks unstable. To stabilize the canal banks, it is recommended that the canal banks be modified and that future channel dredging be performed in a manner that will not destabilize the banks. • In certain locations, raising the levees may be necessary • Certain bridges that cross canals may not be high enough to serve as a continuation of the canal levees with freeboard.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Mitigation Action	Assess high-pressure pipelines to ensure they meet seismic standards; Conduct upgrades, as needed
Year Initiated	2019
Applicable Jurisdiction	Salt Lake County and all participating jurisdictions
Lead Agency/ Organization	Utility Companies, Salt Lake County Public Works & Municipal Services, Local Public Works/Engineering Departments, MSD
Supporting Agencies/ Organizations	
Applicable Goal(s)	Goals: 1, 2, 3, 5
Potential Funding Source(s)	Private Sector Funds, HMA Grants
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	High
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Initiated/New Action	
2020		
2021		
2022		
2023		

Existing Mitigation Actions

The following are existing mitigation actions that are still in progress. During the 2019 update, these actions and projects were modified and/or amended, as needed.

- Promote Firewise Initiative and Develop CWPPs within At-Risk Communities
- Promote the Fix the Brick Program
- Help County Jurisdictions Procure FMA Grants
- Assist Emergency Managers in the Design of Pandemic Mitigation Programs
- Assist Emergency Managers in Public Education about Radon Kits

Mitigation Action	Promote Firewise Initiative and Develop Community Wildfire Protection Plans (CWPP) within At-Risk Communities
Year Initiated	2015
Applicable Jurisdiction	Salt Lake County and All Participating Jurisdictions
Lead Agency/ Organization	Salt Lake County UFA
Supporting Agencies/ Organizations	All participating communities within the County
Applicable Goal(s)	Goals: 1, 2, 4, 6
Potential Funding Source(s)	Grants
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Hundreds of thousands to millions of dollars
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Wildfire
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	One thing unique to Utah, is the CWPP ties in with communities becoming Firewise. Salt Lake County has 19 high risk wildland fire communities, and most are within UFA's response area. Salt Lake County is currently working with each community to develop CWPP and work towards Firewise recognition where applicable. Once the CWPP is complete, grants are applied for on their behalf by the SMEs involved and most communities will typically receive a monetary reward to complete the projects identified in the CWPP.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Ongoing	
2020		
2021		
2022		
2023		

Mitigation Action	Promote the Fix the Brick Program throughout the County
Year Initiated	2016
Applicable Jurisdiction	Salt Lake County and All Participating Jurisdictions
Lead Agency/ Organization	Salt Lake County and All Participating Jurisdictions
Supporting Agencies/ Organizations	State of Utah
Applicable Goal(s)	Goal: 1, 2
Potential Funding Source(s)	HMA Grant
Estimated Cost	High
Cost Analysis (Low, Medium, High)	High
Benefits (loss avoided)	Hundreds of thousands to millions of dollars
Benefit Analysis (Low, Medium, High)	High
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Earthquake
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Salt Lake County's large number of non-reinforced brick residences poses a large problem in the event of a major earthquake. SLCo EM will help county jurisdictions present the "Fix the Bricks" program. This program is part of the Salt Lake City and State of Utah effort to mitigate the effects of a large-scale earthquake by minimizing post- earthquake personal injury and requirement for outside assistance.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	Ongoing	Annual applications for pre-disaster mitigation funding to continue this project are likely.
2020		
2021		
2022		
2023		

Mitigation Action	Help County Jurisdictions Procure FMA Grants
Year Initiated	2015
Applicable Jurisdiction	Salt Lake County and All Participating Jurisdictions
Lead Agency/ Organization	SLCo EM
Supporting Agencies/ Organizations	All participating jurisdictions within the County
Applicable Goal(s)	Goals: 1, 2, 4, 6
Potential Funding Source(s)	General Fund
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Hundreds of thousands to millions of dollars
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Medium
Hazards Mitigated	Flood
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	SLCo EM will help County jurisdictions procure grants for flood mitigation assistance through presentation at a special emergency managers' meetings. Sub-committees will be formed as needed to accomplish needed tasks or explore different topics.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	In progress	
2020		
2021		
2022		
2023		

Mitigation Action	Assist Emergency Managers in the Design of Pandemic Mitigation Programs
Year Initiated	2015
Applicable Jurisdiction	Salt Lake County and All Participating Jurisdictions
Lead Agency/ Organization	SLCo EM, Salt Lake County Health Department
Supporting Agencies/ Organizations	All participating jurisdictions within the County
Applicable Goal(s)	Goals: 1, 4, 6
Potential Funding Source(s)	Local Funds
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Long Term
Priority and Level of Importance (Low, Medium, High)	High
Hazards Mitigated	Public Health Epidemic/Pandemic
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	Salt Lake County is the home of both the University of Utah's Medical Facilities and the Intermountain Healthcare's facilities possessing state of the art infectious disease physicians and treatment facilities. SLCo EM will host presentations from these facilities and the County Health Department to the County's emergency managers to assist them in designing their mitigation programs for dealing with pandemics.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	In progress	
2020		
2021		
2022		
2023		

Mitigation Action	Conduct Seminar to Assist Emergency Managers in Public Education about Radon Kits
Year Initiated	2015
Applicable Jurisdiction	Salt Lake County and All Participating Jurisdictions
Lead Agency/ Organization	SLCo EM
Supporting Agencies/ Organizations	Salt Lake County Health Department
Applicable Goal(s)	Goals: 1, 4
Potential Funding Source(s)	General Funds
Estimated Cost	Low
Cost Analysis (Low, Medium, High)	Low
Benefits (loss avoided)	Medium
Benefit Analysis (Low, Medium, High)	Medium
Projected Completion Date (Also list as Short, Long-term, or Ongoing)	Ongoing
Priority and Level of Importance (Low, Medium, High)	Low
Hazards Mitigated	Radon
Recommended Mitigation Action/Implementation Plan and Project Description	
Action/ Implementation Plan and Project Description:	SLCo EM will conduct a half day seminar to help emergency managers educate their citizens in procuring radon testing kits. A presentation from the Salt Lake County Health department will be made.

Mitigation Action and Project Maintenance		
Year	**Status**	**Comments**
2019	In progress	
2020		
2021		
2022		
2023		

NFIP-Specific Mitigation Actions and Implementation

The following mitigation strategies demonstrate Salt Lake County and its participating jurisdictions' continued support and compliance with NFIP requirements, as appropriate.

- Countywide Action—Help County Jurisdictions Procure FMA Grants
- Countywide Action—Elevate and/or Mitigate Roadways in Low-Lying Areas Prone to Flooding
- Countywide Action—Conduct Flood-Specific Impact Studies
- Countywide Action—Work with Communities not Currently in the NFIP to Adopt the Program
- Countywide Action—Develop a County-Wide Program to Purchase Repetitive Loss Properties
- Countywide Action—Provide Information to Flood-Prone Areas about the Need for NFIP Coverage

Other priorities within Salt Lake County related to NFIP participation include: 1) Increased CRS participation throughout the county; 2) Increase in the number of flood insurance policies; 3) Increased number of CFMs throughout the county; 4) Post-flood damage estimate training for county and municipal staff; 5) Acquisition of severe repetitive loss and repetitive loss properties; 6) Higher regulatory standards including higher freeboard, cumulative substantial damage and substantial improvement threshold, and enforcing floodplain regulations in areas of known urban, typically shallow depth, flooding.

NFIP participation, compliance, and status information for each participating jurisdiction can be found in Volume 2 in each of the respective capability assessments.

Completed Mitigation Actions

Because the implementation of this Plan is critical to creating greater community resilience, completion of mitigation actions is an important indicator of implementation and activity in the County. As of the 2019 update of this plan, all mitigation actions at the county level are in new or ongoing phases. Many of the previous actions at the county level were to conduct seminars and trainings for emergency managers. Because those actions did not reflect the new priorities and needs of the county, they were removed.

The 2019 Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan is a living document, however, and will continue to be updated on a 5-year cycle, as Salt Lake County officials recognize the significance of these strategies and how such actions can protect the County. The actions that have been completed at the jurisdictional level, can all be viewed in the annexes found in Volume II.

Participating Jurisdiction Mitigation Actions

The mitigation strategies for each participating jurisdiction can be found in each respective annex in Volume 2 of this plan.

Plan Integration Strategy

Plan integration is the process by which communities look critically at their existing planning framework and align efforts with the goal of building a safer, smarter community. Plan integration involves a two-way exchange of information and incorporation of ideas and concepts between the Salt Lake County Multi-Jurisdictional Multi-Hazard Mitigation Plan and other community plans. Specifically, plan integration involves the incorporation of hazard mitigation principles and actions into community plans and community planning mechanisms.

The following demonstrates Salt Lake County and its participating jurisdictions' continued effort to integrate mitigation into other community plans and efforts:

- Goal 6: Advocate, support, and promote the continued coordination and integration of disaster planning efforts throughout the County.

Although existing county and local plans acknowledge hazards and risks, clear attempts to specifically integrate and reference the 2015 mitigation plan were not well documented. Goal 6 was added to make sure subsequent updates accomplish this important task.

Comprehensive Plan	Yes	No
Land Use	Yes	No
1. Does the future land-use map clearly identify natural hazard areas?	X	
2. Do the land-use policies discourage development or redevelopment within natural hazard areas?	X	
3. Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?	X	
Transportation	Yes	No
1. Does the transportation plan limit access to hazard areas?	X	
2. Is transportation policy used to guide growth to safe locations?	X	
3. Are movement systems designed to function under disaster conditions (e.g., evacuation)?	X	
Environmental Management	Yes	No
1. Are environmental systems that protect development from hazards identified and mapped?	X	
2. Do environmental policies maintain and restore protective ecosystems?	X	
3. Do environmental policies provide incentives to development that is located outside protective ecosystems?	X	
Public Safety	Yes	No
1. Are the goals and policies of the comprehensive plan related to those of the FEMA Local Hazard Mitigation Plan?	X	
2. Is safety explicitly included in the plan's growth and development policies?	X	
3. Does the monitoring and implementation section of the plan cover safe growth objectives?	X	
Zoning Ordinance	Yes	No
1. Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?	X	
2. Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?	X	

Comprehensive Plan	Yes	No
3. Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?	X	
4. Does the ordinance prohibit development within, or filling of, wetlands, floodways, and floodplains?	X	
Subdivision Regulations	Yes	No
1. Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?	X	
2. Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?	X	
3. Do the regulations allow density transfers where hazard areas exist?	X	
Capital Improvement Program and Infrastructure Policies	Yes	No
1. Does the capital improvement program limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?	X	
2. Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?	X	
3. Does the capital improvement program provide funding for hazard mitigation projects identified in the FEMA Mitigation Plan?	X	
Other	Yes	No
1. Do small area or corridor plans recognize the need to avoid or mitigation natural hazards?	X	
2. Does the building code contain provisions to strengthen or elevate construction to withstand hazard forces?	X	
3. Do economic development or redevelopment strategies include provisions for mitigation natural hazards?	X	
4. Is there an adopted evacuation and shelter plan to deal with emergencies from natural hazards?	X	

Plan Implementation and Maintenance

Evaluating, updating, and monitoring this plan are critical to maintaining its value and success in the County's hazard mitigation efforts. A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a five-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

This section details the formal process that will ensure that the Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions' existing plans, policies, and programs. SLCo EM will assume lead responsibility for **implementation** and **monitoring** of this plan maintenance strategy. Although the County will have primary responsibility, plan implementation and **evaluation** will be a shared responsibility among all planning partners and agencies identified as lead agencies in the mitigation action plans. Completion of this strategy is the responsibility of each planning partner. This was conveyed to each planning partner as an expectation at the beginning of the planning process. Many of the mitigation actions developed by the participating jurisdictions include 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.

Incorporation Into Other Planning Mechanism

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The comprehensive plans of participating jurisdictions are considered to be integral parts of this plan. The County and partner municipalities have also planned for the impact of natural hazards through adoption of zoning ordinances. The plan development process provided the County and the municipalities with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans (when applicable) and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

Once the Mitigation Plan is promulgated, participating jurisdictions will be able to include this plan's information in existing programs and plans. These could include the General or Master Plan, Emergency Response or Operations Plans, Municipal Codes, Capital Improvements Plan, or Community Design Guidelines, among others. All municipal planning partners are committed to creating a linkage between this hazard mitigation plan and their jurisdiction-specific plans by identifying a mitigation action as such and giving that action a high priority.

Some action items do not need to be implemented through regulation. Instead, they be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

Maintenance Schedule and Evaluation Process

Periodic monitoring and updates of this Plan are required to ensure that the plan's goals are kept current and that local mitigation strategies are being carried out. This portion of the Plan outlines the procedures for completing revisions and updates. The Plan will also be revised to reflect lessons learned or to address specific hazard incidents arising out of a disaster.

Annual Review Procedures

County jurisdictions will be responsible to annually review their mitigation strategies described in this Plan, as required by the Utah Division of Emergency Management (UDEM), or as situations dictate, such as following a disaster declaration. SLCo EM will regularly monitor the Plan and is responsible to make revisions and updates. This process may include the County organizing a Mitigation Planning committee comprised of individuals from the jurisdictions and organizations responsible to implement the described mitigation strategies.

Progress toward the completion of the strategies will be assessed and adjustments may be made, as needed. If SLCo EM, the participating jurisdictions, or UDEM determines that a modification of the Plan is warranted, an amendment to the Plan may be initiated as described below.

Plan Amendments

The SLCo EM 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, SLCo EM 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 Salt Lake County website www.slcoem.org. The review and comment period for the proposed Plan amendment will last for not less than thirty (30) 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. SLCo EM will review the proposed amendment along with comments received from other parties and submit a recommendation to the SHMO and FEMA within sixty (60) days of the end of the comment period.

In determining whether to recommend approval or denial of a Plan amendment request, the following factors will be considered:

- There are errors or omissions made in the identification of issues or needs during the preparation of the Plan; and/or
- New issues or needs have been identified which were not adequately addressed in the Plan; and/or
- There has been a change in information, data or assumptions from those on which the Plan was based.
- The nature or magnitude of risks has changed.
- There are implementation problems, such as technical, political, legal or coordination issues with other agencies.

Upon receiving the recommendation of SLCo EM, a public hearing will be held. SLCo EM will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, SLCO EM 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.

Five-Year Plan Review

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The planning partnership intends to update the hazard mitigation plan on a five-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the County or participating municipality's comprehensive plan

Typically, the same process that was used to create the original plan will be used to prepare the update. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The partnership governing bodies will adopt their respective portions.

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 Unified Fire Authority and Salt Lake County Emergency Management websites to provide opportunities for public participation and comment. The Plan will also be available for review at the offices of SLCo EM.

SLCo EM has been designated as the lead agency in preparing and submitting the Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan, which includes coverage for all incorporated jurisdictions within Salt Lake County in addition to unincorporated areas. With limited resources, however, it becomes difficult to both identify and to individually contact the entirety of the broad range of potential people and agencies that may stand to benefit from the Plan. This being the case, the following course of action has been established.

STEP 1

SLCo EM will publicly advertise all hearings, requests for input, and meetings directly related to the mitigation planning process. Meetings of the Mitigation Planning Team 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.

STEP 2

The County has established a mailing list of many local agencies and individuals that may have an interest in the 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, SLCo EM 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, SLCo EM will also make initial contact and solicitation for input from each incorporated jurisdiction within the region. All input is voluntary. Staff time and resources may 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.

Overarching Policies

The following policies will guide SLCo EM staff in making access and input to the Salt Lake County Multi-Jurisdictional Hazard Mitigation Plan as open and convenient as possible:

Participation

All citizens of the region are encouraged to participate in the planning process, especially those who may reside within identified hazard areas. SLCO EM will take whatever actions possible to accommodate special needs of individuals including the impaired, non-English speaking, persons of limited mobility, etc.

Access to Meetings

Adequate and timely notification to all area residents will be given as outlined above to all hearings, forums, and meetings.

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 Plan, and/or any other documents prepared for distribution by SLCo EM that may be adopted as part of the Plan by reference. SLCo EM may charge a nominal fee for printing of documents that are longer than three pages.

Technical Assistance

Residents as well as local jurisdictions may request assistance in accessing the program and interpretation of mitigation projects. SLCo EM staff will assist to the extent practical, however, limited staff time and resources may prohibit staff from giving all the assistance requested. SLCo EM will be the sole determiner of the amount of assistance given all requests.

Public Hearings

The County will plan and conduct public hearings according to the following priorities:

- Hearings will be conveniently timed for people who might benefit most from mitigation programs
- Hearings will be accessible to people with disabilities (accommodations must be requested in advance according to previously established policy)
- Hearings will be adequately publicized. Hearings may be held for a number of purposes or functions including: Identification and profile of hazards; developing mitigation strategies; and reviewing Mitigation Plan goals, performance and future Plans.

Future Revisions

Future revisions of the Plan shall include:

- Continuation of the search for more specific mitigation actions
- An analysis of progress of the plan as it is revised.

Plan Adoption

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. This plan will be submitted for a pre-adoption review to the State and FEMA prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted.

After a thorough review, the Salt Lake County Council adopted the plan on <date adopted>. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix D of this volume.

Appendices

Appendix A: Acronyms and Definitions

Abutment (dam) – the valley side against which a dam is constructed.

Acre-Foot – An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Acre-Foot of Water – approximately 326,000 gallons of water, or approximately a football field covered by one foot of water.

Active Faults – An active fault is defined as a fault displaying evidence of displacement along one or more of its traces during Holocene time (about the last 11,000 years).

Aftershocks – earthquakes during the seconds, hours, days to months following a larger earthquake (main shock) in the same general region.

Alluvial Fan – a cone-shaped deposit of stream sediments, generally deposited at the base of a mountain where a stream encounters flatter terrain.

Amplitude (seismic waves) – the maximum height of a wave crest or depth of a trough. Amount the ground moves as a seismic wave passes, as measured from a seismogram.

ATV – All Terrain Vehicle

AQI – Air Quality Index

Asset – An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Avalanche path – the area in which a snow avalanche runs; generally divided into starting zone, track, and runout zone.

Basin and Range Physiographic Province – consists of north-south-trending mountain ranges separated by valleys, bounded by the Rocky Mountains and the Colorado Plateau to the east and the Sierra-Cascade Mountains to the west (includes western Utah).

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the “100-year” or “1-percent-annual-chance” flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin – A basin is the area within which all surface water – whether from rainfall, snowmelt, springs, or other sources – flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Bearing Capacity – the load per unit area, which the ground can safely support without excessive yield.

Bedrock – solid in-place rock sometimes exposed and sometimes concealed beneath the soil.

Benefit – A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis – A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost-effectiveness.

Block Faulting – see normal fault

Building – A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment – A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components – an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

CIP – Capital Improvement Plan

Collapsible Soil (hydrocompaction) – loose, dry, low-density soil that decreases in volume or collapses when saturated for the first time following deposition.

Critical Areas – An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations. These could include: environmentally sensitive areas that include wetlands fish and wildlife habitat conservation areas; geologically hazardous areas; areas with a critical recharging effect on aquifers used for potable water; and frequently flooded areas. Critical areas have measurable characteristics which, when combined, create a value for or potential risk to public health, safety and welfare.

Critical/Essential Facilities – Structures meeting one or more of the following criteria:

- Fire stations, police stations, storage facilities for vehicles/equipment needed after a hazard event, and emergency operation centers.
- Hospitals, nursing homes, and housing which is likely to contain occupants who may not be sufficiently mobile to avoid injury or death as a result of a hazardous event
- Public and private utility facilities, which are vital to maintaining or restoring normal services to, damaged areas after a hazardous event.
- Structures or facilities that produce, store, or use highly flammable, explosive, volatile, toxic and/or water reactive materials

CFR – Code of Federal Regulations

CFS – Cubic feet per second

Community Rating System (CRS) – The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Dam – Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure – Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow – involves the relatively rapid, viscous flow of surficial material that is predominantly coarse grained.

Debris Slide – Debris slides consist of unconsolidated rock, soil, or coarse-grained material that has moved rapidly down slope, mainly along a planar surface. They occur on slopes greater than 65 percent.

DFIRM – Digital Flood Insurance Rate Maps

Disaster Mitigation Act of 2000 (DMA) – The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin – A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought (Agricultural) – lack of water for crop production in a given area

Drought (Hydrologic) – lack of water in the entire water supply for a given area.

Drought (Meteorological) – lack of precipitation compared to an area's normal amount

Drought (Socioeconomic) – lack of water sufficient to support an area's population

Earth Flow – Involves fine-grained material that slumps away from the top or upper part of a slope, leaving a scarp, and flows down to form a bulging toe.

Earthquake – An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Earthquake Fault Zone – earthquake fault zones are regulatory zones around active faults. The zones are used to prohibit the location of critical facilities and structures designed for human occupancy from being built astride an active fault. Earthquake Fault Zones are plotted on topographic maps at a scale of 1-inch equals 2,000 feet. The zones vary in width, but average about one-quarter mile wide.

Earthquake-Induced Seiche – Earthquake generated water waves causing inundation around shores or lakes and reservoirs.

Enhanced Fujita Scale – The Enhanced Fujita Scale or EF Scale, which became operational on February 1, 2007, is used to assign a tornado a 'rating' based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DIs) and Degrees of Damage (DoD) which help estimate better the range of wind speeds the tornado likely produced. From that, a rating (from EF0 to EF5) is assigned. The EF Scale was revised from the original Fujita Scale to reflect better examinations of tornado damage surveys so as to align wind speeds more closely with associated storm damage. The new scale has to do with how most structures are designed.

EPA – U.S. Environmental Protection Agency

Epicenter – the point on the earth's surface directly above the focus of an earthquake.

Epoch – geologic time unit lasting more than an age but shorter than a period (Epoch 2008).

EPZ – Emergency planning zone

Erosion – the removal of earth or rock material by many types of processes, for example, water, wind, or ice action.

ESA – Endangered Species Act

Expansive Soil and Rock – soil and rock that contain clay minerals that expand and contract with changes in moisture content.

Exposure – Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent – The specific measurement of an hazard occurrence, often based on a scientific scale. Sometimes used interchangeably with the term “Magnitude.”

Fault – a break in the earth along which movement occurs.

Fault Segment – section of a fault that behaves independently from adjacent sections.

Fault Zone – an area containing numerous faults.

Federal Emergency Management Agency (FEMA) – authorized under Section 404 of the Stanford Act. Provides funding for hazard mitigation projects that are cost-effective and comply with existing post-disaster mitigation programs and activities. These projects cannot be funded through other programs to be eligible.

FERC – Federal Energy Regulatory Commission

Fill – material used to raise the surface of the land generally in a low area.

Firewise Communities Program – A program of the National Fire Protection Association that encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk. The program is co-sponsored by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters.

Fire-Resistant Vegetation – plants that do not readily ignite and burn when subjected to fire because of inherent physiological characteristics of the species such as moisture content, fuel loading, and fuel arrangement.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study – A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Flash Flood – A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Floodplain – Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodplain (100-year/500-year) – Floodplains that have the potential to flood once every 100 or 500 years or that has a 1% (100-year) or 0.2% (500-year) chance of flooding equal to or in excess of that in any given year.

Floodway – An area of land immediately adjacent to a stream or river channel that, in times of flooding, becomes an enlarged stream or river channel and carries the floodwater with the highest velocity.

Fluvial – concerning or pertaining to rivers or streams.

FMA – Flood Mitigation Assistance program

Focus – the point of origin of an earthquake within the earth, and the origin of the earthquake's seismic waves.

Fog – Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the

effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Formation (geologic) – a mappable rock unit consisting of distinctive features/rock types separate from units above and below.

Freeboard – Freeboard is the margin of safety added to the base flood elevation.

Frequency – For the purposes of this plan, frequency refers to how often a hazard of specific magnitude and/or duration is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Frequency (seismic waves) – the number of complete cycles of a seismic wave passing a point during one second.

Fuel (fire) – vegetation, building material, debris, and other substances that will support combustion.

Fuel Break – a change in fuel continuity, type of fuel, or degree of flammability of fuel in a strategically located strip of land to reduce or hinder the rate of fire spread.

Fuel Type – a category of vegetation used to indicate the predominate cover of an area.

Geographic Information System (GIS) – GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Glacial Moraine – debris (sand to boulders) transported and deposited by glacial ice along a glacier's sides or terminus.

Goal – A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Graben – a block of earth down dropped between two faults.

Gradient (slope) – a measure of the slope of the land surface.

Ground Failure – a general term referring to any type of ground cracking or subsidence, including landslides and liquefaction-induced cracks.

Ground Shaking – the shaking or vibration of the ground during an earthquake.

Ground Water – that portion of subsurface water that is in the zone of saturation.

Gypsiferous Deposits – soil or rock containing gypsum, which can be subject to dissolution.

Gypsum – a mineral composed of hydrated calcium sulfate. A common mineral of evaporates.

Hazard – A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation – Any action taken to reduce or permanently eliminate the long-term risk to human life and property and the environment posed by a hazard.

Hazard Mitigation Plan – The Plan resulting from a systematic evaluation of the nature and extent of vulnerabilities posed by a hazard present in society that includes the strategies needed to minimize future vulnerability to hazards.

Hazard Mitigation Grant Program (HMGP) – Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

HAZUS-MH – Hazards United States – Multi-hazards; Earthquake loss estimation software using GIS databases developed by FEMA.

Hazards U.S. Multi-Hazard (Hazus-MH) Loss Estimation Program – Hazus-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus-MH software program assesses risk in a quantitative manner to estimate damage and losses associated with natural hazards. Hazus-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. Hazus-MH has also been used to assess vulnerability (exposure) for other hazards.

Head (landslide) – the upper parts of the slide material along the contact between the disturbed material and the main scarp.

Holocene – geologic epoch covering the last 10,000 years (after the last Ice Age).

HUD – U.S. Department of Housing and Urban Development

Hydraulics – Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology – Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

IBC – International Building Code

Intensity – For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Igneous Rocks – rocks formed by cooling and hardening of hot liquid material (magma), including rocks cooled within the earth (for example, granite) and those that cooled at the ground surface as lavas (such as basalt).

Impermeable – materials having a texture that does not permit water to move through.

Inventory – The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

IPCC – Intergovernmental Panel on Climate Change

Interfluve – land between two streams in the same drainage basin (Interfluve 2004)

Intermountain Seismic Belt (ISB) – zone of pronounced seismicity, up to 120 miles wide and 800 miles long, extending from Arizona through central Utah to northwestern Montana.

IRC – International Residential Code

Lacustrine – concerning or pertaining to lakes.

Lake Bonneville – a large, ancient lake that existed 30,000 to 12,000 years ago and covered nearly 20,000 square miles in Utah, Idaho, and Nevada. The lake covered many of Utah's valleys, and was almost 1,000 feet deep in the area of the present Great Salt Lake.

Lake Bonneville Sediments – sediments deposited by Lake Bonneville, found in the valleys, which range from gravels and sands to clays.

Landslide – a general term for a mass of earth or rock, which moves down slope by flowing, spreading, sliding, toppling, or falling (see slope failure).

Landspout – Tornado occurring with a parent cloud in its growth stage and with its vorticity originating in the boundary layer. The parent cloud does not contain a preexisting midlevel mesocyclone. The landspout was so named because it looks like a weak Florida Keys waterspout over land.

Lateral Spread – lateral down slope displacement of soil layers, generally several feet or more, above a liquefied layer.

Levee (flood) – a berm or dike used to contain or direct water, usually without an outlet or spillway.

Lightning – Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a “bolt,” usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction – sudden large decrease in shear strength of a cohesionless soil (generally sand or silt) caused by collapse of soil structure and temporary increase in pore-water pressure during earthquake ground shaking.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude (earthquake) – a quantity characteristic of the amplitude of the ground motion of an earthquake. The most commonly used measurement is the Richter magnitude scale; a logarithmic scale based on the motion that would be measured by a standard type of seismograph 60 miles from the earthquake's epicenter.

Metamorphic Rocks – rocks formed by high temperatures and/or pressures (for example, quartzite formed from sandstone).

Mitigation – the act of reducing or preventing hazards that affect society or those things deemed important to society

Mitigation Actions – Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Modified Mercalli Intensity (MMI) – the most commonly used intensity scale in the U.S.; it is a measure of the severity of earthquake shaking at a particular site as determined from its effect on the earth's surface, man, and man's structures.

Montmorillonite – a clay mineral characterized by expansion upon wetting and shrinking upon drying.

NASA – National Aeronautics and Space Administration

Natural Vegetation – native plant life existing on a piece of land before any form of development.

NCDC – National Climatic Data Center

NEHRP – National Earthquake Hazards Reduction Program

NFIP – National Flood Insurance Program

NFPA – National Fire Protection Association

NOAA – National Oceanic and Atmospheric Administration

Normal Fault (block faulting) – fault caused by crustal extension in which relative movement on opposite sides is primarily vertical; for example, the Wasatch fault.

NRC – National Research Council

NWS – National Weather Service

Oolite – spherical grains of carbonate sand with a brine shrimp fecal pellet nucleus.

OTA – Congressional Office of Technology Assessment

Outlet (dam) - a conduit through which controlled releases can be made from the reservoir.

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 2007)

Peak Ground Acceleration – Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Peat – unconsolidated surficial deposit of partially decomposed plant remains.

Period (geologic) – a standard (world-wide) geologic time unit.

Permeability – the capacity of a porous rock or soil for transmitting a fluid.

Physiographic Province – a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piping (problem soil and rock) – a weak incoherent layer in unconsolidated deposits that acts as a channel directing the movement of water. As the layer becomes saturated it conducts water to a free face (cliff or stream bank for example) that intersects the layer, and material exits out a "pipe" formed in the free face. Piping can occur in a dam as the result of progressive development of internal erosion by seepage.

Pore Space – the open spaces in a rock or soil between solid grains. The spaces may be filled with gas (usually air) or liquid (usually water).

Porosity – the ratio of the volume of pore space in rock or soil to the volume of its mass, expressed as percentage.

PDM – Pre-Disaster Mitigation Grant Program

PDSI – Palmer Drought Severity Index

PGA – Peak Ground Acceleration

Preparedness – Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration – These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence – The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Probable Maximum Flood (PMF) – a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in a region.

Probable Maximum Precipitation (PMP) – the maximum amount and duration of precipitation that can be expected to occur on a drainage basin.

Problem Soil and Rock – geologic materials that are susceptible to volumetric changes, collapse, subsidence, or other engineering geologic problems.

Project Impact – An initiative of the Federal Emergency Management Agency intended to modify the way in which the United States handles natural disasters. The Goal of Project Impact from a Federal Government perspective is to reduce the personal and economic costs of hazard events by bringing together the private and public sector to better enable the citizens of a community to protect themselves from natural hazards.

Quaternary – a geologic time period covering the last 1.6 million years.

Recurrence Interval – the length of time between occurrences of a particular event (an earthquake, for example).

Repetitive Loss Property – Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period) – This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

RHRC – Regional Hub Reception Center

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk – Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment – Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking – This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation: Risk Ranking = Probability Impact (people property economy)

Robert T. Stafford Act – The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Rock Fall – abrupt free fall or down slope movement, such as rolling or sliding, of loosened blocks or boulders from an area of bedrock. The rock-fall runout zone is the area below a rock-fall source that is at risk from falling rocks.

Rock Topple – forward rotation movement of a rock unit(s) about some pivot point.

RSI – Regional Snowfall Index

Runout Zone (avalanche) – where a snow avalanche slows down and comes to rest (deposition zone). For large avalanches, the runout zone can include a powder- or wind-blast zone that extends far beyond the area of snow deposition.

Sand Blow (earthquake) – deposit of sandy sediment ejected as water and sand to the surface, formed when ground shaking has caused liquefaction at depth.

Scarp – a relatively steeper slope separating two more gentle slopes. Scarps can form as result of earthquake faulting.

Sediment – material that is in suspension, is being transported, or has been moved from its site of origin by water, ice, or wind, and has come to rest on the earth's surface either above or below the sea level.

Sedimentary Rocks – rocks formed from loose sediment such as sand, mud, or gravel deposited by water, ice, or wind, and then hardened into rock (for example, sandstone); or formed by dissolved minerals precipitating out of solution to form rock (for example, tufa).

Seiche – a standing wave generated in a closed body of water such as a lake or reservoir. Ground shaking, tectonic tilting, sub aqueous fault rupture, or landslides into water can all generate a seiche.

Seismic Waves – vibrations in the earth produced during earthquakes.

Seismicity – seismic or earthquake activity.

Sensitive Clay – clay soil that experiences a particularly large loss of strength when disturbed. Deposits of sensitive clay are subject to failure during earthquake ground shaking.

SFHA – Special Flood Hazard Area

Shear Strength – the internal resistance that tends to prevent adjacent parts of a solid from "shearing" or sliding past one another parallel to the plane of contact. It is measured by the maximum shear stress that can be sustained without failure.

Shear Stress – a stress causing adjacent parts of a solid to slide past one another parallel to the plane of contact.

SHELDUS – Spatial Hazard Events and Losses Database for the U.S.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Slope Failure – a general term referring to any type of natural ground movement on a sloping surface (see landslide).

Slump – a slope failure that slides along a concave rupture surface. Generally slumps do not move very far from the source area.

Snow Avalanche – a rapid down slope movement of a mass of snow, ice, and debris.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems.

Spectral Acceleration – measurement for approximate horizontal force experienced in a model earthquake. Measurements are specific to the frequency of shaking found to affect buildings during and earthquake. A 0.2-second period affects primarily one- and two-story buildings while 1.0- second period of spectral acceleration affects buildings approximately 10 stories in height.

SPI – Standardized Precipitation Index

Stafford Act – Robert T. Stafford Disaster Relief and emergency Assistance Act, PL 100-707, signed into law November 23 1988: amended the Disaster Relief Act of 1974, PL 93-288.

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Starting Zone (avalanche) – where the unstable snow or ice breaks loose and starts to slide.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

StormReady Program: A program of the National Weather Service that helps arm America's communities with the communication and safety skills needed to save lives and property--before and during a storm event. StormReady helps community leaders and emergency managers strengthen local safety programs. StormReady communities are better prepared to save lives from the onslaught of severe weather through advanced planning, education and awareness.

Stream Bank Erosion – Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Subsidence – a settling or sinking of the earth's crust.

Surface Fault Rupture (surface faulting) – propagation of an earthquake-generated fault rupture to the ground surface, displacing the surface and forming a scarp.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Tectonic Subsidence – subsidence (down dropping) and tilting of a basin on the down dropped side of a fault during an earthquake.

Thunderstorm – A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Toe (landslide) – the margin of disturbed material most distant from the main scarp.

Tornado – A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Track (avalanche) – the slope or channel down which a snow avalanche moves at a fairly uniform speed.

Unconsolidated Basin Fill – un-cemented and non-indurated sediment, chiefly clay, silt, sand, and gravel, deposited in basins.

Urban Area – a geographical area, usually of incorporated land, covered predominately by engineered structures including homes, schools, commercial buildings, service facilities, and recreational facilities.

USACE – United States Army Corps of Engineers

USGS – U.S. Geological Survey

Velocity (ground motion) – the rate of displacement of an earth particle caused by passage of a seismic wave.

Vulnerability – Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damage, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Wasatch Fault – a normal fault that extends over 200 miles from Malad City, Idaho to Fayette, Utah, and trends along the western front of the Wasatch Range.

Watershed – A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Weathering – a group of processes (such as the chemical action of air, rainwater, plants, and bacteria and the mechanical action of temperature changes) whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.

Wildfire – uncontrolled fire burning in vegetation.

Wildland Area – a geographical area of unincorporated land covered predominately by natural vegetation.

Wildland Urban Interface (WUI) – Wildland vegetation and forested areas adjacent to or intermingled with residential developments.

Windstorm – Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zone of Deformation (earthquake) – the width of the area of surface faulting over which earth materials have been disturbed by fault rupture, tilting, or subsidence.

Zoning Ordinance – The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components – a zoning text and a zoning map.

44 CFR – Title 44 of the Code of Federal Regulations

100-Year Flood – The term “100-year flood” can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Appendix B: Plan Process and Development

Monthly Stakeholder Mitigation Meeting

A monthly stakeholder Hazard Mitigation meeting was held on the 2nd Monday of each month. Meetings started in May and went through December. All jurisdictional representatives and regional stakeholders were invited.

Salt Lake County Hazard Mitigation Workshop Attendees

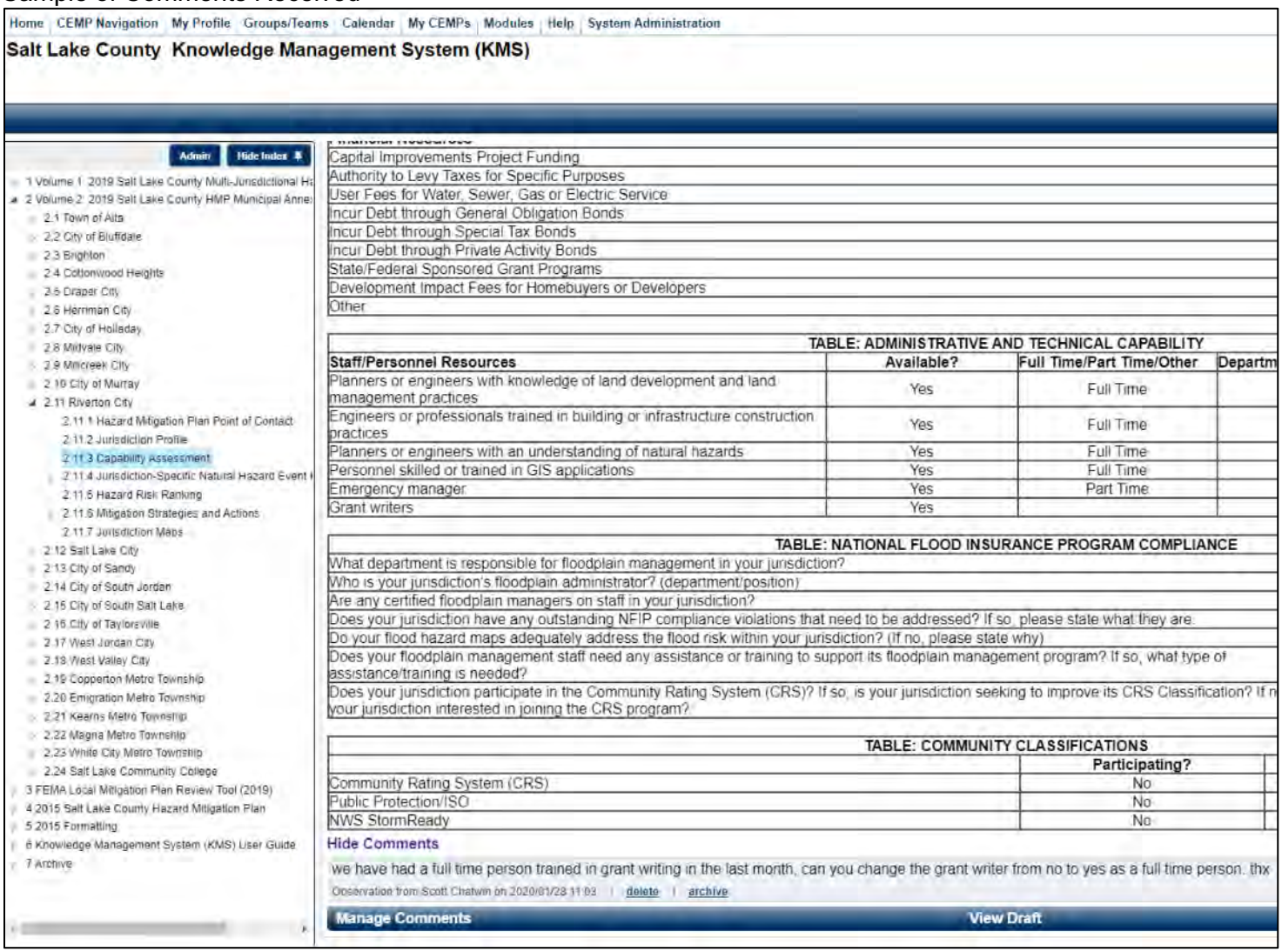
Double-click link below to access the full registration and attendee list.

SLC-HMPWorkshop-Attendees.xlsx

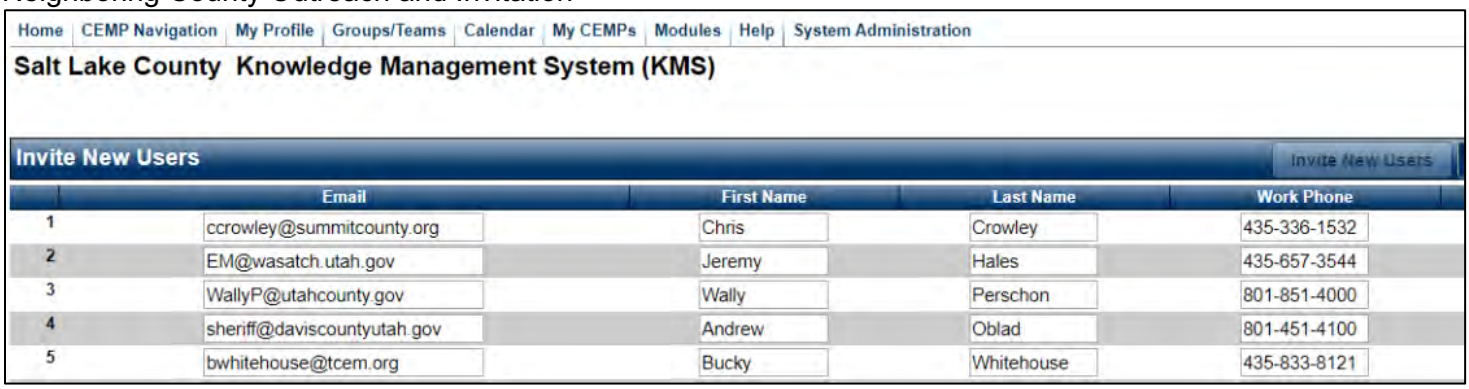
WorkshopSign-inSheet.pdf

Online Planning System and Stakeholder Participation

Sample of Comments Received



Neighboring County Outreach and Invitation



Resources and Tools for Planning Partners

Double-click link below to access the full Handout. This handout provided sample mitigation projects and ideas for planning partners.

SaltLakeCounty Mitigation Actions (E

Jurisdiction-Specific Hazard Concerns

Salt Lake County Hazards

Name:_____**; E-mail:** _____**;**

Jurisdiction/Organization/Agency: _____

Natural Hazards	
Hazards	Please describe any specific and/or unique **concerns/risks** that this hazard poses to your jurisdiction and/or organization. For example, are there properties that are at risk of **repetitive damages** from this hazard? Are certain population groups in your jurisdictions more vulnerable to this hazard? Are there specific neighborhoods or areas in your community that are more at risk from one of these hazards?
Avalanche	
Dam Failure	
Drought	
Earthquake	

Handout: New Mitigation Actions (Salt Lake County)

Name:

Organization/Department:

E-mail:

Phone:

New Mitigation Action (Please Describe):

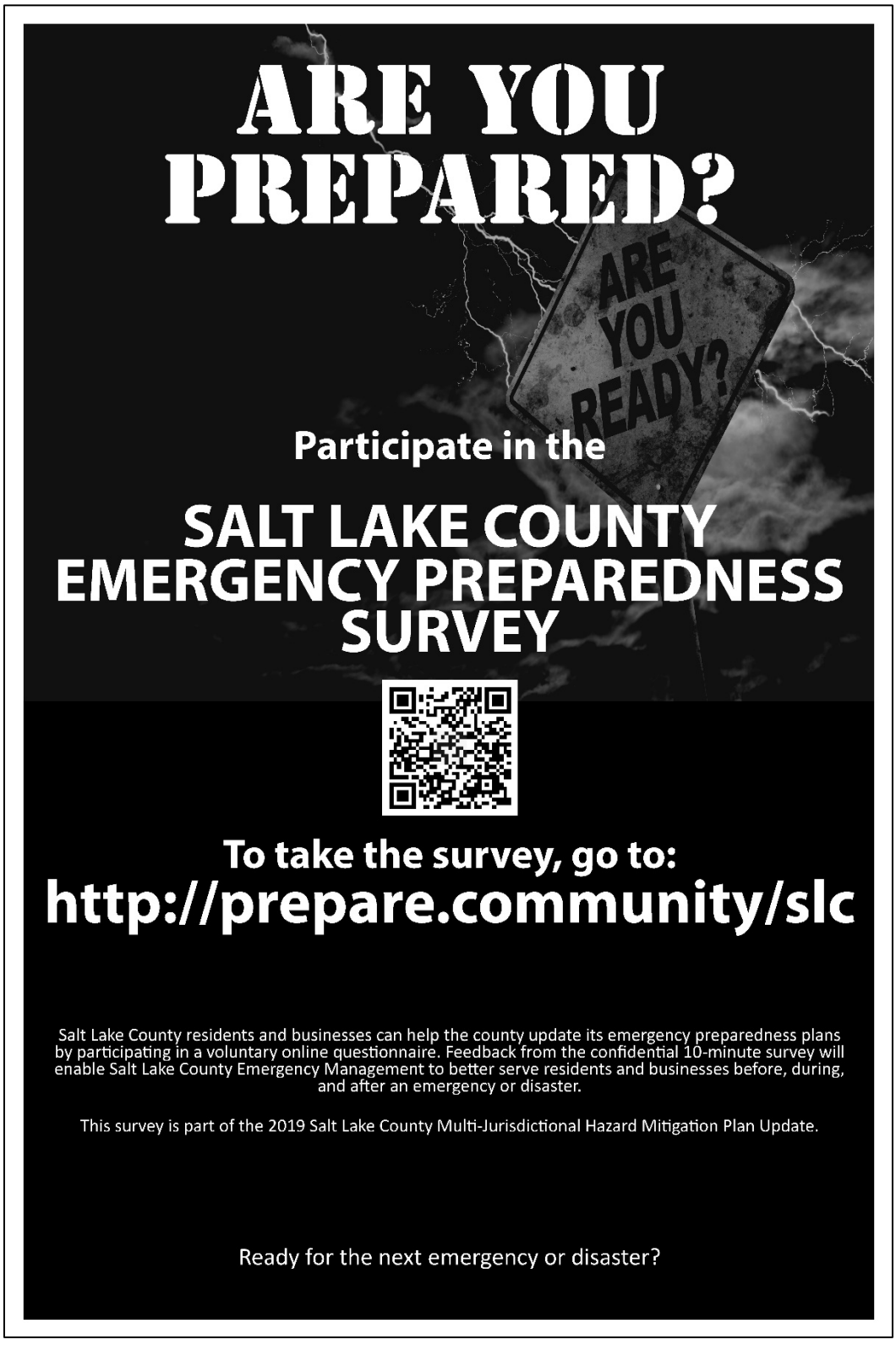
Year Initiated	**2019 (New Mitigation Action)**
Applicable Jurisdiction	
Lead Agency/Organization	
Supporting Agencies/Organizations	
Potential Funding Source	
Estimated Cost	
Benefits (loss avoided)	
Projected Completion Date	
PRIORITY (High, Medium, Low)	

Please indicate if the mitigation goals below are applicable to the new mitigation action/project). Check <u>All</u> That Apply.

Mitigation Goals			
X	Place an "X" by the applicable goal(s)		Advocate, support, and promote the use of laws and local regulations and ordinances aimed to mitigate hazards and to enhance resiliency.
	Protect the lives, health, and safety of the citizens of Salt Lake County before, during, and after a disaster.		Promote education and awareness programs, campaigns, and efforts designed to encourage citizens, private and public entities to mitigate and become more resilient to disasters.
	Protect and eliminate and/or reduce damages and disruptions to critical facilities, structures, and infrastructure during disasters.		Enhance and protect the communication and warning/notification systems in the County.
	Advocate, support, and promote the continued coordination and integration of disaster planning efforts throughout the County.		Ensure and promote ways to increase government and private sector continuity of services during and after a disaster.

Appendix C: Public Participation Documentation

Survey Outreach Materials



Salt Lake County

KEITH BEVAN
PLANNING & INTELLIGENCE SECTION
SALT LAKE COUNTY EMERGENCY

SALT LAKE COUNTY EMERGENCY MANAGMENT

CELL PHONE: (801) 842-7742
OFFICE PHONE: (801) 743-7200
E-MAIL: KBEVAN@UNIFIEDFIRE.ORG

FOR IMMEDIATE RELEASE

Contact:

Keith Bevan, Planning and Intelligence Section
Salt Lake County Emergency Management
Phone: (801) 743-7200; Email: KBevan@unifiedfire.org

SALT LAKE COUNTY RESIDENTS INVITED TO PARTICIPATE IN COMMUNITY PREPAREDNESS STUDY

SALT LAKE COUNTY, UTAH – Salt Lake County residents and businesses can help the county update its emergency preparedness plans by participating in a voluntary online questionnaire. Feedback from the confidential 10-minute survey will enable the Salt Lake County Emergency Management to better serve residents and businesses before, during, and after an emergency or disaster.

Some sample questions are:

- Please indicate where you go to obtain emergency and disaster preparedness related information?
- Do you believe that your household and/or place of business might ever be threatened by the following hazards?
- What might prevent you from leaving your place of residence if there was an evacuation order?
- In an evacuation, would you or anyone in your household require special assistance?

To fill out the questionnaire, go to: http://prepare.community/slc

The survey will remain open until September 30, 2019. For a hard copy version of the survey, please contact the Salt Lake County at KBevan@unifiedfire.org or call (801) 743-7200.

- ### -

SALT LAKE COUNTY EMERGENCY PREPAREDNESS SURVEY

Encuesta de preparación

Participate in the conversation!
¡Participe en la conversación!

Salt Lake County Emergency Management
EM
Unified Fire Authority

To take the survey, go to:
Para participar en la encuesta, visite:

http://prepare.community/slc

Are you prepared for the next emergency or disaster?
¿Está preparado/a para la próxima emergencia o desastre?

Please take our confidential survey at:
Tome nuestra encuesta confidencial en:

http://prepare.community/slc

Questions or Concerns? Please contact:
¿Preguntas o preocupaciones? Contáctenos:

Salt Lake County Emergency Management
P: (801) 743-7200

To request a Survey in an alternate format such as large print, please call (801) 743-7200.

https://www.slcoem.org/

Survey Results

Double-click link below to access the full Survey Report.

SLCOEm.MitigationSurveyResults2019.pdf

Sample Outreach Activities

Figure. Riverton Public Outreach Event to Understand Public Perception and Mitigation Priorities

Figure. Herriman Public Outreach Event to Understand Public Perception and Mitigation Priorities

Appendix D: Plan Adoption Resolutions from Planning Partners

[Insert Upon Plan Approval and Adoption]

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